SAMSUNG

Contents

1. Utility purpose

Samsung utility is intended for repair of SpinPoint HDD manufactured by Samsung. In addition to large series of 3.5” drives, the utility also supports 2.5” and Serial ATA Samsung HDD. All models supported by the utility are listed in *Table 2.1*

The utility offers the following features:

- reading/writing of service data
- passwords removal
- S.M.A.R.T. initialization
- loading of Burn-In test resources (supplied as individual files for import into your database)
- heads map modification
- analysis of Burn-In test results
- monitoring of Burn-In test progress
- reading of Flash ROM image via terminal
- writing ROM image
- work with defect lists
- editing of zone translation table
- logical scanning
- physical scanning
- heads testing
- disconnection of faulty heads
- low-level formatting.

Database resources for Burn-In tests are supplied on the installation CD of PC-3000 for Windows, they are also available from personal customer folders on our technical support server.

2. Structure of drive families

Table 2.1.

Drive family	Model	Capacity, Gb	Heads	Max LBA
NEXUS NEON 1.8”	HS041GA HS081HA	40 80	1 2	78,242,976 156,301,488
N2 N2B 1.8:”	HS040HB HS060HB HS080HB HS120JB	40 60 80 120	2 2 3 4	78,242,976 117,304,992 156,301,488 234,441,648
M40, MN40, M40D MAGMA 2.5”	MP0302H MP0402H MP0603H MP0804H	30 40 60 80	2 2 3 4	58,711,968 78,242,976 117,304,992 156,368,016
M40S, M40SG, MN40S MAGMA 2.5” (SATA)	HM020GI HM20GIJ HM040HI HM060II HM080JI	20 20 40 60 80	1 1 2 3 4	39,179,952 39,179,952 78,242,976 117,304,992 156,368,016

M60P, M60D, M60S, M60SD M60(S) 2.5”	HM040HC HM041HI HM060HC HM060HI HM080IC HM080II HM100JC HM100JI HM120JC HM120JI	40 40 60 60 80 80 100 100 120 120	2 2 2 2 3 3 4 4 4 4	78,242,976 78,242,976 117,304,992 117,304,992 156,368,016 156,368,016 195,371,568 195,371,568 234,441,648 234,441,648
M80P, M80S MAGNUM 2.5”	HM080HC HM080HI HM120IC HM120II HM160JC HM160JI	80 80 120 120 160 160	2 2 3 3 4 4	156,368,016 156,368,016 234,441,648 234,441,648 312,581,808 312,581,808
M5_P1 2.5”	HM080GC HM121HC HM160HC	80 120 160	1 2 2	156,368,016 234,441,648 312,581,808
M5S1, M5S2 MANGO 2.5”	HM080GI HM160HI HM250JI	80 160 250	1 2 4	156,368,016 312,581,808 488,397,168
MT1 2.5”	HM400LI HM500LI	400 500	6 6	781,422,768 976,771,055
M6S_2D 2.5”	HM061GI HM080GI HM121HI HM160HI HM251JI HM320JI	60 80 120 160 250 320	1 1 2 2 4 4	117,304,992 156,301,488 234,441,648 312,581,808 488,397,168 625,142,448
M7S2 2.5”	HM120GI HM250HI HM320II HM500JI	120 250 320 500	1 2 3 4	234,441,648 488,397,168 625,142,448 976,771,055
M7E 2.5”	HM161GI HM251HI HM321HI HM501II HM641JI	160 250 320 500 640	1 2 2 3 4	312,581,808 488,397,168 625,142,448 976,771,055 1,250,263,728
M8E 2.5”	HN-M160MBB HN-M250MBB HN-M320MBB HN-M500MBB HN-M640MBB HN-M750MBB HN-M101MBB	160 250 320 500 640 750 1000	1 1 2 2 3 3 4	312,581,808 488,397,168 625,142,448 976,771,055 1,250,263,728 1,465,149,168 1,953,525,168
V11P VOYAGER 11PLUS	SV1021H SV2042H SV3063H SV4084H	10.2 20.4 30.6 40.8	1 2 3 4	19,932,192 39,865,392
V40 VICTOR	SV2001H SV3012H SV4002H SV6003H SV6014H SV8004H	20 30 40 60 60 80	1 2 2 3 4 4	39,179,952 58,711,968 78,242,976 117,304,992 117,304,992 156,368,016

V40P VICTORPLUS	SV2011H SV4012H	20 40	1 2	39,179,952 78,242,976
P40 PUMA	SP2001H SP20A1H SP4002H SP40A2H SP6003H SP60A3H SP8004H SP80A4H	20 20 40 40 60 60 80 80	1 1 2 2 3 3 4 4	39,179,952 39,179,952 78,242,976 78,242,976 117,304,992 117,304,992 156,368,016 156,368,016
VL40 VANGO	SV0211H SV0401H	20 40	1 1	39,179,952 78,242,976
VL40P VANGOPLUS	SV0221N SV0411N	20 40	1 1	39,179,952 78,242,976
V60 VERNA	SV0301H SV0602H SV0813H SV0823H SV1204H	30 60 80 80 120	1 2 3 3 4	58,711,968 117,304,992 156,368,016 156,368,016 234,493,056
V60 VERNALITE	SV0221H SV0412H	20 40	1 2	39,179,952 117,304,992
PL40, PL40S PANGO	SP0411N SP0411C	40 40	1 1	78,242,976 78,242,976
P80H, P80VA RUBICON	SP0421N SP0622N SP0822N	40 60 80	1 2 2	78,242,976 117,304,992 156,368,016
P80VEM CAESAR	SP0451N SP0842N	40 80	1 2	78,242,976 156,301,488
V80, V80P, V80PL, V80CE VELOCE	SV0301N SV0602N SV0802N SV0802E SV0903N SV1203N SV1203E SV1204N SV1604N SV1604E	30 60 80 80 90 120 120 120 160 160	1 2 2 2 3 3 3 4 4 4	58,711,968 117,304,992 156,368,016 156,368,016 175,869,792 234,493,056 234,493,056 234,493,056 312,581,808 312,581,808
P80, P80VE, P80VT, P80D, P80P, P80PL, P80S PALO	SP0311N SP0401N SP0401C SP0612N SP0802N SP0812N SP0812C SP1203N SP1213N SP1213C SP1604N SP1614N SP1614C	30 40 40 60 80 80 80 120 120 120 160 160 160	1 1 1 2 2 2 2 3 3 3 4 4 4	58,711,968 78,242,976 78,242,976 117,304,992 156,368,016 156,368,016 156,368,016 234,493,056 234,493,056 234,493,056 312,581,808 312,581,808 312,581,808
P80A	SP1223N SP1624N SP1634N	120 160 160	3 4 4	234,493,056 312,581,808 312,581,808
P80SD, P80SDT, P80PLUS,	HD040GJ HD080HJ	40 80	1 2	78,242,976 156,301,488

DELPHI	HD120IJ HD160JJ	120 160	3 4	234,441,648 312,581,808
P80M	SP1243N SP1253N SP1644N SP1654N	120 120 160 160	3 3 4 4	234,441,648 234,441,648 312,581,808 312,581,808
P120, P120S POSEIDON	SP1613N SP1603C SP2014N SP2004C SP2514N SP2504C	160 160 200 200 250 250	3 3 4 4 4 4	312,581,808 312,581,808 390,721,968 390,721,968 488,397,168 488,397,168
T133, T133S TRIDENT	HD250KJ HD300LD HD300LJ HD301LJ HD320LD HD400LD HD400LJ HD401LJ	250 300 300 300 320 400 400 400	5 6 6 6 6 6 6 6	488,397,168 586,072,368 586,072,368 586,072,368 625,142,448 781,422,768 781,422,768 781,422,768
P160S PARAGON	HD080GJ HD160HJ	80 160	1 2	156,301,488 312,581,808
T166, T166S, T166C TRIDENT2	HD160HJ HD161HJ HD251KJ HD252KJ HD320KJ HA320KJ HD321KJ HD402LJ HD403LJ HD500LJ HA500LJ HD501LJ	160 160 250 250 320 320 320 400 400 500 500 500	2 2 5 5 5 5 5 6 6 6 6 6	312,581,808 312,581,808 488,397,168 488,397,168 625,142,448 625,142,448 625,142,448 781,422,768 781,422,768 976,771,055 976,771,055 976,771,055
S166 STORM2 (MARVELL CHIP)	HD081GJ HD082GJ HD161HJ	80 80 160	1 1 2	156,301,488 156,301,488 312,581,808
S166 STORM2_G (GIGACUBE CHIP)	HD081GJ HD082GJ HD161HJ	80 80 160	1 1 2	156,301,488 156,301,488 312,581,808
S250 TRIDENT3	HD162HJ HD200HJ HD250HJ	160 200 250	2 2 2	312,581,808 390,721,968 488,397,168
F1 DT F1_3D	HD161GJ HD162GJ HD251HJ HD252HJ HD321HJ HD322HJ HD401IJ HD402IJ HD501IJ HD502IJ HD642JJ HD752LJ	160 160 250 250 320 320 400 400 500 500 640 750	1 1 2 2 2 2 3 3 3 3 4 6	312,581,808 312,581,808 488,397,168 488,397,168 625,142,448 625,142,448 781,422,768 781,422,768 976,771,055 976,771,055 1,250,263,728 1,465,149,168

	HD753LJ HD102UJ HD103UJ	750 1000 1000	6 6 6	1,465,149,168 1,953,525,168 1,953,525,168
F1 ECOGREEN F1_3D	HD252HI HD322HI HD502JI HD642JI HD753LI HD103UI	250 320 500 640 750 1000	2 2 4 4 6 6	488,397,168 625,142,448 976,771,055 1,250,263,728 1,465,149,168 1,953,525,168
F2 ECOGREEN F2_EG	HD502HI HD103SI HD154UI	500 1000 1500	2 4 6	976,771,055 1,953,525,168 2,930,277,168
F3_2D F3	HD502HJ HD103SJ	500 1000	2 4	976,771,055 1,953,525,168
F3_4D	HD153WI HD203WI	1500 2000	7 8	2,930,277,168 3,907,029,168
F4	HD165GJ HD166GJ HD255GJ HD256GJ HD322GJ	160 160 250 250 320	1 1 1 1 1	312,581,808 312,581,808 488,397,168 488,397,168 625,142,448
F4_3D	HD155UI HD204UI	1500 2000	6 6	2,930,277,168 3,907,029,168

2.1. HDD 1.1 appearance

Fig.2.1. A PALO hard disk drive.

1 – manufacturer – Samsung; 2 – drive family – PALO; 3 – serial number;
4 – model – SP1213C; 5 – size in LBA and GB; 6 – Part Number (P/N);
7 – Material Mixing.

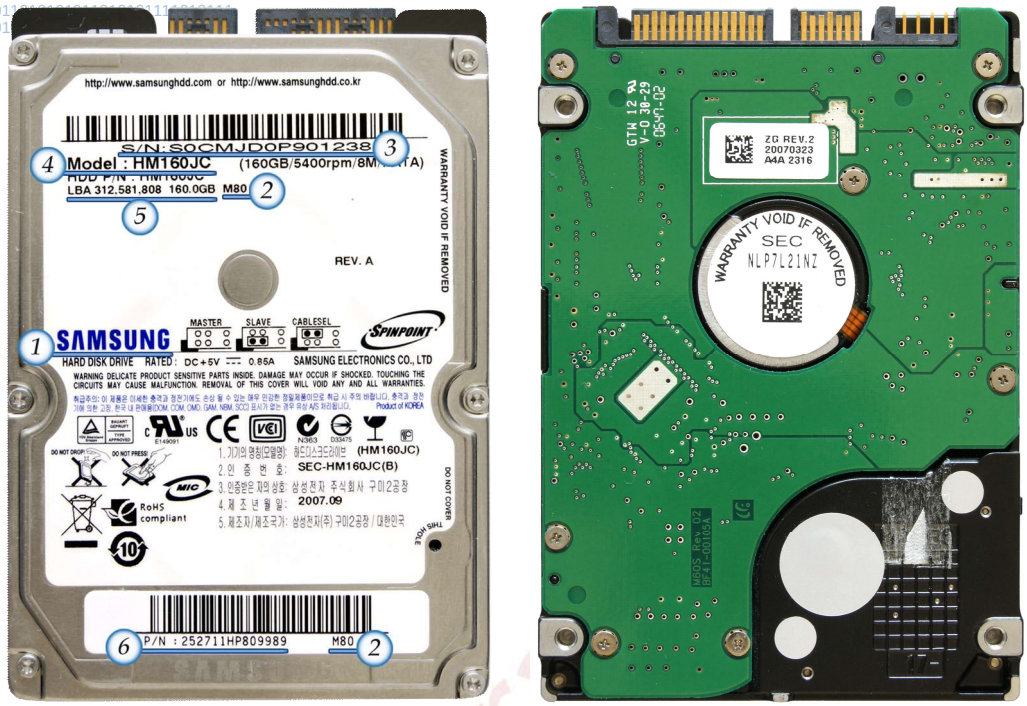

Fig.2.2. A M80 hard disk drive.

1 – manufacturer – Samsung; 2 – drive family – M80; 3 – serial number;
4 – model – HM160JC; 5 – size in LBA and GB; 6 – Part Number (P/N).

Fig.2.3. A F1_3D hard disk drive.

1 – manufacturer – Samsung; 2 – drive family – F1_3D; 3 – serial number;
4 – model – HD103UI; 5 – size in LBA and GB; 6 – Part Number (P/N).

Fig.2.4. A M8E hard disk drive.

1 – manufacturer – Samsung; 2 – drive family – M8E; 3 – serial number;
4 – model – HN-M500MBB; 5 – size in LBA and GB; 6 – Part Number (P/N).

2.2. Explanation of 1.2 of model labels

HDD label explanation for an early Samsung model using SP1213C drive as an example (Fig. 2.1):

S - Drive class (S – desktop 3.5”, M – mobile 2.5”,).

P - SpinPoint line

12 - Drive capacity (expressed as tens of GB).

1 - The generation principle for this value is not determined completely. The value characterizes the cache size and also distinguishes models of the same capacity and class belonging to different drive families.

3 - The value defines the number of drive heads. Please note that the manufacturer may specify in the model name (mostly for marketing-related reasons) a higher or lower number of heads than the drive actually has. These peculiarities should be kept in mind while selecting a donor drive for head replacement *(see section 5.10).*

C - Drive interface (H – PATA (UDMA 100), N – PATA (UDMA 133), C – SATA I).

HDD label explanation for a newer Samsung model using HD103UI drive as an example (Fig. 2.3):

H - HDD (hard disk)

D - Drive class (D – desktop 3.5”, E – enterprise 3.5” (RAID – версия), M – mobile 2.5”, S – slim 1.8”).

10 - Drive capacity expressed as tens (or hundreds) of GB.

3 - The generation principle for this value is not determined completely. The value characterizes the cache size and also distinguishes models of the same capacity and class belonging to different drive families.

U - The number of heads (G – 1, H – 2, I – 3, J and S – 4, K – 5, L and U – 6, W – 8). Similarly to the labels of earlier drive families, the information about the number of heads sometimes may be inaccurate. Precise information can only be found in the HDD ID of a specific drive after reading it in the utility.

I - Interface (D – PATA, C – mini PATA, J – SATA II (7200 rpm), I – SATA II (5400 rpm), A – ZIF, B – CE ATA, X and Y – USB).

2.3. Detecting 1.3 the family of a drive

To identify the family of a Samsung drive, you can check its firmware version or the marks on the drive (label, marks on the HDA or the PCB). The first method is only applicable when a HDD reaches readiness and returns its HDD ID. The utility uses it for automatic detection of the drive family.

The second method has to be used when automatic family detection is impossible for some reason. E.g., it can be helpful when a drive fails to reach the ready state or when you need to select a donor drive while there is no available PC-3000 suite. First, find the marks on the drive *(see chapter 2)*, then compare them against the list of drive families *(see Table 2.1)* to determine the family they belong to. Please keep in mind that marks on the label, PCB and HDA may differ. This is caused by the fact that some drive families share common components (for example, RUBICON drives bear the PALO print on their HDA label and RUBICON on their PCB; M80 drives bear the M60 print on PCB and M80 on the label). Thus, if a drive family cannot be identified unambiguously, you have to check the list of models in the potential drive families and select the family containing this particular model. There are also drive families with identical model names and HDA marks (for example, STORM2 and STORM2_G, they can be distinguished by the manufacturer of the controller: Marvell in the first family, Samsung in the second).

2.4. Conventional subdivision of drives into groups of families

Some specific peculiarities demand introduction of a conventional subdivision of Samsung drives in two large groups: drives using classic architecture and drives using Trinity architecture.

The first group includes *(Table 2.1)* NEON 1.8”; 2.5” drives beginning with the MAGMA family through M6S_2D, and 3.5” drives beginning with V11P through TRIDENT3.

The second group includes all remaining drive families, *(Table 2.1)*: N2B 1.8”; 2.5” drives beginning with M7S2, and 3.5” drives beginning with F1_3D.

Classic drives use just one system head and double-digit error codes *(see chapter 11)*. Trinity drives use three system heads (being thus more reliable than classic drives), and four-digit error codes, which are more convenient for recognition and classification *(see chapter 12)*.

3. Getting started

1) Plug the UDMA cable from ATA0 or ATA1 port of the PC-3000 UDMA tester board in the IDE connector of the HDD. To connect a Serial ATA drive, use the PC PATA-SATA adapter. To connect a 2.5” PATA drive, use the PC-2” adapter (adapters for 1.8” drives are not included in the product package, they are purchased separately). USB drives are connected using the standard USB ports of the host computer.

2) Connect power supply to the drive (PC-2”, PC PATA-SATA adapter) from the corresponding channel of the PC-3K PWR2 power control adapter.

3) Switch on the HDD power supply using the power toggle (toolbar) icon.

The drive can be connected to a COM port using the PC-KALOK adapter or the PC USB TERMINAL adapter. Please find below the schemes for drive connection to terminal.

3.1. Connecting Samsung 2.5” mini PATA drives to terminal

To connect 2.5” Samsung mini PATA drives to terminal, use the PC-2” adapter. Jumpers of the adapter should be set as shown in the *Fig 3.1*

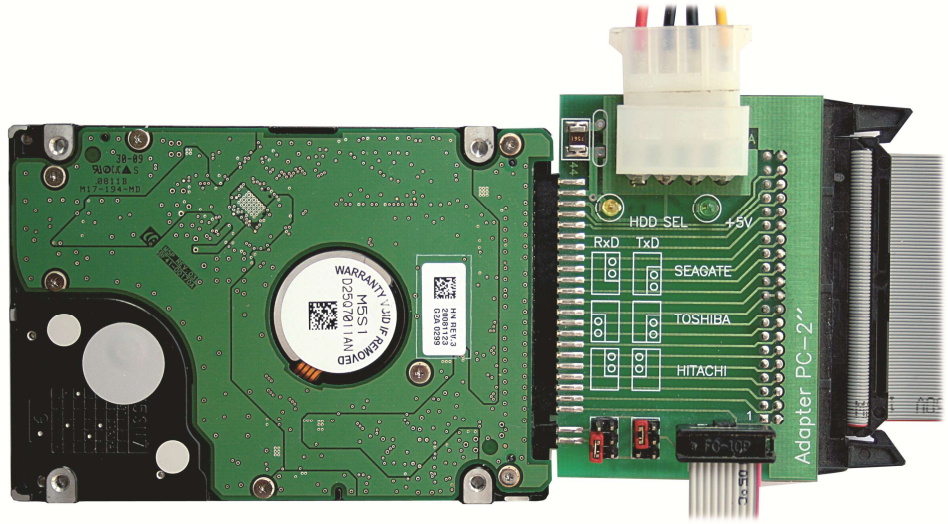

Fig.3.1. PC-2" jumper settings.

3.2. Connecting Samsung 2.5" SATA drives to terminal

Samsung 2.5" SATA drives should be connected to terminal using the PC SAMSUNG adapter *(Fig. 3.2).*

3.3. Connecting Samsung 1.8" and 2.5" drives to terminal

There are two methods that can be used to connect Samsung 1.8" and 2.5" USB drives to terminal. The first method implies terminal connection to contact pads, the second – to the factory openings corresponding to these pads *(Fig. 3.3, Fig. 3.4).* The size and pinout of contacts on a pad are always the same *(Fig. 3.3, Fig. 3.4),* while the location and sizes of openings may differ depending on the drive model. The correspondence between the openings and the Rx and Tx signals should be identified by the direction of the copper tracks to the contact pads.

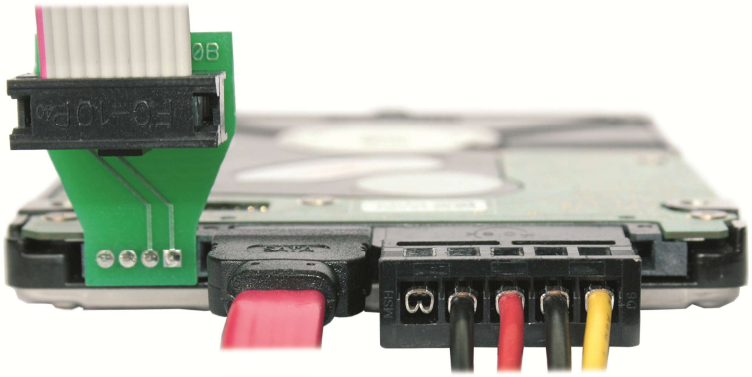

Fig. 3.2. PC-SAMSUNG adapter connection to a 2.5" SATA drive.

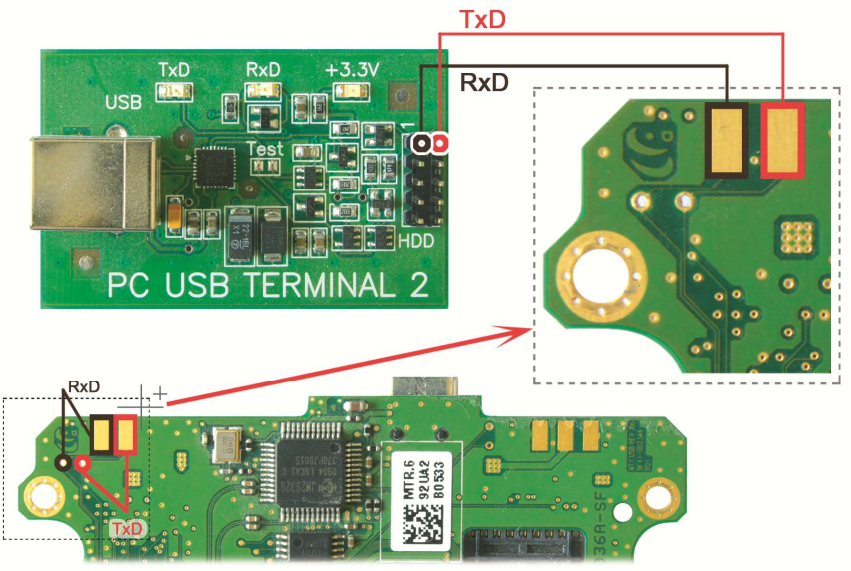

Fig. 3.3. Terminal contacts on a MT1 PCB

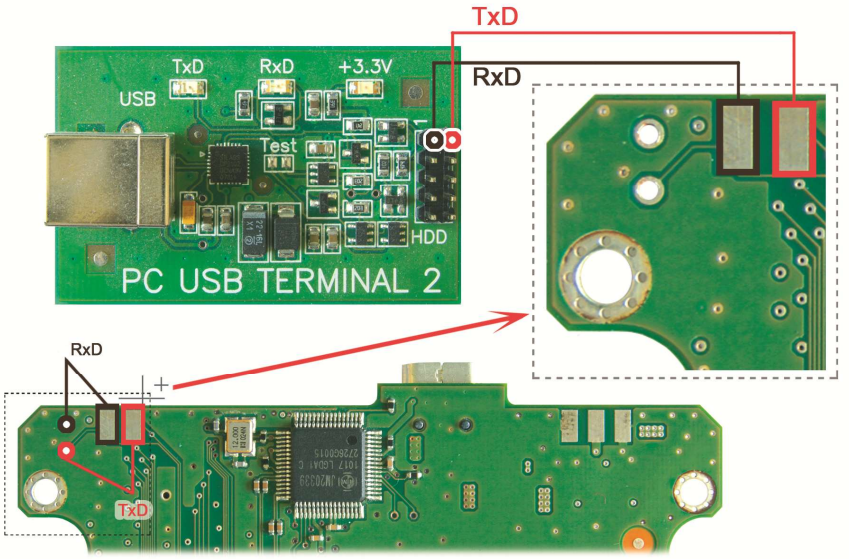

Fig. 3.4. Terminal contacts on a M7S2 PCB.

3.4. Connecting Samsung 3.5” drives to terminal

To connect Samsung 3.5” PATA or SATA HDD to terminal, use the PC USB TERMINAL and the PC-SEAGATE adapters. PC-SEAGATE adapter must be connected to the drive so that the Master jumper remains in place. Thus the ATA interface of PC-3000 will remain accessible. The scheme for adapter connection to the drive is shown in the *Fig. 3.5.* Master jumper does not affect the terminal operation.

With 3.5” Serial ATA drives the PC-SEAGATE adapter should be used in the same manner, no jumper is set over the free couple of contact pins *(Fig. 3.6).*

Trinity drives have just two pairs of contacts. To connect the terminal to various drives, you can also use the PC-SEAGATE adapter; the last pair of adapter contacts on the rights side remains free then *(Fig. 3.7).*

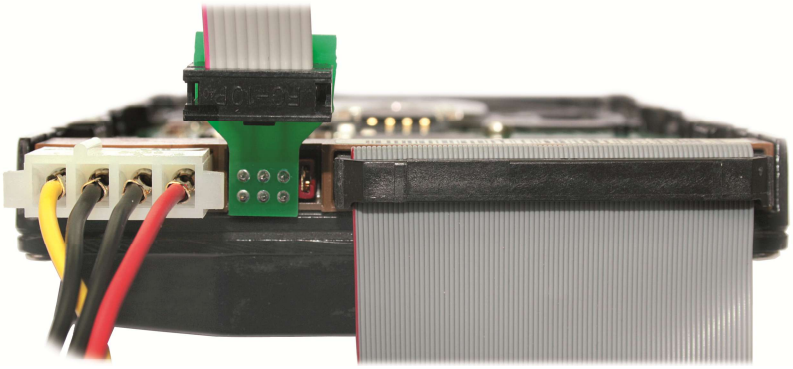

Fig.3.5. Connection of the PC-SEAGATE adapter to a 3.5” PATA drive

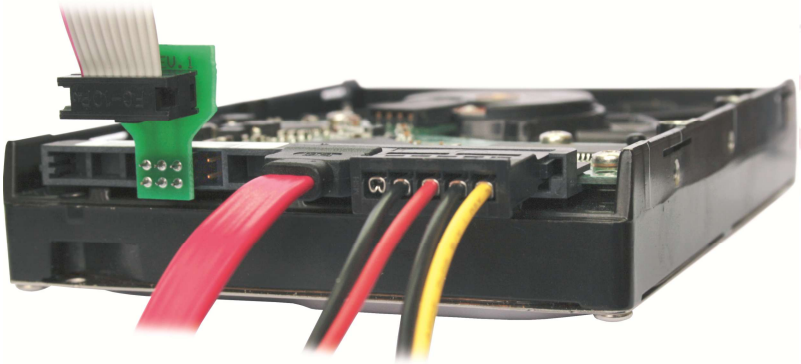

Fig.3.6. Connection of the PC-SEAGATE adapter to a 3.5” SATA drive.

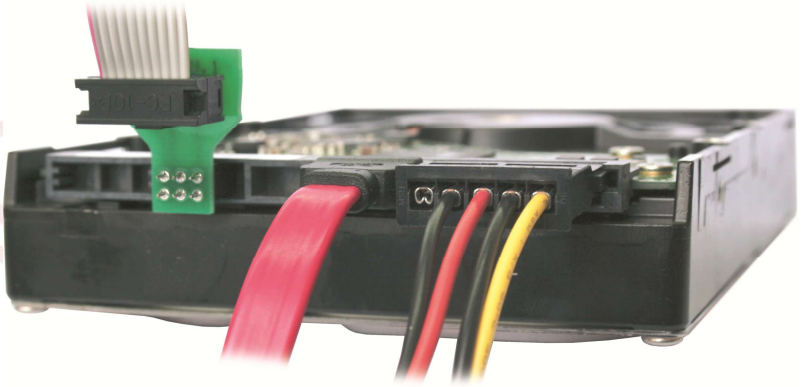

Fig.3.7. Connection of the PC-SEAGATE adapter to F1_3D, F2_EG, and F3 drives.

3.5. Manual COM port configuration

After successful utility start all necessary COM port settings are applied automatically. If the universal utility is used, or the initialization of the Samsung utility gets interrupted, the COM port settings have to be defined manually. To do that, open the utility settings ([Alt] + [T]) and specify in the «Uses port» field the COM port that the drive is connected to. In the main menu, select: «Tools» → «COM port settings», enter the COM port data exchange rate in the «Rate» field (38400 for V11P and VICTOR models, 57600 – for other models supported by the utility).

Open the terminal window («Tools» → «Terminal»), move focus to terminal window by clicking on it, and press [Enter]. After that you should be able to monitor the information output by the drive. In normal status the drive must be in the «ENG>(Engine)» mode. If you press [Esc], firmware operation will be interrupted and the drive will switch to «DBG>(Debug)» mode. You can obtain a list of commands supported by the current drive by entering the «HE» or «HE1» command.

If after power-up a firmware initialization error occurs, then the terminal will display the code of that error, for example: LED 13 000. Error code values can be found in *chapter 11,12*.

Sometimes a HDD in error state just stops sending data to terminal. In such cases you can identify an error using the LED signals (please see *Fig. 9.9* for the connection scheme). Long signals denote the first digit of the code, short signals represent the second digit, i.e. code 13 will be output as one long and three short signals.

The «CR=LF» terminal button in the PC-Samsung utility must be depressed as it controls wrapping of the lines output by a HDD to terminal.

4. Launching the utility

After utility launch, it displays a «Utility start» window, which serves for selection of the operation mode. If the utility succeeds in reading HDD ID at the start, it will select the family corresponding to HDD firmware in the «HDD family» panel. Otherwise, the drive family selector will not be set and the «Utility start» button will remain inactive.

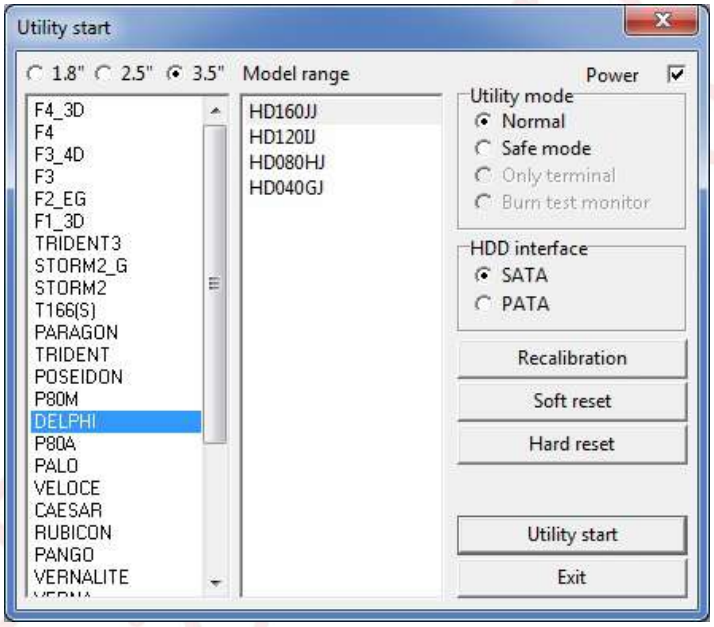

Fig.4.1.

Attention! Use the «HDD interface» panel to select SATA, if the drive uses that interface and has been connected to the tester complex via a PATA–SATA adapter. The step is important, because Serial ATA drives use a different format of read/write commands compared to commands in drives belonging to the same family but using the PATA interface.

There are four methods, which you can use to launch the Samsung utility:

1) ***Normal*** – the utility will start and read all necessary modules.
2) ***Safe mode*** – the utility will start but it will not try to access the modules in service area. Instead, it will load the default modules table and make just an attempt to read the technological drive ID (no access to SA surface occurs), which sometimes may be the default ID for VERNA and older drive families. The mode may be necessary in case of a knocking HDD, when a drive after a soft reset fails to reach readiness and so you have to set appropriate jumpers for work in Safe mode *(please see section 8.10.2)*.
3) ***Only terminal*** – in that mode the utility has access to the drive exclusively by the terminal (not every drive family supported)
4) ***Burn test monitor*** – in that mode the utility only allows monitoring of a running Burn test; all technological tests are disabled. The utility reads nothing from the connected drive when it starts in that mode. You have to specify the running Burn test in a corresponding dialog before the utility displays its monitoring window; the step is necessary to load the respective Burn script into the monitoring window. If you click Cancel in the selection

dialog, the opened window will be empty and it will contain no test script. Please refer to *section 6.3* for details on the monitoring mode.

In Normal start mode, after precise drive family selection the utility will read the HDD ID, modules table and other additional information from service area, results of that procedure will appear in log.

Samsung drives frequently remain «busy» if their pre-start internal diagnostics reveals damaged service data preventing a drive from work with user data area, e.g., corrupted translation modules *(see section 7.8.)*. Such damage does not interfere with operations over the service area; therefore, a soft reset command sent individually to a drive makes it enter the «ready» state. Before pressing the «Utility start» button in the corresponding window, wait until the drive reaches readiness, and if it cannot do so, send a soft reset to make the drive initialize its parameters properly if the command succeeds. If a drive does not report ready after the command, it may mean errors in ROM or modules affecting the system start.

The utility uses technological ID to obtain the zone allocation table, service area SPT, Flash ROM version and the number of heads in a drive. You can modify some of those parameters in the «Utility status» dialog *(see section 5.1)*. If the technological ID has not been read, the utility will use default SA SPT and the number of heads.

The utility reads the modules table from FIT module. If the reading procedure encounters an error or module structure parsing reveals internal corruption, then the utility will load to the table some values stored in it as constants. FIT module is found in some (not all) of Samsung drive families, and so the utility always uses the default modules table with them. You can switch between the employed tables of modules selecting the «Use the default modules table» or «Load modules table from HDD» options in the «Utility status» dialog *(see section 5.1)*. Please refer to section for a more detailed description of the modules table.

After utility launch, its «Tests» menu provides access to the following features:

1) ***Utility status***

2) ***Service information:***

HDD resources backup

Work with ROM

- Read ROM via terminal
- Write ROM
- View information about ROM dump
- Module FIPS reading
- Module FIPS writing
- FIPS module clearing

Work with RAM

- HDD initialization with head map changing in RAM
- RAM head map editing

Work with BURN

- BURN test result report
- Write BURN resources to HDD
- Download file into HDD
- Start Burn-In test
- Resume Burn-In test

Work with service area

- Heads test
- SA structure test
- Read modules
- Write modules
- Reading service tracks
- Writing service tracks
- Table of zone translation
- Erase service area

Edit S/N

HDD ID editor

Security subsystem

Password information

Clearing passwords

Work with database

Export HDD resources

Resource master copy creation in DB

Import HDD resources

3) ***Format***

4) ***Surface test:***

Logical test

Physical test: reading

Physical test: writing

Combined test

5) ***Defect list:***

Defect lists report

-Combined test

Defects editing

Rebuild S-List

Rebuild T-List

A-LIST clearing

Transfer A-LIST to S-LIST

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

5. «Tests» menu

Specific utility features can be invoked from the «Tests» and «Tools → Utility extensions» menus. The «Tests» menu includes single pass actions while the «Utility extensions» menu offers interactive functions of the utility. The remaining features are inherited from the kernel of the PC-3000 suite; they are described in the corresponding part of user documentation.

5.1. Utility status

Selection of that menu item displays the parameters of the currently connected HDD and allows the operator to modify them, if necessary. If the utility fails to identify the drive during start, it will assume default values for some of the parameters. For models using more than 1 head, the number of heads will be assumed to be equal to 4. Service area SPT value is constant within a drive family, so the default value should also be correct. However, in PALO P80VE drive family SA SPT is different, it is equal to 832.

The «Utility status» dialog looks as follows:

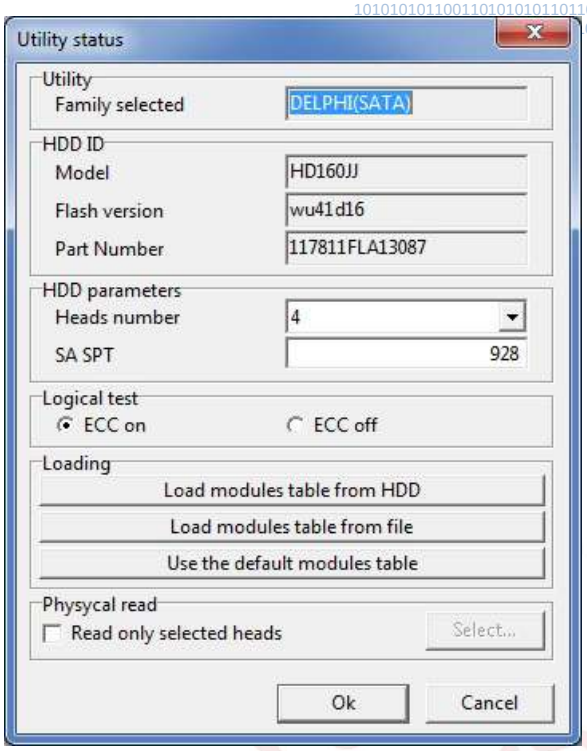

Fig.5.1.

If the utility used a default modules table during HDD initialization, in the «Utility status» window you can reload the modules table from service area on disk. You may also act to the contrary if the loaded modules table is invalid.

The option that allows you to enable or disable ECC is used during logical drive scanning *(see section 5.5.1).* ECC disabling turns off the error correction system; the number of revealed defects of magnetic surfaces can increase.

Select the option «Read only selected head» avoids reading utility service information on defective heads. Option is required in the case of reading service modules used to build head map in the «Data Extractor», as if trying to read data from a damaged drive head may hang.

5.2. Work with terminal

5.2.1. Set COM port data transfer rate

This submenu contains the set of commands used to control the terminal connection with a drive.

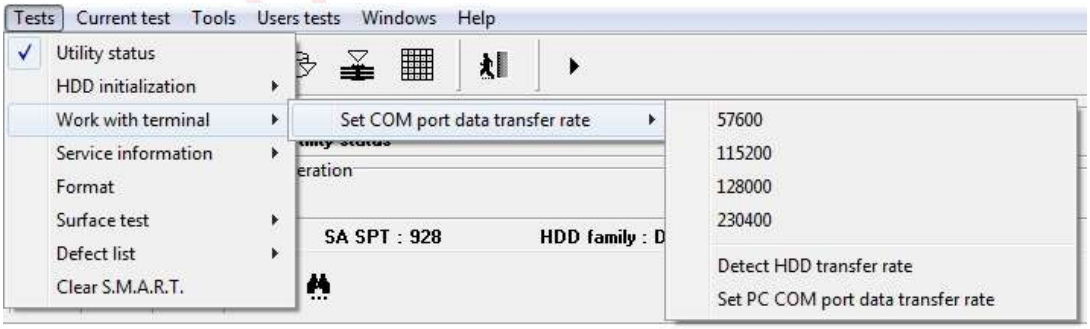

Fig.5.2.

The command to «Detect HDD transfer rate» allows you to identify the current data exchange rate of the drive terminal automatically, and configures the current COM port rate as appropriate.

The functionality for switching of the COM port baud rate allows changing the data exchange rate of drive interaction with the terminal.

5.3. Service information информация

5.3.1. HDD resources backup

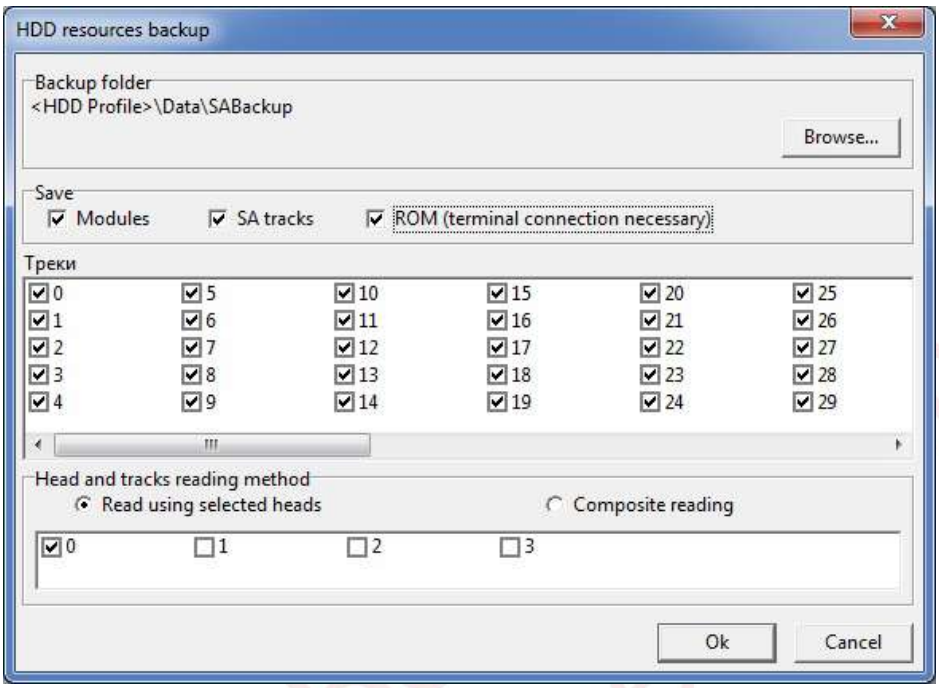

Fig.5.3.

The command displays a dialog window, which you can use to read service data resources (modules, tracks, RAM) from a HDD to its profile folder: <HDD Profile>\Data\SABackup. The method differs from «Resource master copy creation in DB» *(see section 5.3.7.2)* because it does not check the structure of service data being intended mostly for quick saving of service information from a drive before its testing.

«HDD resources backup» window contains two frames where you can select the tracks and heads to be used for reading of the selected tracks. The opportunity to select the tracks, which should be backed up, is arranged to allow skipping of unformatted tracks. Individual tracks cannot be skipped during the backup procedure. Please see *section 5.3.5.5* for details regarding tracks reading.

If the backup sequence includes ROM contents, you will have to connect the selected drive to a COM port *(see chapter 3)*

5.3.2. Work with ROM

5.3.2.1. Read ROM via terminal

The command reads ROM image via COM port of a drive. The code thus read will be identical to an image copied in a programmer device.

Fig.5.4.

In order to perform the procedure, you should connect your HDD to terminal *(see section 3)*. ROM contents will be read using the DF command with two options: the first one specifies the initial address, the second stands for data length in words. As soon as the command is issued, the drive returns a ROM dump. The utility will convert the received data and verify its checksum.

ROM reading dialog offers to store ROM contents in a respective profile folder: <HDD Profile>\Data\ROM or to database. When reading to a profile folder, you can enable the option, which makes the utility ignore checksum errors – it means that despite checksum errors the resulting file will be created in the specified folder anyway.

ROM reading takes up to 2 minutes.

The utility displays progress in its information panel.

Attention! You can considerably speed up ROM reading via terminal by increasing the COM port exchange rate *(see section 5.2.1)*.

5.3.2.2. Write ROM

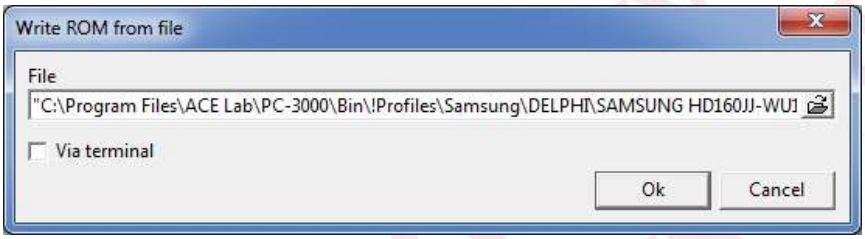

Fig.5.5.

ROM recording in Samsung drives is performed using the standard «92h» command or the terminal «DN» command. The procedure of ROM recording in a drive is managed by a special program (loader) containing microcode, which the utility automatically appends to the dump to be written before the drive boots up. Loaders for various drive families may differ; they may also vary within a family depending on the PCB type or revision. Please keep that in mind selecting the drive family, P/N or Platform Id before ROM recording because incorrect selection may result in corruption of the data stored in ROM chip.

When ROM is recorded via ATA, you can monitor the progress of the procedure in terminal. First, «E» will be output indicating the beginning of ROM erase process, then «P» will indicate the start of recording (programming), finally «V» will appear as the recorded data are verified. After successful completion «OK will be output to the terminal and the drive will switch to the «BOOT>» mode. In case of recording failure the error code will be output to terminal and ATA registers.

To pass control to the loaded firmware, the drive power must be switched off and then on again. Please see below a sample terminal log of a PALO HDD after successful ROM recording.

```
…
EPVOK
BOOT>
```

ROM loading options:

1) ***Via terminal*** – ROM dump will be recorded through terminal using the DN command.
2) ***Disable checking HDD Platform Id*** – the option is available for Trinity drives only. It disables the hardware check of firmware version (Platform Id). The option allows you to avoid the «Invalid Platform Id» error while writing a ROM to a board with incompatible firmware. Please keep in mind that recording of incompatible firmware may result in breakdown of the control board.

Attention! While writing to ROM you have to ensure that the versions of ROM and overlays in service area match. Otherwise the drive will be unable to reach readiness after ROM recording with subsequent power switch off and on.

5.3.2.3. Get head map

This menu item is available for classic drives only, for Trinity drives the utility offers its extended version. It allows the operator to view the map of drive heads from a HDD or ROM file. To check the map of HDD heads, the drive must be connected to terminal. The utility uses terminal commands to read the necessary portion of drive ROM and display the heads map.

The heads map is necessary during donor selection for replacement of a heads stack *(see section 9.10)* in situations when a malfunctioning drive cannot reach readiness and does not allow reading the heads map from its service area but still enters the DBG> mode in terminal.

Attention! To make a HDD enter the DBG> mode, press the Esc key during its initialization (while the terminal window is open).

5.3.2.4. View information about ROM dump

This menu item is available for Trinity drives only, it serves as an extended version of the «Get head map» *(section 5.3.2.3)* option. It allows you to identify the firmware type (Main Code, HTBI Code), its original name, Platform Id (firmware identifier that determines its compatibility with the hardware of the drive) and the heads map.

5.3.2.5. FIPS module reading and writing

Reading and writing of the FIPS module are supported for Trinity drives only. These procedures are used to read from ROM the FIPS module containing all kinds of information about the results of the last burn test – and record it back. The module can be accessed via both ATA and terminal.

5.3.3. Work with RAM

5.3.3.1. RAM head map editing

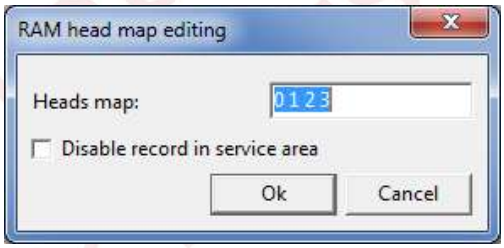

Fig.5.6.

The option to «Disable record in service area» blocks all writing operations in the SA. It may be helpful if the writing head is malfunctioning and a corrupting record in the service area may destroy the modules essential for drive operation.

5.3.4. Work with BURN

The menu contains options intended for preparation and launch of BURN-In tests of Samsung hard disk drives.

5.3.4.1. BURN test result report

This command generates a report on the results of a Burn test based on the following modules: BRSLT, BTIME, ELOG. The report will contain:

1) ***General information*** – data of the BRSLT module pertaining to Burn test completion status. The information contains the result code (test stop) and the number of successful test steps as well as the total number of errors that occurred while running the test and other additional records. In case of Burn test completion error you can use the content of that module for an approximate estimate of causes behind test stop.
2) ***Burn test duration*** – data of the BTIME module about the duration of every test step.
3) TOTAL NUMBER OF BURN TEST ERRORS – the number of errors, which occurred while the Burn test was running summarized for every zone and every head from the ELOG module.

4) ***Total number of burn test errors, stepwise*** – summed-up number of Burn test performance errors per every step of the test taken from the ELOG module.

5) ***Burn test error log*** – ELOG module data containing a list of all (but for 0x7F) errors revealed while a Burn test was running.

While parsing the ELOG module, the utility does not take into account records of RCC (0x7F) errors. Supposedly, these are recoverable errors, i.e. errors after which a drive can recover using its standard internal means (ECC algorithm). The number of such errors frequently surpasses the number of all the other ones many times. When **a drive** generates its defect lists, it also takes into account all types of errors except for 0x7F.

5.3.4.2. Write BURN resources to HDD

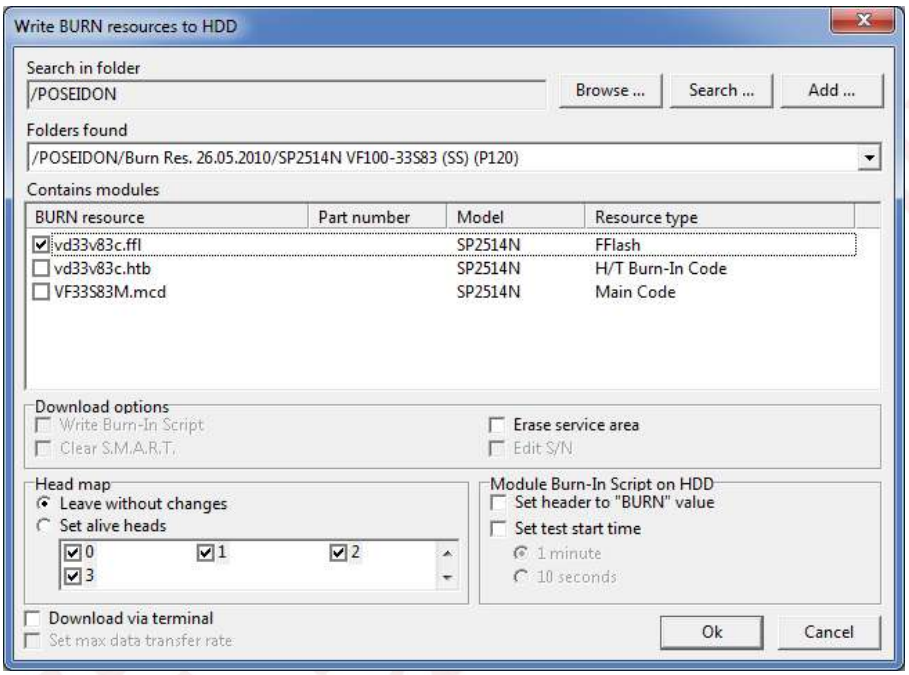

Fig.5.7.

The mode is designed to search for – and load into drive the codes for BURN-In test (Burn Code, HTBI Code, H/T Code, FFlash), or code for the normal operation mode (Main Code). Please see *section 9.11.2* for cases, when one of those codes has to be used.

Use the «Search…» button to find the necessary folder. Depending on the drive family, you will see an offer to enter the model or four initial figures of Part number (see the number on top of HDA case). The values can already be entered if they have been specified in the utility, then you will just have to reconfirm them. Select the search method and press «Ok».

The search results will appear in the «Folders found» dropdown menu with the contents of each folder displayed in the «Contains modules» field. Each folder on the lowest level contains just one set of resource files. For drives belonging to V11P, VICTOR, PUMA, VICTORPLUS, VERNA, VERNALITE, and VANGO families you will have to select the folder according to the label on drive's back end *(see Fig 9.7).* For newer drive families the folder name may indicate the corresponding firmware version for selection of the resources.

Attention! Available startup options may vary depending on the selected drive family.

Write Burn-In Script, Write Overlay, Write Geometry Script, Write Downsize Geometry Script

The option is available when a Burn-In Script (Overlay, Geometry Script, Downsize Geometry Script) is present in the list of the selected resource. Burn-In Script (Overlay, Geometry Script, Downsize Geometry Script) will be loaded to drive before or after (in F1_3D and earlier families) the resource selected in the list is loaded.

Erase service area

The option is available while writing HT, FFlash or Burn-In Code (depending on the drive family). The utility will write the resource selected in the list and then erase the service area. Clearing the service area is recommended before you start the Burn-In test in order to prevent the remaining service area modules from influencing the test results.

Clear S.M.A.R.T.

The option is available while loading Main Code. The command initializes S.M.A.R.T. parameters. After its execution and drive initialization following it, S.M.A.R.T. parameters will be returned to their original values.

Set Downsize Flag

The option is available for Samsung drive families that support creation of Downsized models by setting the Downsize flag before test start instead of a special Burn-In test (Downsize Burn-In). The command to set the Downsize flag is sent via the terminal.

Send command to run Burn-In test

The option is available for drive families, where the Burn-In test is invoked by sending a start command. The command to start Burn-In is sent via the terminal after all selected resources are loaded. Burn-In test starts immediately in that case.

Options for work with the heads map (heads map editing is only available with simultaneous loading of H/T or FFlash code):

Leave unchanged

The option tells the utility to make no operations with the heads map.

Specify enabled heads

The option tells the utility to leave in heads map just the numbers of selected physical heads. Thus, if a drive has heads «0» and «1», and head «1» only is specified, then head «0» will be disabled using software method *(see section 9.1.3)*. Heads map editing is available both via ATA and terminal (though it is only supported for some drive families).

Attention! Disabling all drive heads at the same time is strongly discouraged because enabling them again is not always possible.

Options for BISPT module correction in the service area:

Change header to BURN

When enabled, the option forces modification of the Burn script module header from any value to BURN. The header tells the drive to start the test.

Change timeout before test

The option changes the default time (5 minutes) to a smaller value: 10 seconds or 1 minute.

Two additional options:

Download via terminal

When this option is enabled, recording of resources and transfer of commands will be performed through the terminal only. Some other settings may become inactive, when this option is selected.

Attention! Some resources (Burn-In Script, Geometry Script for Trinity drives) will be written via terminal irrespectively of the setting selected for this option. This approach is determined by the fact that some commands for loading of resources have no ATA counterparts.

Set max data transfer rate

When enabled, the option configures the utility to load resources via terminal at the highest data exchange rate supported by the drive family. Code recording takes several seconds (usually < 30), as soon as the code loading procedure completes and the drive reports on readiness, the utility displays a notification of successful recording. Some

HDD models may stop the spindle during the procedure. For procedure completion, you will have to switch the HDD power supply off and on again.

While disabling heads in 2.5” drives you may encounter a situation when a command to modify the heads map makes a drive disable wrong heads, or a drive may leave them enabled altogether. This behavior is caused by an error in the firmware of classic 2.5” drives: a drive defines its heads map correctly only when its ROM contains the default heads map. To prevent such situations, you are advised to load HT or FFlash code having indicated all heads as enabled before you proceed to disabling heads in 2.5” drives. Then the drive ROM will contain the default heads map. After that you will have to repeat HT/FFlash code recording, this time with the necessary map for your purposes.

You can verify the current heads map using the command to «Display heads map» *(see section 5.3.2.3)*.

5.3.4.3. Download file into HDD

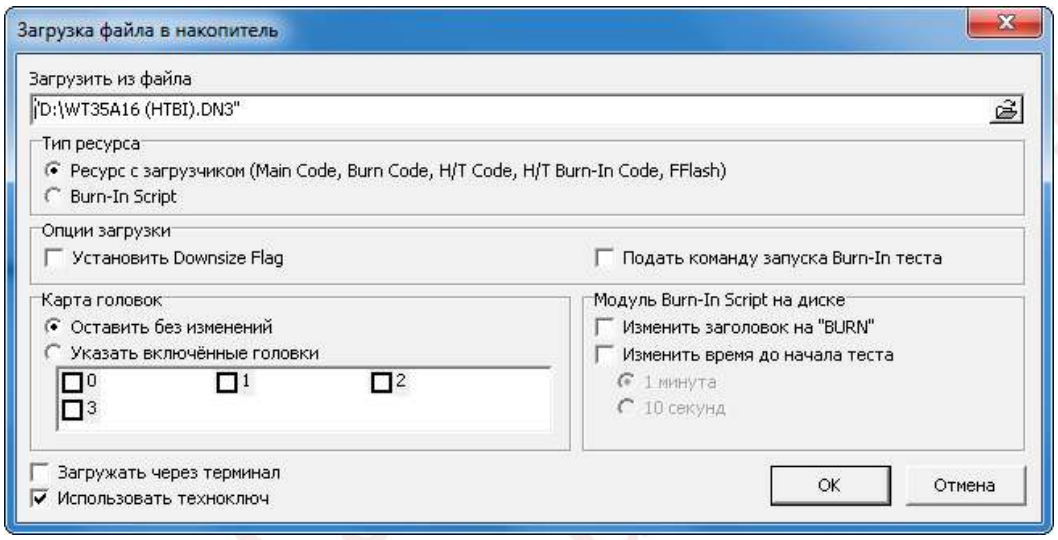

Fig. 5.8.

The mode is designed to allow loading of an arbitrary file to a HDD. You should use it in cases, when you have your own resources containing BURN-In tests that are not found in the database resources. In that case, you are advised to use the manufacturer’s tables of Samsung HDD for selection of test codes necessary for a specific drive. Please note that H/T or FFlash code has to be written to a HDD when heads map is modified. Form appearance may be various depending on drive family.

Several resource types loading are supported:

- ***Resource with loader*** – necessary to choose when Main Code, Burn Code, H/T Code, H/T Burn-In Code, Fflash are loading;
- ***Burn-In Script*** – necessary to choose when Burn-In test is loading in the drive;
- ***Geometry Script*** – choose when Geometry Script is loading;
- ***Overlay*** – must be chosen when firmware overlays are loading.

Attention! The menu item is not intended for loading of BURN-In script files and separate overlay files. Such files can be written as individual modules. The utility will load successfully files containing loader code; otherwise the drive will return an error.

5.3.4.4. Start Burn-In test

Run the command to start Burn-In test through terminal. The test should be used when, for whatever reasons, the drive was loaded Burn resources, but testing did not start.

Attention! All the necessary resources for testing need to be loaded into the drive, otherwise it returns an error.

5.3.4.5. Resume Burn-In test

Run the command to resume Burn-In test through terminal. This test is available when working with hard drives architecture Trinity. The test can be used to manually start the Burn-In test when the drive is not automatically renewed self-test.

Attention! All the necessary resources for testing need to be loaded into the drive, otherwise it returns an error.

5.3.5. Work with service area

5.3.5.1. Heads test

The test reads and writes (selectively) a single track in sector mode using the specified heads. The utility outputs test results to log.

The test can be used to identify heavily damaged or completely malfunctioning heads. Successful test completion does not mean that a head is fully functional. Physical scan test is recommended for more thorough testing of drive heads.

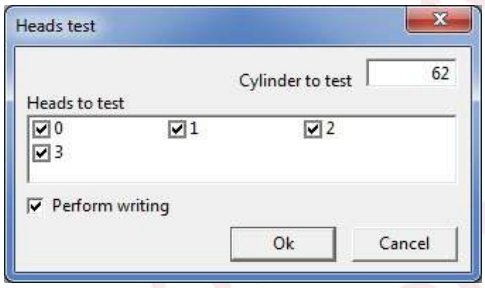

Fig. 5.9.

- ***Cylinder to test*** – the field should be used to define the cylinder that the utility will read and write (selectively). By default the field contains a cylinder within service area that contains no modules.
- ***Heads to test*** – heads that will be used for testing.
- ***Perform writing*** – when enabled, the option forces writing to the specified track before reading; read data will be compared to the written information.

5.3.5.2. SA structure test

This test checks the integrity of service data modules and outputs a report on service information structure to the «Reports» tab; the said report describes the zone allocation table, table of modules and results of their reading.

The majority of modules in Samsung HDD do not have checksums; therefore, error-free reading and module header serve as a criterion of their integrity. The importance of a potential mismatch between a module header and the standard header is defined by the importance of that very module. Certain modules can have no header at all or they may be completely filled up with zeroes until the drive uses them for the first time.

Service data integrity check is performed using the zero head (usually a system one) of a drive. Other heads in a HDD are used to store copies for most modules accessible via the system head. During operation a drive performs recording using all its heads, that feature can be used for **service data recovery,** unless the integrity of those copies has suffered. Errors in system information structure accessible via other heads do not affect drive's operation. Single-head HDD do not use copies of service data modules.

In the modules table, the ***Real Header*** field means the header read from a module while the ***Standard Hdr*** demonstrates the standard header for such modules, the ***Read*** field informs about successful reading or errors.
CrLev identifies module importance, it is explained as follows:

A – unique modules for the current HDD (cannot be borrowed from another drive)
B – modules can be borrowed from a HDD having the same firmware version
C – modules can be cleared from within the utility (can be recorded using a standard template)
D – modules do not influence firmware start or data access
d – modules influence data
s – modules influence system start (adaptive data, etc.)
r – modules employed for self-testing/ self-recovery routine (BURN).

5.3.5.3. Read modules

This mode is intended for reading of HDD service files. The list of modules to be read is based on the modules table loaded during utility initialization *(see section 4)*. Read information is stored upon operator's choice to a profile folder or a database folder.

When reading to a profile folder, you can enable the option to ignore reading errors. In that case the module portion read with an error will be filled with code 0ADDEh (displayed as DE AD when viewed in Hex Editor), and the file of that module will be preserved with the ***.bad** extension. The mode may be useful when you need to save service modules from a malfunctioning drive but a part of some module fails to be read. Besides, the module part that a drive fails to read may contain no information, e.g., last sectors of a SLIST module.

Composite module reading is supported; then in cases when errors occur while reading a module with the zero head, the utility attempts reading using next heads until a sector is read.

Module name in profile folder is generated using one of two possible methods depending upon HDD family. If a drive belongs to a family with a modules table stored in service area *(see section 7.3.)*, then the file name will consist of a hexadecimal identifier and module name delimited by space. If the family of the current HDD has no such table, then the file name will consist of module name only. In both cases the resulting files will have the ***.rpm** extension.

In the database folder, module names are generated in a similar manner, though without any extensions.

If a drive has more than 1 reading/writing head, then the utility will generate a subfolder in the Modules folder named according to the number of head used for reading of the modules stored inside it. If a drive has more than 1 head but composite reading has been used, retrieved modules will also be saved in Modules root folder.

Attention! When the utility saves any resources to the database, it supplements the information that identifies a resource within a model, with an additional description, which helps distinguish it from identical resources of other drives. You should keep that in mind when editing the fields in the «Utility status» dialog *(see section 5.1)*, to allow future searching for those resources using the values of those fields.

5.3.5.4. Write modules

This mode is intended for recording of HDD service files – writing them from a profile folder or another specified folder to the drive being tested. Recording is also possible from a database.

To allow module recording, its name must correspond to filename format for the selected drive family. If a module has an identifier, the module name following it will be ignored. If a module has no identifier, then the utility will identify it by its name.

Module recording will be performed using all selected heads.

During selection of the mode for recording from database, the utility displays the following form:

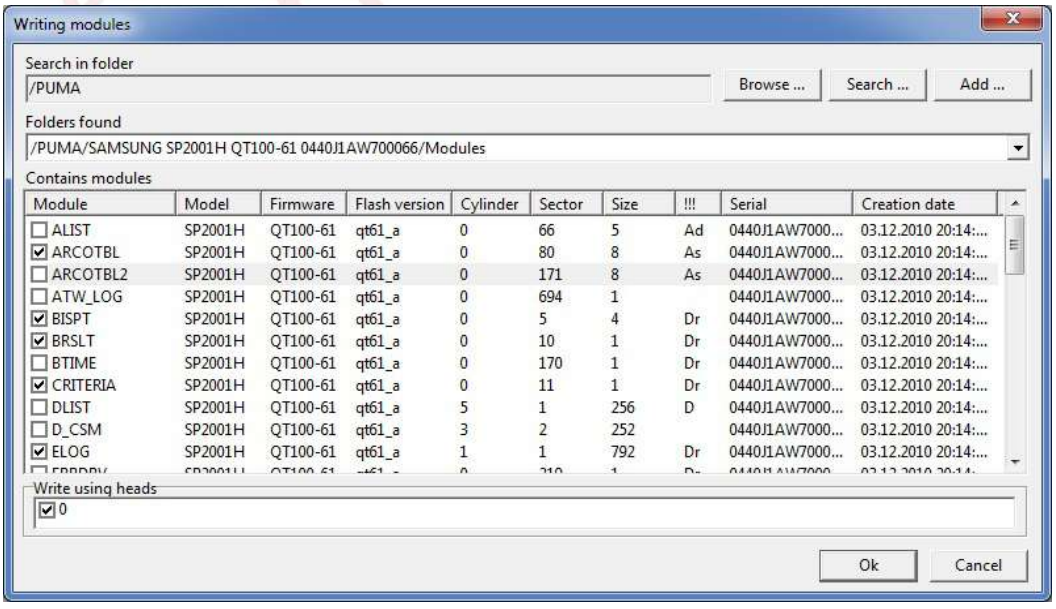

Fig. 5.10.

Purpose of the buttons:

- ***Browse…*** – select the database folder, which will be used while searching.
- ***Search…*** – displays a dialog with the settings of parameters and search method and then starts the search procedure.
- ***Add…*** – allows adding a folder to the «Folders found» list without a search procedure.

The «Folders found» dropdown list shows all folders containing modules defined by search parameters or added without a search.

5.3.5.5. Reading service tracks

The command reads service information as individual tracks. The procedure may be useful when you suspect that a drive contains information, which has not been included into the list of modules.

When the utility reads tracks, it creates a map of read sectors storing it in track profile within the database or as a file named after the track with the ***.map** extension in the profile folder. Track file name is generated according to the pattern: C<track number>_H<head number>.

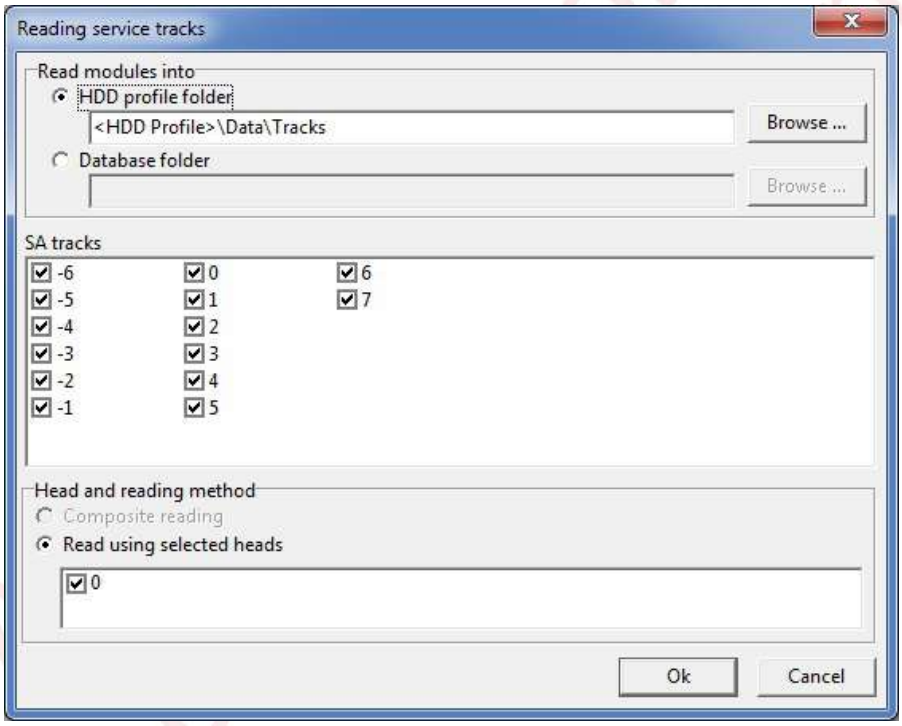

Fig. 5.11.

You can specify composed reading as the method to be used while copying tracks, then the head number section of the track name will contain the «FF» characters. Such reading method creates a single resulting file from each track, reading is performed using the zero head; whenever an error occurs, the utility tries to read the same sector using the next head and proceeds in that manner until it reads the sector. Some modules of minor importance have no copies recorded for other heads; therefore a track read using the composite method can differ from the track produced by the system head.

Service area of Samsung HDD practically always contains unformatted tracks or track portions. The routine reading the sectors of such tracks will return an AMN or UNC error. Besides, we have noticed that such errors decrease the value of S.M.A.R.T. attribute 196 (reallocations count), which can be restored by resetting all S.M.A.R.T. parameters. You are advised to click the «Skip ([Ctrl]+[B])» button on the main toolbar whenever such a track or track area is encountered. The read track portion will be saved.

5.3.5.6. Writing service tracks

- ***«To selected heads»*** – in that mode the utility will write a track using the number from which it has been originally read; the operator has to specify the head number.
- ***«Head used to read the track»*** – in that mode the utility writes a track in accordance with its number and the head number specified in track name. If some of the selected tracks have been read using composite access, the utility will display an additional dialog, where you can select the heads to use for recording of such composed tracks.

The utility will write only those track sectors, which are marked as read in track map.

Enabled «Ignore write error» option allows recording of tracks without stops if write errors occur during the process.

5.3.5.7. Erase service area

Attention! The test has experimental purpose. Erasing the service area makes the user data area inaccessible and it can render a drive inoperable!

You can erase the service area before launch of a Burn test if you have already recorded HT Code or FFlash to the HDD. After erasing switch the drive power supply off and on. Once the microprogram in ROM fails to find the service modules and script module, it will start checking the service area and generation of the main service modules. You can observe completion of such test if you connect the drive to terminal. After the test be sure to check the header of the BISPT script module and write Burn Code or HTBI Code.

Fig.5.12.

- ***«Initial cylinder» / «Final cylinder»*** – the range of service area tracks that will be erased.
- ***«By heads»*** – the field contains numbers of the heads that will be used to erase the specified tracks.
- ***«Fill»*** – selection of the pattern for recording to surface.

5.3.5.8. Zone translation table

«Zone translation table» test is intended for modification of the order, in which zones are translated and for «cutting off» the zones that should not be used by setting the maximum LBA value.

The feature is supported for the following drive families: PALO, RUBICON, P80A, POSEIDON, DELPHI, CAESAR, P80M, TRIDENT, T166, STORM2, TRIDENT3, NEON, PARAGON, F1_3D, F2_EG, F3, F3_4D, F4, F4_3D, M7S2, M7E, and M8E. These families contain an additional table used during operation for definition of the order, in which zones are translated. Translation there can begin with any of the existing heads and continue using the same head through several adjacent zones. That peculiarity is used in the utility to define the required translation order and restrict the HDD volume excluding zones that contain a large number of defects. TRIDENT and T166(S) drive families contain such table in the '06 CONFIG' module, F1_3D, F2_EG, F3, F3_4D, F4, F4_3D, M7S2, M7E, M8E – in the '9D PARAM_DM' module, in other mentioned families the table is stored in a separate '5D CONFIG2' module.

Dialog window of the test contains the translation table with an indication of the head and zone number. Zones are arranged in the translation order from the top down. The utility displays the number of logical sectors used in a zone, initial and final LBA of a zone. Arrow buttons can be used to move the highlighted area; the initial and final addresses of the selected zone will change at that.

After the defective zones are relocated to the table end, you should select the option to restrict drive volume and specify the final LBA (by double-clicking the zone containing that LBA).

- The option to restrict volume ***By MAX LBA command*** means generation of a standard ATA command. Changes will appear in the SETMAX module.
- The option ***By CONFIG module edit*** indicates that editing of the 06 CONFIG module is required. In that case, the utility will modify the CONFIG module leaving the SETMAX module clean.

All changes will be saved after clicking the OK button. To apply the changes, the operator has to switch the drive's power supply off and on.

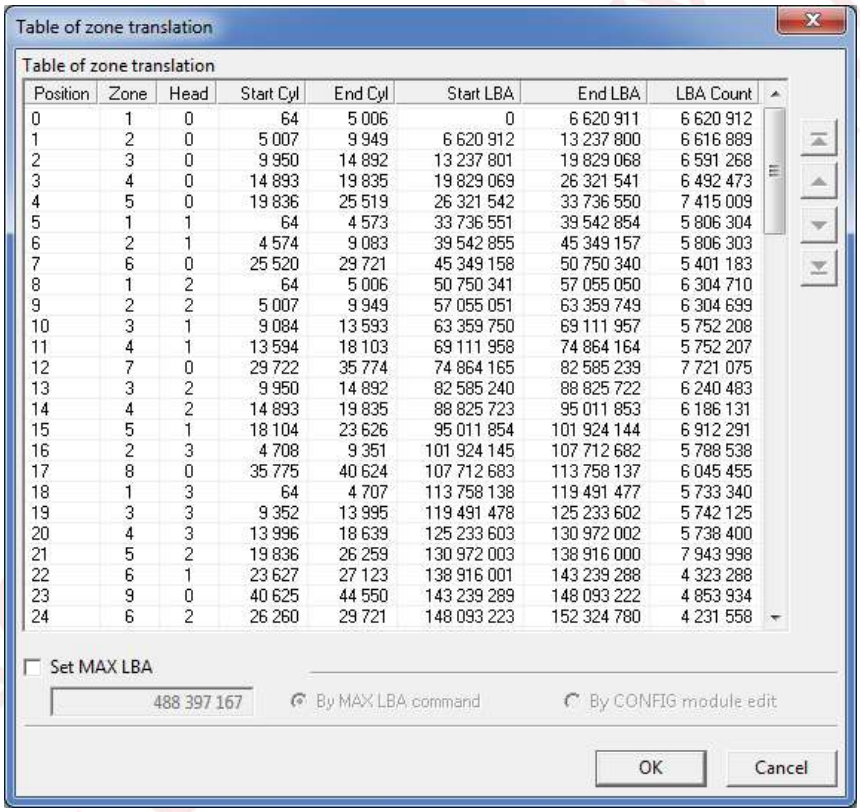

Fig.5.13.

5.3.5.9. Edit S/N

The command opens a dialog window for serial number entry. The dialog contains the value read from HDD ID substituted by default. After input of a new serial number the utility writes it to the SNTBL module. To make the new number appear in HDD ID, switch the drive power supply off/on and read the HDD ID again.

5.3.5.10. Edit HDD ID

This feature is available for Trinity HDD only. The mode offers the following opportunities:

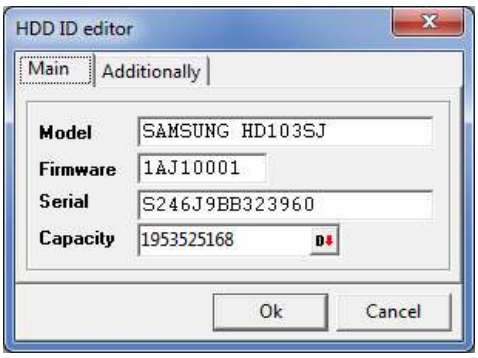

Fig. 5.14

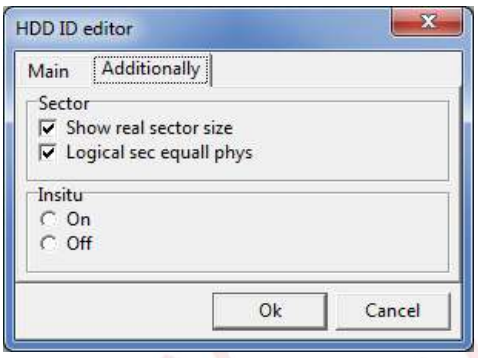

Fig. 5.15

- Editing of the model name by changing the HDD ID drive capacity in the 9D PARAM_DM module. The Model list *(Fig. 5.14)* contains the manufacturer's list of standard models. When a model is selected from that list, the value in the Capacity field changes automatically. Editing of the Capacity field allows you to create nonstandard models that do not exist in the manufacturer's range of products.
- Serial number modification by editing of the 07 SNTBL module.
- Editing of the sector parameters displayed in the HDD ID *(Fig. 5.15)*. The operation only makes sense in HDD using Advanced format[1]. The option to «Show real sector size» allows you to enable in the HDD ID indication of actual physical sector size for the drives which use hidden physical sector size (F4_3D, M8E). If the «Logical sec equall phys» option is selected, the logical sector size will be set to 4 Kbytes, otherwise it will be 512 bytes.
- Enabling and disabling of internal Insitu testing – quick self-test of the drive performed during start and checking the quality of heads, surface condition and integrity of firmware modules. If the read/write heads are malfunctioning, Insitu test may considerably slow down the drive start, cause corruption of firmware modules and knocking sounds. Test results are stored in the 93 IN_SITU module.

Advanced Format is data storage format developed by IDEMA Long Data Sector Committee for HDD. It is intended to minimize the formatting overhead by using sectors of 4Kbytes instead of traditional 512-byte sectors.

5.3.6. Security subsystem

Information about passwords in Samsung HDD is preserved in the SECURITY module. The utility manipulates the module while working with that group of commands.

5.3.6.1. Password information

The command generates a report on set passwords in a HDD and its protection level.

5.3.6.2. Clearing passwords

The command fills with zeroes the user password, disables the flag indicating that a password is set, and records the modified module using all drive heads.

Attention! You will have to switch the drive's power off and on again to make the changes effective.

5.3.7. Work with database

The submenu contains additional features for work with the database.

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[1] – Advanced Format is data storage format developed by IDEMA Long Data Sector Committee for HDD. It is intended to minimize the formatting overhead by using sectors of 4Kbytes instead of traditional 512-byte sectors.

5.3.7.1. Export HDD resources

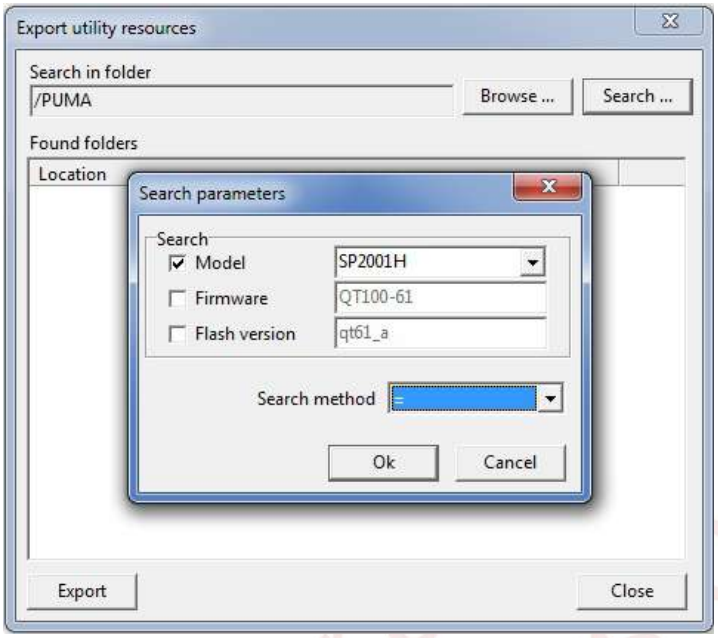


Fig.5.16.

The mode combines options available for export of resources and search for them in a DB. Pressing the «Search…» button opens a form, where you should enter the search parameters. When you specify the criteria, the utility will start looking for **module folders** matching those criteria. All folders will be added to the «Location» list where you can export the necessary folders by checking the corresponding boxes.

The resources will be exported to PC-3000 resource files (***.pcr**).

5.3.7.2. Resource master copy creation in DB

The mode is intended for storage of service information in database. The dialog window is identical to the window used in the «HDD resources backup» mode *(see section 5.3.1)*. The selected resources will be saved to Modules, ROM and Tracks subdirectories of the specified database folder. Before the backup, the utility will check the service data structure and create a report saved in an «info» file in the HDD's folder.

5.4. Format

This command initiates low-level drive formatting. The utility will use the zone allocation table to send in sequence track formatting command for all user area tracks. A HDD uses a random memory block to fill sectors with. Formatting procedure is also applied to the reserved space tracks (see section 7.1). When formatting, a drive takes into account its defect lists and skips defective areas. If an error occurs while writing to a certain track during format, the damaged sector or track will remain in place; the drive will not reassign it.

5.5. Surface test

5.5.1. Logical scan

Logical scanning can be used in cases of minor damage to HDD surfaces, when the time necessary to find and hide affected sectors is considerably less than Burn-In test duration and also when you have no data set necessary for a Burn test.

This test employs the scanning routine of the universal utility. However, in the Samsung utility you can control the drive's ECC mode during the scan process. In order to disable or enable data correction in a drive, open the «Utility status» and use the «Logical scan» section to select the necessary option.

If you disable ECC, sector reading errors will make the drive initiate retries itself, scanning speed will be somewhat slower and the performance chart will demonstrate small gaps resulting from the delays caused by repeated reading attempts. The number of hardware retries is limited, so the probability of error detection increases compared with normal operation mode.

If you need a more thorough surface check on a drive, you are advised to use recording as the first step during test since automatic reassignment of defects works more efficiently in case of write errors.

After scanning completion the utility will display a dialog where you can select further actions over the revealed defects. Two options are available:

- ***«Convert to Physical CHS»*** – the utility will translate found defects into physical notation, create a list of those defects and open it in defect list editor.
- ***«Add into S-LIST»*** – the utility will translate found defects into physical notation, add them into the defect list in S-LIST module and open it in defect list editor.

In both cases the defect list opened in the editor will be saved first to a 'Defects\slist.chs' file in the HDD profile folder.

The utility converts defective sectors from logical notation using its internal algorithm; it reads the S-LIST module first to that effect. The translation rate may differ with various drives; it also depends upon the number of defects in S-LIST.

Please refer to the Defect list section for additional information on work with defects.

5.5.2. Physical test

The test is designed for a surface check of user data area; it is based on reading and writing accomplished with factory commands in accordance with physical drive parameters.

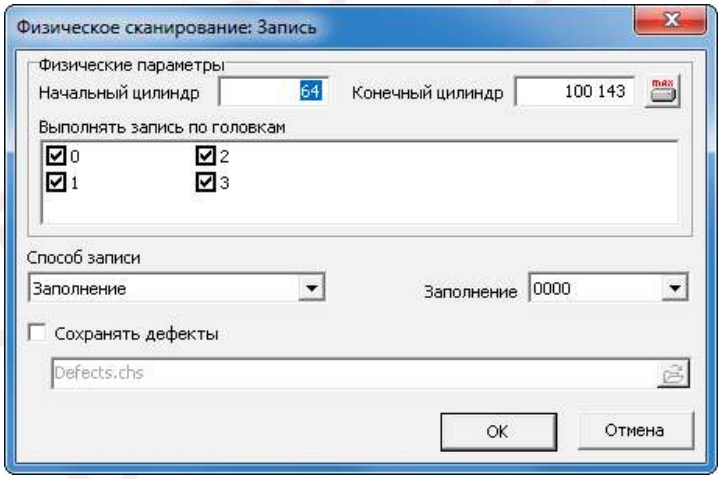


Fig.5.17.

- ***«Initial cylinder», «Final cylinder»*** – range of the tracks to test.
- ***«Write using heads»*** – list of the heads that will be used for testing.
- ***«Write method»*** – pattern used for recording. Two options are supported: Fill – a word in hexadecimal notation; 'Data combination with CHS value – the beginning of each sector will contain information about the cylinder, head and the number of that sector.
- ***«Save defects»*** – when the option is enabled and the output file is defined, the utility will list all the defects revealed while scanning to the specified file.

If defects have been found, the utility displays after scanning completion the following dialog suggesting the following actions over the revealed defective sectors:

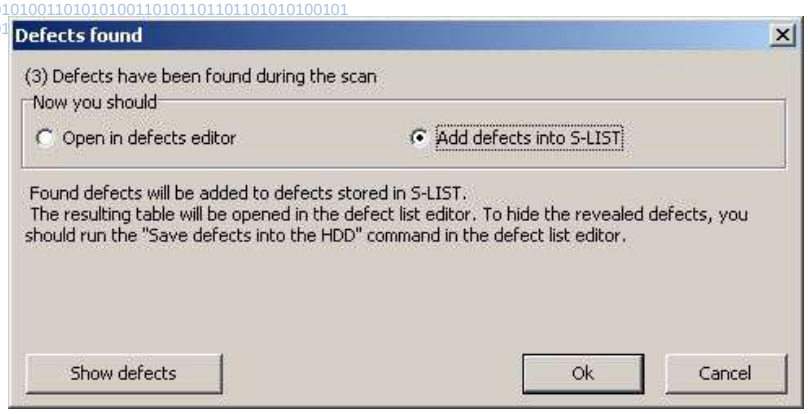


Fig.5.18.

- ***«Open in defects editor»*** – the utility will open the list of defects in corresponding editor.
- ***«Add defects to S-LIST»*** – found defects will be added to S-LIST module and opened in defects editor.

5.5.3. Combined test

This test offers an opportunity to test a drive using its physical parameters at the logical scan rate. The test works with zones that can be selected by the corresponding head, LBA, cylinder, etc. The dialog displayed after test selection contains two tabs: «General» *(Fig. 5.19)* and «Additionally» *(Fig. 5.20).* Let us examine the basic settings.

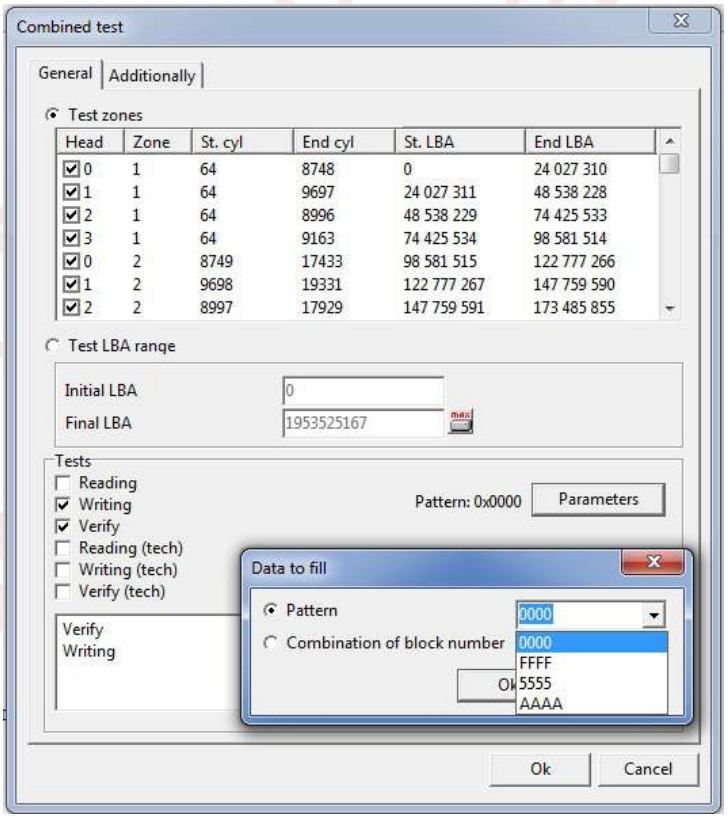


Fig.5.19. Basic settings

On the «General» tab you can use the «Tests» group to select the test, which the utility will run sequentially while scanning the surface. The following set of tests is supported:

- ***Reading.***
- ***Writing.*** The data for writing should be selected in the «Parameters» menu. You can use filling with a pattern or with a combination including the block number.
- ***Verify.***
- ***Reading (tech).***
- ***Writing (tech).*** Similarly to logical writing, you can choose between various options for data recording.
- ***Verify (tech).***

Now please have a look at the «Additionally» tab. Users can configure the following scan settings:

- ***Scan direction*** – direction of testing from the beginning to the end (forward) or from the end to the beginning (reverse).
- ***HDD timeout*** – when this time elapses, the feature expecting reading (writing, verification) of a block of sectors will be interrupted and an error will be registered.
- ***One LBA commands timeout*** – when this time elapses, the feature expecting reading (writing, verification) of a single sector will be interrupted and an error will be registered.
- ***Skip if an error occurred*** – when this option is selected, the number in the sectors defined in the corresponding field will be skipped on a read/write error.
- ***Don't search sector where error occurred*** – the utility will not seek sectors with errors.
- The ***«Save defects»*** checkbox allows you to save the list of defects revealed while scanning to a file. File path is specified in the field below.

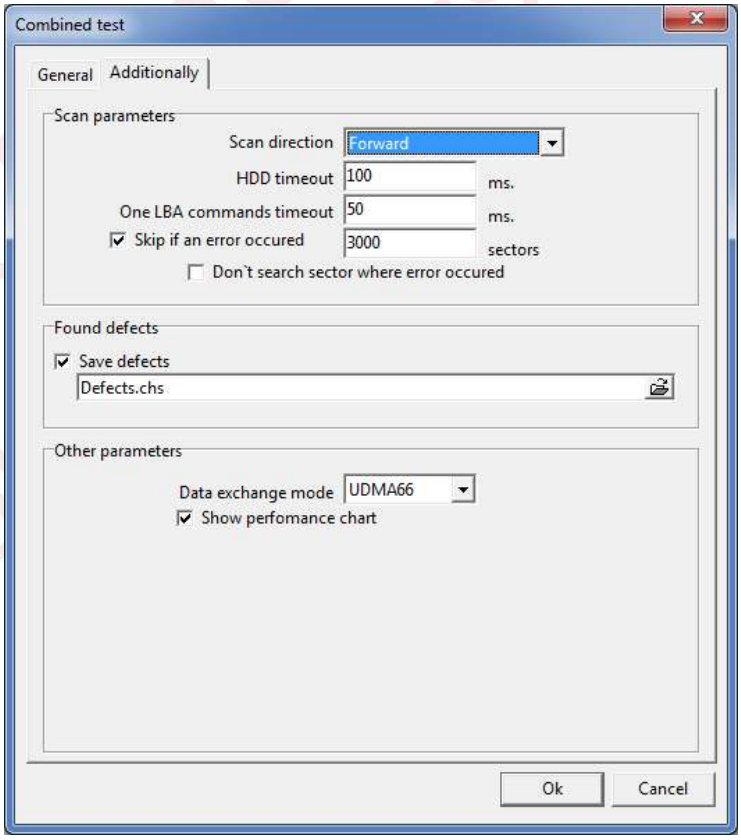


Fig.5.20. Additional settings

Additional settings:

- ***Data exchange mode*** – the option allows to select the data transfer mode for the interface from the list.
- ***Show performance chart*** – if enabled, the checkbox configures the utility to display performance chart during the test.

If scanning reveals defects, the utility will display a dialog suggesting possible further operations with them:

- ***Open in defects editor*** – the utility will open the list of defects in corresponding editor.
- ***Add defects to S-LIST*** – found defects will be added to S-LIST module and opened in defects editor.

Fig.5.21.

5.6. Defect list

5.6.1. Defect lists report

This test reads and parses the following defect list modules: ALIST, TLIST, SLISTHDR, SLIST, and DLIST. In addition, the utility generates a table containing the total number of defects per every zone and each head for the SLIST and DLIST modules. SLIST module contains records of defective tracks in addition to those of defective sectors.

Records of reassigned sectors in ALIST module have a "shifted" physical notation compared with the records represented in SLIST. The offset depends upon the presence of defects from SLIST module within the same track, i.e. if a record of a defective sector (e.g., C:24,H:0,S:1) exists at the same time in SLIST and ALIST tables, these records will point to different sectors.

5.6.2. Defects editing

The mode is intended for work with the defects stored in the SLIST table since that module contains records of all defective sectors and tracks in a HDD. The utility loads and opens the SLIST defects table into defect list editor. Whenever you save the list, all defect records with respective modifications will be saved to the following modules: SLISTHDR, SLIST, TLIST, ALIST, CONFIG and CONFIG2 (in drive families where that module exists). HDD use those modules to build their dynamic translators reflecting the changes in the list of drive defects.

After saving of defects you are advised to perform low-level drive formatting to ensure its normal operation using the «Tests» → «Format» menu; the procedure is mandatory for some drive families.

5.6.2.1. Defect list editing

The utility can open defect editor either automatically (after selection of the «Defects editing» test) or from the menu: «Tools» → «Defect list edit» ([Ctrl]+[D]). In the first case the utility loads SLIST, displays a file saving dialog and opens the corresponding table in CHS format. When you invoke the editor from the standard «Tools» menu the table has to be created within the editor by pressing an appropriate button or [Ctrl]+[N] key combination. Then you will be able to select the table type (LBA or CHS) and the editor will proceed to creating an empty list.

While the defect list editor window is open, all its available features can be invoked from the context-sensitive menu that opens after right-clicking the table. In addition to standard save, add, table and defect highlighting commands, the editor includes features specialized for the PC-Samsung utility.

The following features are available for a defect list in logical notation:

Convert to physical format Alt+1 – the utility will translate logical addresses of defects into physical CHS. The utility performs the translation using its internal algorithm; it reads the S-LIST and CONFIG2 modules to do that. As a result, the LBA table will be converted into PCHS.

Reassign defects Alt+2 – defective sectors will be reassigned to reserved HDD space. First, the utility converts logical defects to physical notation (CHS) for the connected drive; it reads the S-LIST and CONFIG2 modules to do that.

That command can be used when you need to hide a small number of defective sectors without translator modification and data corruption.

The following features are available for a defect list in Physical CHS (PCHS) notation:

Save defects into the HDD Alt+1 – the utility saves the defect list and respective modifications to the following modules: SLISTHDR, SLIST, TLIST, ALIST, CONFIG, CONFIG2 (if present). The table of reassigned sectors in the ALIST module will be cleared during the saving procedure since it contains relative values, which may become invalid after entered modifications. In order to save reassigned sectors as defects, you will have to add them in defect list editor ([Alt]+[2]).

Add defects from A-LIST Alt+2 – the utility appends to defects table records about reassigned sectors from the ALIST module. Shifted values of reassigned sectors will be converted by the utility automatically.

Add defects from D-LIST Alt+3' – the utility reads and parses the DLIST module adding all records of defective sectors to the defect list editor table skipping duplicate records. This procedure and the next operation may be useful if the SLIST and copies thereof for other heads are corrupted when you need to recover data from such drive. In that case you will need to open the defect list editor ([Ctrl]+[D]), create a PCHS table and add to it defect records from the DLIST and TLIST modules. (In case of data recovery formatting should be skipped).

Add defects from T-LIST Alt+4' – the utility reads and parses the TLIST module adding all records of defective tracks to the defect list editor table skipping duplicate records.

Sort defects Alt+5 – the utility sorts the records of the table loaded into defect list editor in accordance with the logical sector addressing order. You do not have to use the feature when saving the defect list, because the latter will be sorted automatically in such cases.

Grouping to tracks Alt+6' – the feature allows you to convert several records of defective sectors within a single track into a defective track record under the same number. The grouping threshold dialog must specify the threshold equal to the number of defective sectors, which you wish to convert into a single defective track. The procedure will group all records that satisfy the grouping condition. You are not advised to use the procedure unless it is really necessary since the reserved space is limited and the maximum number of single-track defects is therefore limited, too.

Filling gaps [Alt]+[7].

The command fills the gaps between defective tracks and defective sectors in accordance with the criteria selected in the dialog.

Remove defects for head [Alt]+[8].

The command deletes all defect records for the specified head. You will have to select the head for record removal in the corresponding dialog.

Remove defects for zone [Alt]+[9].

The command deletes defect records for the specified zone. You will have to select the zone for record removal in the corresponding dialog.

Statistics [Alt]+[A].

The command displays a window with a diagram reflecting the distribution of defects among the HDD zones and heads.

5.6.3. A-LIST clearing

This command clears the table of reassigned sectors and corrects the reserved area table. It can be useful before a logical scan with subsequent relocation of defects.

Fig.5.221.

Sometimes the table gets filled during data recovery process because of multiple errors. In that case you can also clear A-LIST to return the data sectors to their original location. However, you should keep in mind that the sectors reassigned before the recovery process could be occupied with user data which might become partially corrupted after such clearing. A-LIST clearing does not affect the translator.

- ***A-LIST clearing by ALIST initialization command***. The procedure is performed by the drive itself after a corresponding command, i.e. the drive resets A-LIST automatically and performs firmware initialization.
- ***A-LIST clearing by utility method***. The procedure is performed by the utility. In that case the utility reads the A-LIST module, clears the defects it contains, modifies its auxiliary service data and writes the module back to drive. After such clearing you have to switch the drive's power supply off and on again to apply the changes.

5.6.4. Trasfer A-LIST to S-LIST

The test moves records of defective sectors from the ALIST module to SLIST; the ALIST table of reassigned records will be cleared after the records are added to SLIST.

5.6.5. Rebuild S-LIST

The procedure is intended for structural restoration of the S-LIST module in case of its corruption. During the procedure the utility reads information about defects from the T- and D-LIST modules and validates it. If the check is successful, information about defects is converted to necessary form and recorded to S-LIST. After procedure completion, you will have to switch the drive power supply off and on again.

5.6.6. Rebuild T-LIST

During this procedure the utility reads information about defective tracks from the S-LIST module. Once the validity check completes (successfully) the utility converts the data to necessary form and uses it to re-create T-LIST. After procedure completion, you will have to switch the HDD power supply off and on again.

5.7. Clear S.M.A.R.T.

The command initializes S.M.A.R.T. parameters. After its execution and drive initialization following it, S.M.A.R.T. parameters will be returned to their original values. One exception is attribute 5 (the number of reallocated sectors). The parameter is calculated during drive start based on the ALIST module (Auto Reassign List), so if the module is filled above the threshold specified for it then defects have to be transferred from ALIST to the SLIST module or the ALIST module has to be cleared first to allow decreasing the said attribute value *(please see section 5.6.3).*

6. «Tools» → «Utility extensions» menu

6.1. Modules table

The «Modules table [Ctr]l+[Alt]+[1]» extended mode is intended for interactive work with service area modules using its built-in hex editor. If you select that menu item, the utility opens an additional «Modules table» tab on the same level with the «Log» tab.

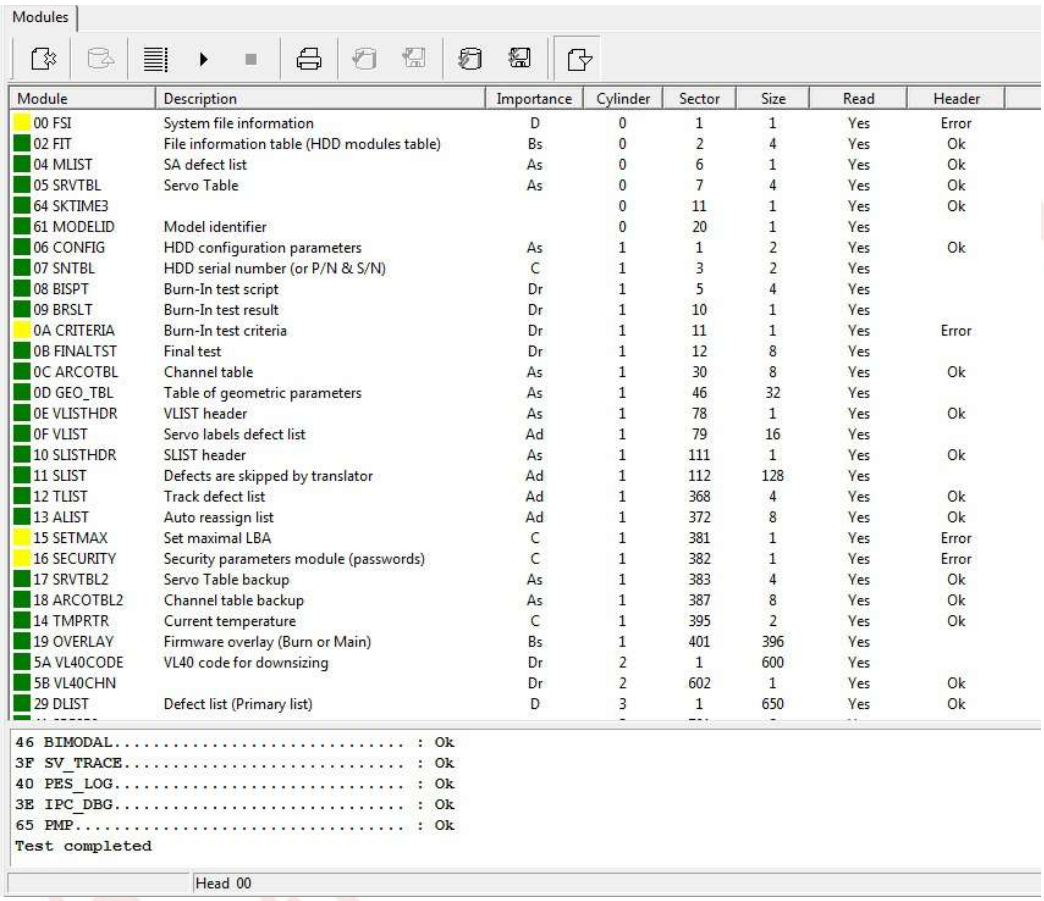


Fig.6.1.

In that mode you can check modules, open them for reviewing, editing, and save modifications. After module check-up the utility adds a colored square in the «Module» column before module identifier and name; the square reflects check-up results: red – the module has not been read; yellow – error in module header (i.e. the header read from the module does not match the header in module table); green – the check revealed no errors. The results of module reading are displayed in the «Read» column, header check-up results appear in the «Header» column; the utility checks module header only if the modules table contains a record stating that such check is necessary. Please see details on modules checking in *section 5.3.5.2*; see section for details on modules table.

The following additional actions are possible:

- ***View*** – opens a module for viewing and editing within the built-in hex editor (in the «View» tab). Please see further the screen and a description of available features.
- ***Select the head for reading*** – dropdown menu for selection of the head to be used while reading (checking) modules. The utility resets check results when you select another head. The current head number is displayed in the lower status panel.
- ***Start SA structure test (F9)*** – displays a dialog window, where you can select the modules to be tested and launch the SA test.
- ***Terminate (Esc)*** – stops checking of service modules.

- ***Report*** – creates a report in the additional «Reports» tab. You can save the report to a corresponding profile folder or print it out.
- ***Rewrite module from DB*** – opens a window for search and recording of a selected module from the database to the drive being tested.
- ***Rewrite module from file*** – opens a dialog for overwriting a module on the HDD being tested with copies from the profile folder.
- ***Rewrite modules group from DB*** – opens a dialog for overwriting a group of modules on the HDD being tested with copies from the DB *(see section 5.3.5.4)*.
- ***Rewrite modules group from files*** – opens a dialog for overwriting a group of modules on the HDD being tested with copies from the profile folder *(see section 5.3.5.4)*.
- ***Show log*** – command for process monitoring, it opens an additional log window in the lower part of the «Modules» tab.

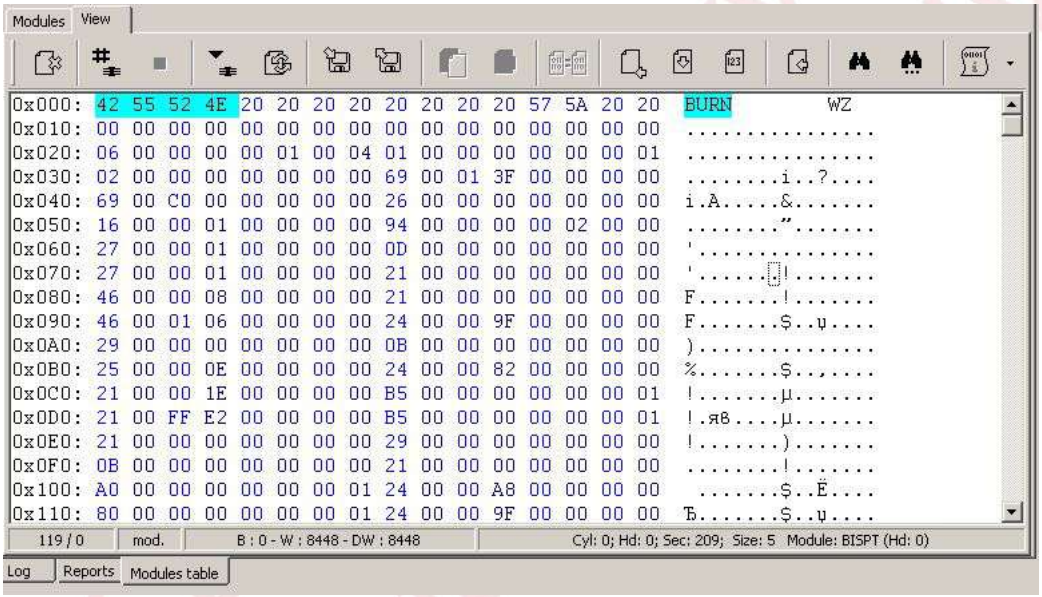


Fig. 6.2.

The «View» tab provides access to the following features:

- ***Data selection (Ctrl+Enter)*** – opens a dialog window, where you can select the module to view.
- ***Select the head for writing*** – dropdown menu, where you can select the head that will be used to record the modified module. «All heads» is the default value.
- ***Save data to HDD*** – the command writes a modified module to the drive being tested. The utility performs recording using the head specified in the «Select the head for writing» menu.
- ***Cancel*** – reloads a module from drive to editor. The button is accessible if you have made changes to a module, but have not recorded the module back to drive yet.
- ***Save*** – saves a module loaded into editor to a binary file with the user-defined path.
- ***Loading*** – loads into editor data from a user-defined file. If you save the data to the drive being tested, it will replace the module downloaded from that drive (location is specified in the lower status bar).
- ***Copy (Ctrl+C)*** – copies a selected fragment to clipboard, which you can use while editing a loaded module.
- ***Paste (Ctrl+V)*** – inserts a copied fragment into the currently loaded module.
- ***Find (Ctrl+F)*** – performs search for hexadecimal data in the currently loaded module.
- ***Find next (Ctrl+L)*** – looks for the next instance of the sought data.

6.1.1. Hex editor plag-ins

Internal Hex editor of the utility has a set of plug-ins. They are invoked from the editor toolbar *(Fig. 6.2)* or the context menu displayed after clicking the right button of the mouse. Available plug-ins:

- ***Recalculate CS for the selected area (2 bytes)*** – the command recalculates the checksum for the area highlighted in the editor. The checksum will be recorded in the last 2 bytes of the area.
- ***Recalculate CS for the selected area (4 bytes)*** – the command recalculates the checksum for the area highlighted in the editor. The checksum will be recorded in the last 4 bytes of the area.
- ***Words sum (2 bytes)*** – the command sums up all 2-byte words in the area highlighted in the editor. The result will be output in a modal dialog.
- ***Double words sum (4 bytes)*** – the command sums up all 4-byte words in the area highlighted in the editor. The result will be output in a modal dialog.
- ***Parse FIT*** – the plug-in is available only when the 02 FIT module is open in the editor. The results of the plug-in operations are displayed as a table of modules in the Reports tab.

6.2. Viewing andediting HDD resources

The mode is intended for viewing and editing the content of firmware modules, tracks and buffer RAM. Selection of the item brings up a dialog where you can choose the object to view *(Fig. 6.3)*.

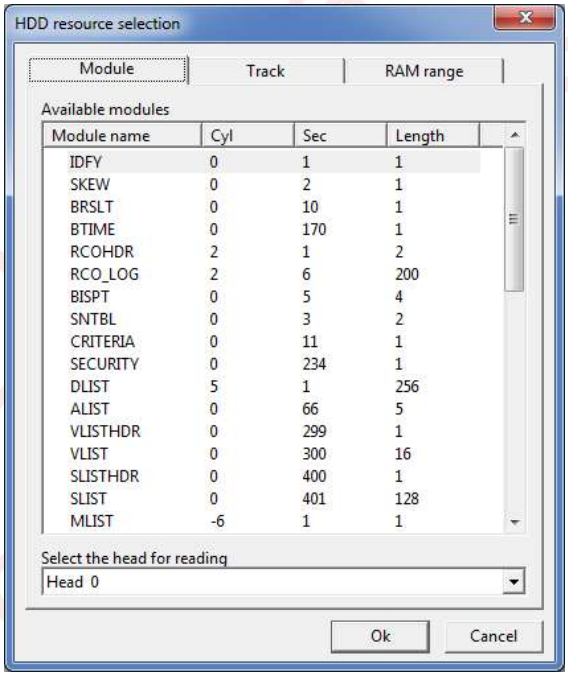


Fig. 6.3.

The Module tab

The tab contains a list of modules in the service area of the connected HDD. When you select a module, the utility reads it and opens it in hex editor. The editor can be used to modify the module and write it to HDD.

The Track tab

The tab contains the zone allocation table. Once a specific cylinder, head and track length is defined, the utility reads the specified track and opens it in the hex editor. The «Cylinder» field can be used to specify any cylinder number, including negative range.

The RAM range tab

The tab contains two fields for definition of the RAM range for reading. The «Address (sect)» field is used to specify the number of the first data sector (512 bytes) in RAM; the «Size (sect)» field defines the size of memory block to read (in sectors). After clicking OK, the utility reads drive RAM and opens the data in the hex editor.

6.3. Burn Test monitoring

The «Burn test [Ctrl]+[Alt]+[2]» extended mode is intended for monitoring of HDD self-testing (Burn test). This monitoring approach can be used as an alternative to drive connection to terminal; it is also one of available utility start methods.

After selection of «Burn test» mode from the «Tools» → «Utility extensions» menu the utility displays a dialog where you should specify the source for Burn Script loading. The script has to be loaded for convenient process monitoring; it also allows editing of individual test steps and their parameters (for most experienced engineers). There are four available variants of script loading:

- ***Read from HDD*** – the utility will read the BISPT module from the service area of the drive being tested. If the drive is waiting for the test to begin (all registers are off), then you will have to send a soft reset using the corresponding button in the dialog to read the module; then switch the HDD power supply again.
- ***Load from database*** – the method allows script reading from Burn resources in your database.
- ***Load from file*** – the method allows script reading from a specified file on disk.
- ***Without BURN script loading*** – if you do not wish to check the Burn test contents, you can start monitoring without a loaded script.

Click the «Launch monitoring» button to start Burn test status monitoring. If the drive has not been monitored before, the utility will create a log record about the started Burn test that will be used for script loading when you start the utility in the 'Burn Test' monitoring' mode.

Note: the utility cannot be closed while Burn test monitoring is in progress.

The monitoring window includes the following elements:

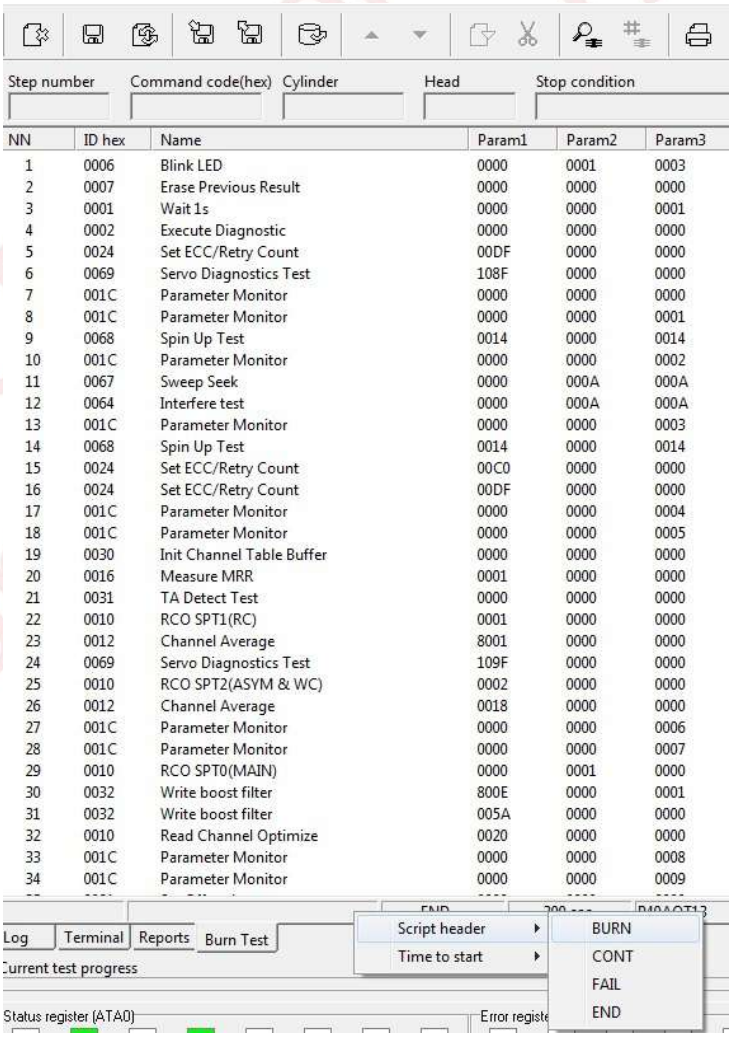


Fig.6.4.

- ***Save to HDD*** – writes window content into the BISPT module of the HDD.
- ***Reread*** – reads the BISPT module from drive refreshing window content.
- ***Save to file*** – saves a Burn script from the monitoring window to a file on disk.
- ***Load from file*** – loads a Burn script from file on disk into the Burn test monitoring window.
- ***Load from database*** – loads a Burn script from Burn resources of your database into the monitoring window.
- ***Move record up ([Ctrl]+[Up])*** – shifts the specified script command one step up.
- ***Move record down ([Ctrl]+[Down])*** – shifts the specified script command one step down.
- ***Editing([F2])*** – edits a Burn script command and its parameters (in a dialog window).
- ***Replace with NOP*** – substitutes the current command with command $0000.
- ***Launch monitoring*** – initiates Burn test status monitoring.
- ***Interrupt status monitoring ([Esc])*** – terminates Burn test status monitoring.
- ***Report ([Ctrl]+[P])*** – creates a Burn script report for printing.
- If the Burn script loaded into the monitoring window has been modified, then all changes will enter into force after you select the ***Save to HDD*** procedure.

Fields of the current test status display the following values:

- ***Step number*** – number of the command being executed, the test step number.
- ***Command code*** – code of the command being executed, step command code.
- ***Cyl*** – the main field value indicates the cylinder being tested; it may also display other values.
- ***Head*** – the head being used for testing at the moment.
- ***Stop condition*** – the completion code for the whole test and its description.

Right-clicking the information panel displays the context menu *(Fig. 6.4)* which you can use to modify the script header and the timeout before test beginning after power switch. All the changes made by the editor to the Burn script will be applied after you select the «Save to HDD» procedure.

6.4. Terminal soft reset ([Ctrl]+[Alt]+[4])

The mode is intended to send a soft reset signal via terminal.

6.5. Terminal hard reset ([Ctrl]+[Alt]+[5])

The mode is intended to send a hard reset signal via terminal.

6.6. Unlocking at«LED 1Axx» error ([Ctrl]+[Alt]+[6])

When errors occur while reading/writing the service area modules in Trinity drives, a HDD stops the spindle motor and outputs to the terminal continuously the error code: LED 1A04 (or LED 1A03). ATA access to the drive is impossible in such cases; soft- and hard reset signals do not remedy the situation. This mode allows automation of the unlocking process and restoring access to the HDD via the ATA interface.

6.7. FIT editor ([Ctrl]+[Alt]+[7])

You may have to move a module or a group of modules to another SA cylinder because of defects that appear in the service area. This mode can be used to edit the directory of drive modules. You can work with the 02 FIT module in the service area or with the ROM image containing the modules table.

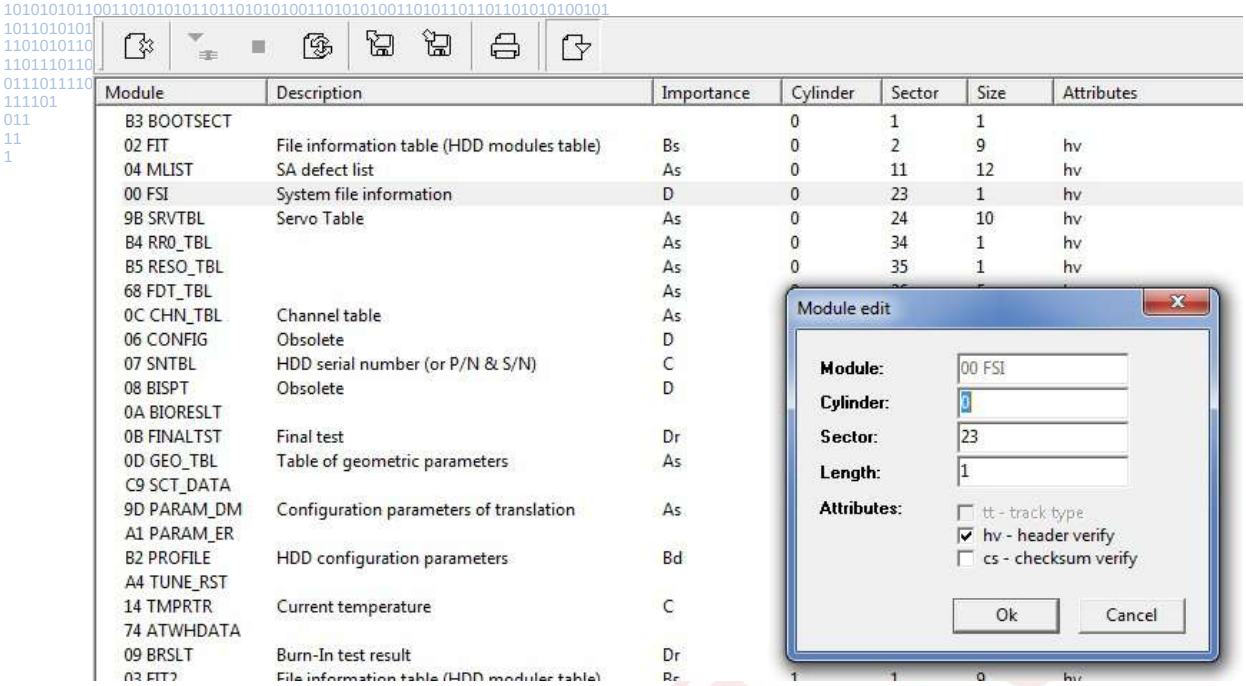


Fig.6.5.

Let us examine the main components of the editor window *(Fig. 6.5)*.

– ***Write to service area*** – saves the modified table to the 02 FIT module in the service area.

– ***Read from service area*** – reads the modules directory from the service area.

– ***Upload*** – loads the modules table from a file (*.rpm) or ROM image (*.bin).

– ***Upload*** – loads the modules table from a file (*.rpm) or ROM image (*.bin).

– ***Report*** – outputs the modules table being edited as a list to the Reports tab.

The «Module edit» window can be used to change the cylinder and sector where a module is located, its length and attributes. You can modify three attributes:

- ***tt (track type)*** – the flag means that the module is located on a cylinder beginning with sector 1 and occupies the number of tracks specified in the length field;
- ***hv (header verify)*** – the flag means that the correspondence of its header to the standard should be verified during module check;
- ***cs (checksum verify)*** – the flag determines checksum presence for a module.

6.7.1. Editing module locations in the FIT editor

While changing the module locations, please keep in mind that firmware of classic drives uses in its operation the modules table from ROM, while module 02 FIT contains just its copy used in the utility. Trinity drives also preserve a modules table in ROM, but the directory is only used during the first stage of firmware initialization, until the 02 FIT module is loaded from the service area. Therefore, in classic drives the modules table has to be edited twice: first in ROM, then in the service area. In Trinity drives just SA modification is sufficient.

The procedure for changing the module location in classic drives is as follows:

1) Rewrite the modules from file in accordance with the new coordinates.
2) Open the saved ROM image in editor.
3) Perform identical manipulations with the modules table.
4) Save the modified ROM image to file.
5) Write the modified ROM image from file to drive.

For Trinity drives the algorithm is somewhat simpler:

1) Save modules to file.
2) Open in the editor 02 FIT module of the drive and enter the necessary changes.
3) Save the modified table to the HDD.
4) Rewrite the modules from file in accordance with the new coordinates.
5) Toggle HDD power supply.

7. Brief technical description of Samsung drives

7.1. Disk space structure

Disk surface in Samsung drives is subdivided into zones. Depending on the family, a drive may have one service area and 16, 24 or 48 user zones. The zero zone starts at the external disk edge and acts as the area allocated for service data. User zones follow the service area, they are numbered from the edge to the center, beginning with 1.

Depending upon the drive's family, the service area includes 8, 16, 24, 64, 128 or 256 tracks beginning with track 0. In V11P, VICTOR, PUMA, VICTORPLUS, VERNA, VERNALITE, and VANGO drive families the service area also includes tracks with negative numbers. Those tracks may contain both modules used during drive operation and copies of some essential modules. The service area may contain some unformatted tracks, for example, in the negative part just a single track is typically used (-6 or -10). Every drive family has a constant service area SPT value.

User data area may be either constant for a specific drive family or adaptive (AZL – Adopted Zone Layout). In the first case the zone allocation table contains fixed numbers of tracks for each zone, their number per zone and the number of sectors per zone track (SPT). Those parameters are calculated once in the most optimal manner during drive model design. There may be differences within a family, if various models use heads or disks from different manufacturers. Firmware versions will also differ because the zone allocation table is stored in ROM.

Adaptive zone allocation tables are used in VANGOPLUS, PANGO, VELOCE, PALO, MAGMA, and newer drives. These tables are designed individually for each drive during its factory test *(see 9.11)*. The number of tracks in a zone and zone SPT will be calculated during the test based on physical parameters of drive heads and the condition of magnetic surfaces. The table below demonstrates a sample zone allocation table for PALO SP0802N.

Table 8.2.

#Z	Head	Initial cylinder	Final cylinder	SPT
1	0	24	2 927	1 067
1	1	24	3 166	1 160
2	0	2 928	6 937	1 056
2	1	3 167	7 505	1 160
3	0	6 938	11 102	1 044
3	1	7 506	12 008	1 134
4	0	11 103	16 170	1 027
4	1	12 009	17 485	1 121

5	0	16 171	19 079	1 015
5	1	17 486	20 634	1 108
6	0	19 080	21 988	1 005
6	1	20 635	23 784	1 093
7	0	21 989	25 874	986
7	1	23 785	27 570	1 082
8	0	25 875	29 351	966
8	1	27 571	31 747	1 056
9	0	29 352	32 366	953
9	1	31 748	35 754	1 031
10	0	32 367	36 381	928
10	1	35 755	38 852	1 015
11	0	36 382	39 896	928
11	1	38 853	42 650	994
12	0	39 897	43 411	894
12	1	42 651	46 942	966
13	0	43 412	47 665	870
13	1	46 943	51 173	928
14	0	47 666	51 019	850
14	1	51 174	55 204	928
15	0	51 020	54 026	828
15	1	55 205	57 891	899
16	0	54 027	57 480	799
16	1	57 892	61 660	870
17	0	57 481	60 827	773
17	1	61 661	65 703	835
18	0	60 828	63 781	747
18	1	65 704	69 334	812
19	0	63 782	66 935	721
19	1	69 335	73 180	773
20	0	66 936	70 502	696
20	1	73 181	76 411	747
21	0	70 503	73 902	662
21	1	76 412	80 187	696
22	0	73 903	76 956	638
22	1	80 188	83 253	696
23	0	76 957	80 068	609
23	1	83 254	86 618	662
24	0	80 069	83 153	580
24	1	86 619	90 033	638

The user data zone contains a certain number of reserved tracks used to compensate the space occupied by defects and as the area for reassigned sectors.

Various models differ in terms of reserved area location and the method of its use.

In V11P and VICTOR drives the reserved area occupies the last eight tracks of every zone for every head. In PUMA, VICTORPLUS, VERNA, VERNALITE, and VANGO drives the reserved space occupies the end of every zone of the last head. The area size is equal to eight tracks multiplied by the number of heads.

In drives of the said models (from V11P, VICTOR to VERNALITE, VANGO) the size of the reserved space will be less if the zone includes defective sectors or tracks duly registered in the SLIST module *(see section 7.5.1);* the space will be smaller by the number of such defective sectors and tracks. The drive will use the remaining portion of that reserved space for reassignment (relocation) of new defective sectors that appear during operation. When reserved space of a certain zone is exceeded, sectors of that zone will not be reassigned to another zone.

In newer classic drives the reserved space is subdivided. They use two reserved tracks in the end of each zone for each head as the source for reassignment of defective sectors; the size of that area is independent from the defects within a zone. The remaining part of the reserved space is located in the last zone following the sector assigned the highest LBA. The size of that area is equal to the total number of sectors available for logical addressing (i.e. valid non-defective sectors excluding the reserved tracks and the service area) minus the number of logical sectors (max LBA+1). This reserve is not used in drive operation, it becomes important only when you use defect list editor or run the Burn test.

Reserved space is subdivided in Trinity drives, too. Their difference from other families is that several sectors in the end of each last cylinder in a zone for every head are used as the space for reassignment.

7.2. Logical addressing of disk space

In V11P and VICTOR drive families logical block addressing (LBA) is cylinder-based: first the sectors of the zero cylinder are numbered for all heads, then the sectors of the first cylinder for all heads, and so on. In PUMA, VICTORPLUS, VERNA, VERNALITE, VANGO, VELOCE, PALO, and MAGMA drive families the addressing is zone-based. First all sectors of the first zone for the zero head are addressed, then all sectors of the first zone for the first head and so on for all heads. Then addressing proceeds to all sectors of the second zone for the zero head, next - the sectors of the second zone for the first head, etc. Alternatively, listing in order can be used:

Z:1,H:0 : LBA_{0} – $LBA_{1:0}$;
Z:1,H:1 : $LBA_{1:0}$ – $LBA_{1:1}$;
Z:1,H:2 : $LBA_{1:1}$ – $LBA_{1:2}$;
Z:1,H:3 : $LBA_{1:2}$ – $LBA_{1:3}$;
Z:2,H:0 : $LBA_{1:3}$ – $LBA_{2:0}$;
Z:2,H:1 : $LBA_{2:0}$ – $LBA_{2:1}$;
Z:2,H:2 : $LBA_{2:1}$ – $LBA_{2:2}$;
Z:2,H:3 : $LBA_{2:2}$ – $LBA_{2:3}$;
…
Z:22,H:0 : $LBA_{21:0}$ – $LBA_{22:0}$;
Z:22,H:1 : $LBA_{22:0}$ – $LBA_{22:1}$;
Z:22,H:2 : $LBA_{22:1}$ – $LBA_{22:2}$;
Z:22,H:3 : $LBA_{22:2}$ – $LBA_{22:3}$;
Z:23,H:0 : $LBA_{22:3}$ – $LBA_{23:0}$;
Z:23,H:1 : $LBA_{23:0}$ – $LBA_{23:1}$;
Z:23,H:2 : $LBA_{23:1}$ – $LBA_{23:2}$;
Z:23,H:3 : $LBA_{23:2}$ – $LBA_{23:3}$.

Please see *section 7.1* for details on allocation of zones in HDD.

Newer drives may use a zone translation table that determines the sequence, in which the translator passes the zones. Depending on the drive family, the table may be stored in the CONFIG, CONFIG2 or PARAM_DM modules.

7.3. Modules table

Hard disk drives belonging to V11P, VICTOR, PUMA, VICTORPLUS, VERNA, VERNALITE, and VANGO families do not use a conventional modules table; their ROM codes contain offsets, which define the locations of modules, but these are not linked to any names or identifiers. Therefore, the utility uses its internal modules table by default whenever working with those HDD families.

Newer classic drives use a normal modules table stored in ROM. Tables of modules in those drives may differ as regards the location and the number of modules depending upon firmware version. As a rule, when Main Code gets loaded to memory, the drive's firmware writes to disk surface a FIT module containing the modules table identical to the one in the code being loaded. A drive does not work with the module after that.

Trinity drives work with the modules table in the service area. During firmware initialization a drive reads the FIT module and then works with its copy in RAM. ROM of these drives also contains a modules table used by default in cases when the FIT table cannot be read for some reason.

The utility at launch loads the modules table from the FIT module or uses the default table if the module is missing or corrupted.

Modules table contains for each module its name, cylinder of its location, sector, length, numeric identifier, flags informing about module track and indicating whether a drive checks module header during work with it. Module header is preserved in the utility and substituted to the table during initialization.

Table 8.3. Default modules table used in PALO drives

ID	Name	Description	Cyl	Sec	Length	Cr. Lev	Header	Verify flag
00	FSI	System files record	0	1	1		FSI	Verify
02	FIT	The table of module locations.	0	2	4	D	FIT	Verify
04	MLIST	SA defects list	0	6	1	As	MLIST	Verify
05	SRVTBL	Servo Table	0	7	4		SV_TBL	Verify
58	SEEKTIME		0	11	1		SEEKTIME	Verify
5D	CONFIG2		0	12	2		CONFIG2	
06	CONFIG	HDD configuration settings	1	1	2	As	CONFIG	Verify
07	SNTBL	HDD serial number (or P/N & S/N)	1	3	2			
08	BISPT	Burn-In test script	1	5	4	Dr	END	
09	BRSLT	Burn-In test results	1	10	1	Dr		
0A	CRITERIA	Burn-In test results	1	11	1		CRITERIA	Verify
0B	FINALTST	Final test	1	12	8			
0C	ARCOTBL	Channel table	1	30	8		CHN_TBL	Verify
0D	GEO_TBL	Table of geometric parameters	1	46	32			
0E	VLISTHDR	VLIST header	1	78	1	As	VLIST_H	Verify
0F	VLIST	Table of defective servo fields	1	79	16	Ad		
10	SLISTHDR	SLIST header	1	111	1	As	SLIST_H	Verify
11	SLIST	Table of sectors skipped by the translator	1	112	128	Ad		
12	TLIST	Table of excluded tracks.	1	368	4	Ad	TLIST	Verify
13	ALIST	Table of reassigned sectors	1	372	8	Ad	RLIST	Verify
15	SETMAX	Set max LBA	1	381	1		SETMAX	Verify
16	SECURITY	Module containing security parameters (passwords)	1	382	1	C	SECURITY	Verify
17	SRVTBL2	Servo Table backup	1	383	4		SV_TBL2	Verify
18	ARCOTBL2	Channel table backup	1	387	8		CHN_TB2	Verify

14	TMPRTR	Current HDD temperature	1	395	2		TMPRTURE	Verify
19	OVERLAY	Firmware overlays (Burn or Main)	1	401	396	Bs	OMLV0Y10	
56	P60CODE	Burn-In resource for model downsizing to P60	2	1	768	Dr		
29	DLIST	Defects list (Primary list)	3	1	650	Dd	DLIST	Verify
41	SPESB0		3	701	2		SPES	
42	SPESB1		3	703	2		SPES	
43	SPESB2		3	705	2		SPES	
44	SPESB3		3	707	2		SPES	
45	SPESB4		3	709	12		SPES	
1A	HDAF_RPT	Functionality test report	4	1	1			
1B	HD_DLIST	Functionality test DLIST	4	2	2			
1C	LATCHFRC	Latch force data	4	4	1		LATCH_FC	Verify
1D	RCOSCRPT	RCO test scripts	4	5	50			
1F	ERRTRK	Bit error rate	4	56	1		BER	Verify
20	ERRZN	Bit error rate 1	4	57	1		BER1	Verify
21	ERRDRV	Bit error rate 2	4	58	1		BER2	Verify
22	SRTDATA	Number of errors during Burn-In test	4	59	1		ER_CNT	Verify
23	SRTSRVO	Number of errors in the SA during Burn-In test	4	60	1		SV_ERCNT	Verify
24	SCN_GRAY	Scan gray data	4	61	1			
25	PARAM	Burn-In channel parameter monitor	4	62	10			
26	WKHEAD	Weak head data	4	72	10		WK_HEAD	Verify
27	TSTPI	Measurement data for TPI during Burn-In test	4	82	4		TPI_WRW	
28	MRTUNEMT	Settings of MR heads	4	86	5	As	MR_TUNE	Verify
1E	BTIME	Burn-In test time	4	91	2		BI_TIME	Verify
53	MRRTABLE		4	93	1		MRR_TBL	Verify
54	NPV_RSLT		4	94	30			Verify
59	HDAF_SPT		4	141	4			
5A	HDAFTIME		4	145	2			
5B	BTIME2		4	151	2			
2A	GEO_00		4	347	84		EG_O00	
2B	TST_ZH	Channels table for BPI test	4	431	64		NZDH0_	
2C	GEO_ZH	BPI test results	4	495	16			
47	CAPSEL		4	511	1		CAP_SEL	Verify
48	CURBPI		4	512	1		CUR_BPI	Verify
49	AZLCSM		4	513	1		AZL_CSM	Verify
4A	AZL_CSM0		4	514	1		AZL_CSM0	Verify
4B	AZL_CSM1		4	515	1		AZL_CSM1	Verify
4C	AZL_CSM2		4	516	1		AZL_CSM2	Verify
4D	AZL_CSM3		4	517	1		AZL_CSM3	Verify
4E	AZL_CSM4		4	518	1		AZL_CSM4	Verify
4F	AZL_CSM5		4	519	1		AZL_CSM5	Verify

50	AZL_CSM6		4	520	1		AZL_CSM6	Verify
2D	AZLBPI		4	521	1		AZL_BPI	Verify
2E	AZL_BPI0		4	522	1		AZL_BPI0	Verify
2F	AZL_BPI1		4	523	1		AZL_BPI1	Verify
30	AZL_BPI2		4	524	1		AZL_BPI2	Verify
31	AZL_BPI3		4	525	1		AZL_BPI3	Verify
32	AZL_BPI4		4	526	1		AZL_BPI4	Verify
33	AZL_BPI5		4	527	1		AZL_BPI5	Verify
34	AZL_BPI6		4	528	1		AZL_BPI6	Verify
35	SKTIME2		4	529	4			Verify
52	INSTABHD		4	533	4		INST	
55	TPICSC		4	537	4			
57	CAPSELDA		4	541	8		CUR_BPI	
36	RCO_LOG	RCO log	5	1	256		RCODATA	
37	SMART	S.M.A.R.T. module of the HDD	11	1	9		SMARTMEM	
38	SMRT_LOG	S.M.A.R.T. log	11	3	4			
39	SMRT_TST	S.M.A.R.T. write test	11	10	5			
3A	SMRT_HLG	Main S.M.A.R.T. log	11	15	512			
3B	BIAS_SHK	Bias shock data	11	527	370			
3D	ELOG	Error log of Burn-In test	12	1	768	Dr		
3C	HD_ERLOG	Error log of the functionality test	12	1	2			
46	BIMODAL		15	1	1		HC_NBTL	
3F	SV_TRACE	Servo trace	20	1	3		ST	
40	PES_LOG	Pes log	20	11	4		SPES	
51	SPSTW	Pes Burn-In log	20	301	1		SPSTW_DA	Verify
3E	IPC_DBG	IPC debug	20	302	1			
5C	PMP		20	304	1			

«Description» and «Cr.Lev» fields are left blank for some modules; their values will be added later, after necessary research.

7.4. Configuration modules

7.4.1. SET_MAX module

The module is used in classic HDD as well as F1_3D and F2_EG Trinity drives. It contains the information about max LBA settings. While uninitialized, the module is filled with zeroes.

7.4.2. SECURITY module

The module is used in classic HDD as well as F1_3D and F2_EG Trinity drives. It contains password information. While uninitialized, the module is filled with zeroes.

7.4.3. SNTBL module

The module contains drive serial number and P/N.

7.4.4. DCO module

The module is used in F1_3D and F2_EG drives. It contains the Device Configuration Overlay settings and is typically filled with zeroes.

7.4.5. PROFILE module

The module is used in all Trinity models except for F1_3D and F2_EG. It contains configuration data of all kinds: max LBA settings, passwords, sector parameters, cache settings, etc.

7.4.6. UNITABLE module

The module is present in the common modules table of V11P, VICTOR, PUMA, VICTORPLUS, VERNA, VERNALITE, and VANGO drive families; it contains HDD configuration data of all kinds and also the zone allocation table of user sectors, i.e. the sectors accessible for logical addressing. The table indicates the number of such sectors in each zone.

7.4.7. CONFIG module

The module is used in all classic drives starting with VANGOPLUS, and contains different configuration-related information. The module is used to store the zone allocation table of user sectors. Depending on the drive family, it may also contain the user password, master password, max LBA and other settings.

7.5. Defect list modules

7.5.1. SLIST and SLISTHDR modules

The SLIST module contains records of defective sectors and tracks, which will not be assigned logical addresses (LBA). All defects in SLIST are sorted in the order, which the translator uses to assign logical addresses to sectors. In some drives the module beginning may contain a record about the number of defects and a table similar to the one in the SLISTHDR module.

The SLISTHDR module (if it exists and is in use) contains information about the number of defects in the SLIST module, and a table of defects distribution among zones and heads.

Note: further references to the SLIST module will imply the SLIST and SLISTHDR modules together.

7.5.2. TLIST and TLISTHDR modules

The TLIST module contains information about the number of defective tracks as well as records of defective tracks arranged by the track numbers. In some drives the module beginning may contain a record about the number of defects and a table similar to the one in the TLISTHDR module.

The TLISTHDR module (if it exists and is in use) contains the table of track defects distribution among zones and heads.

Note: further references to the TLIST module will imply the TLIST and TLISTHDR modules together.

7.5.3. ALIST and ALISTHDR modules

The ALIST module contains the records of reassigned sectors and their number. In some drives the module beginning may contain a record about the number of defects and a table similar to the one in the ALISTHDR module.

The ALISTHDR module (if it exists and is in use) contains the table describing the beginning of reserved space for each zone.

Note: further references to the ALIST module will imply the ALIST and ALISTHDR modules together.

7.5.4. DLIST and DLISTHDR modules

The DLIST module contains information about the defective sectors revealed during factory testing (see section 9.11). Its header may contain the number of found defects and a table of their distribution across zones. Sometimes the header may exist as a separate DLISTHDR module.

Note: further references to the DLIST module will imply the DLIST and DLISTHDR modules together.

7.5.5. MLIST and MLISTHDR modules

The MLIST module and its MLISTHDR header module contain information about defective sectors in the service area. Samsung drives typically have no defects in the service area, so the modules are initially empty or contain just the header.

Note: further references to the MLIST module will imply the MLIST and MLISTHDR modules together.

7.5.6. VLIST и VLISTHDR modules

The VLIST module contains information about defective servo fields. Its header may contain the number of found defects and a table of their distribution across zones. Sometimes the header may exist as a separate VLISTHDR module.

Note: further references to the VLIST module will imply the VLIST and VLISTHDR modules together.

7.6. OVERLAY modules

7.6.1. OVERLAY module

The module is used in classic drives and contains firmware portion that is loaded to RAM during its initialization.

7.6.2. MOVLY001 module

The module is used in Trinity drives and contains the overlay portion of the Main Code.

7.6.3. MOVLY009 module

The module is used in Trinity drives and contains additional portion of the Main Code overlay. It is typically filled with zeroes.

7.6.4. BOVLY001 module

The module is used in Trinity drives and contains the overlay portion of the Burn Code. It is only used in the burn-in process and does not affect normal drive operation.

7.7. S.M.A.R.T. subsystem modules

7.7.1. TMPRTR module

The module contains the values collected over a certain time interval from the HDD temperature sensor.

7.7.2. SMART module

The module contains current values of S.M.A.R.T. attributes for the drive.

7.7.3. SMRT_LOG module

S.M.A.R.T. log

7.7.4. SMRT_TST module

The module contains the S.M.A.R.T. write test results.

7.7.5. SMRT_HLG module

Main S.M.A.R.T. log.

7.7.6. DRM module

The module contains the spindle motor operation logs: spin-up time, power-ons count, power-on hours count, etc.

7.7.7. ALIST и ALISTHDR modules

See details in *section 7.5.3*. The number of reassigned sectors from ALIST is reflected in the attribute 5, and the number of pending sectors appears in the attribute 197 of S.M.A.R.T. information.

7.8. Translator modules

SpinPoint series of Samsung drives use a dynamic translator, i.e. the translator is built each time after firmware start based on the modules containing defect lists. Please see below descriptions of the modules, which may pertain to the translator depending on the drive family.

7.8.1. SLIST and SLISTHDR modules

Section 7.5.1.

7.8.2. TLIST and TLISTHDR modules

Section 7.5.2.

7.8.3. ALIST and ALISTHDR modules

Section 0.

7.8.4. UNITABLE module

Section 0.

7.8.5. CONFIG module

Section 0.

7.8.6. CONFIG2 module

The module is used in VELOCE, PALO, POSEIDON, DELPHI, CAESAR, P80M, TRIDENT, T166(S), STORM2, STORM2_G, TRIDENT3, and PARAGON drives; it contains the zone allocation table for user sectors and the zone addressing table as well as the order of their addressing.

7.8.7. PARAM_DM module

The module exists in Trinity drives only. It describes the sequence of zones translation for different heads. Translation may start in the middle of the heads stack; there are also drives with approximately 20 mln. initial LBA located in 5 first zones for a single head.

7.8.8. GEOTBL module

The module contains geometry settings of the zone table. It describes the zone table of a drive, cylinder ranges of each zone, SPT, and other settings.

8. Diagnostics of malfunctions

Diagnostics of malfunctioning Samsung HDD involves visual inspection, analysis of messages output by a drive to terminal at power-on, and checks of service area modules. Before you connect a drive to the PC-3000 suite and power it on, please make sure there is no external damage of the HDA, burnt or swollen components on the PCB. To avoid accidental short circuit connection, probing the drive power lines is recommended before it is powered on.

If there is no external damage, connect the HDD to PC-3000 and switch on power supply to the HDD. Try to determine by the audible sounds whether the spindle motor spins up and the HDD unparks its heads. Check if the actuator produces knocking sounds hitting the limiting bar during the procedure. Drive start is considered normal when a device reaches the ready state after spinning up the spindle and returns correct HDD ID. In that case you can proceed to service area testing in the specialized utility *(see section 5.3.5.2)*, and then to data recovery using Data Extractor.

Let us examine a few errors that can occur during the drive start consequently making the user data inaccessible. Typical problems of Samsung drives:

- electronics board (PCB) malfunctions;
- firmware corruption in ROM;
- spindle motor malfunctions;
- malfunctions of the read/write heads or commutator;
- corruption of service modules;
- BAD sectors.

8.1. Diagnostics at power-up

Leaving a HDD powered on for extended time periods before the cause of its malfunction becomes clear is strongly discouraged.

Utility start and initialization take quite a while; therefore we shall examine the procedure for starting the specialized utility while the drive being tested is powered-off:

- Plug-in the interface cables and connect the drive to terminal *(see section 3)*.
- Confirm the prompt suggesting to start the utility *(Fig.8.1)*.
- Select the family corresponding to your drive, the utility should be set to Safe mode *(Fig. 8.2)*. For methods of drive family identification please see section 2
- Launch the utility.
- Wait until the initialization completes or click Cancel to interrupt it *(Fig. 8.3)*.
- In the utility window, go to the Terminal tab and switch drive power on *(Fig. 8.4)*.

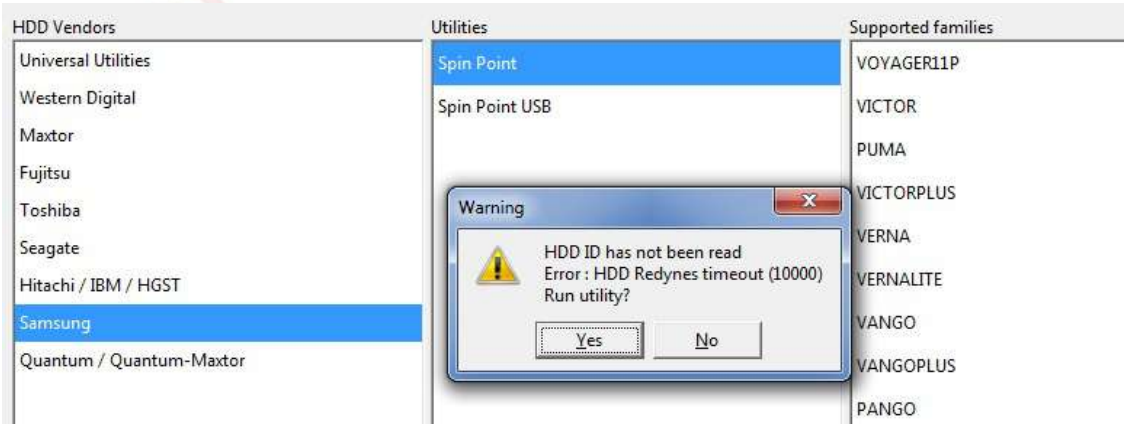
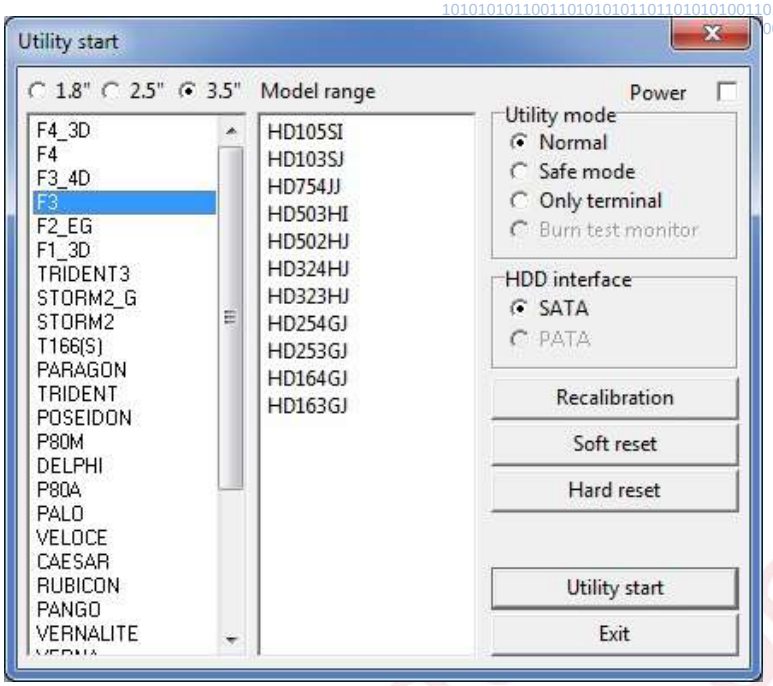


Fig.8.1.



Figc.8.2.

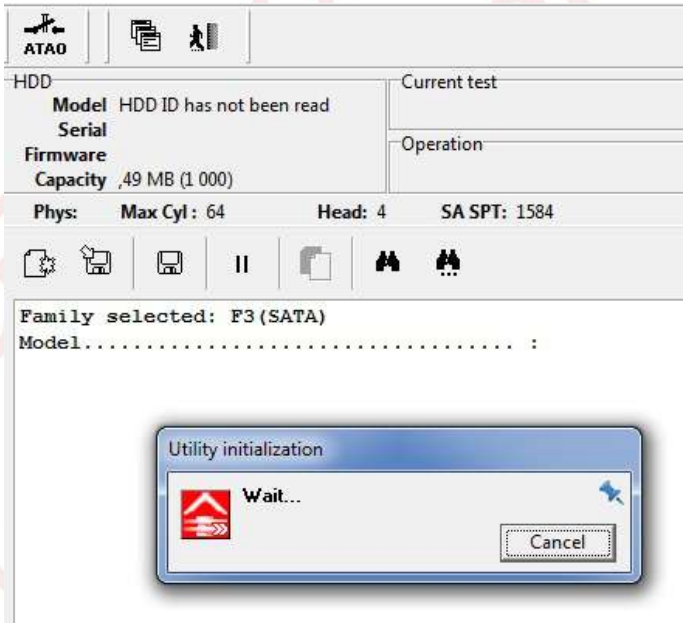


Fig.8.3.

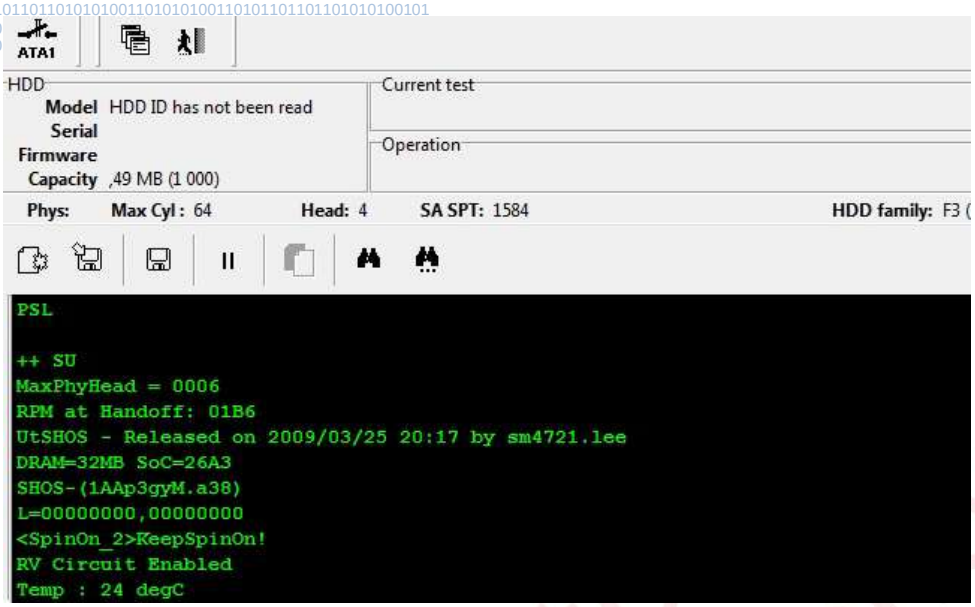


Fig.8.4.

The following situations are possible after the drive is powered:

1) ***The drive spins up the spindle, calibration sounds are audible, no terminal messages appear or the messages are unreadable.*** Typically the situation is caused by incorrect selection of the drive family or wrong COM port settings. In that case it is recommended to revise again the *chapters 2 and 3*. Situation 1 is less frequent in case of PCB malfunctions *(see 8.2)*.

2) ***The spindle motor does not spin up, no messages appear in terminal.*** The situation is caused by an electronics board malfunction *(see 8.2)*.

3) ***Firmware start log is output to the terminal when the drive is powered on.*** In that case you have to analyze the output terminal log. As a rule, specific messages containing a LED error code allow to identify the malfunction. Most frequent terminal messages are described in *sections 8.5 and 8.6*. The tables of terminal error codes can be found in *Appendices 2 and 3, section 11 and 12*.

8.2. Electronics board malfunctions

8.2.1. Oxidization of contact pads

The problem of oxidized contacts in the MHA connector may manifest itself in various ways; therefore, in case of suspected PCB problems be sure to examine and clean the contacts first of all. A common rubber piece can be used for cleaning.

8.2.2. Power circuit malfunction

Power circuits in Samsung drives include components intended for PCB protection against damage resulting from overvoltage. They may be found in both 5 V and 12 V supply lines. Their original marking is TRANSIL, Transient Voltage Suppressors.

If one of the protective components burns out but the remaining circuit remains undamaged, sometimes it should be enough to desolder the damaged component to restore drive operation. If its further use is planned, we recommend replacing the component with an operational one to improve fail-safety of the drive in question. PCB photographs can be found in the *Appendix 1, section 10*.

8.2.3. Failure of the microchip controlling the spindle motor

Fault of the chip controlling the spindle motor or its auxiliary circuitry is a frequent malfunction in Samsung drives. It manifests itself in the inability to spin up the spindle or instability of its rotational speed. The drive may output in terminal «LED 16» messages (classic drives), «LED 1703» and «SpinUp Error» (Trinity drives).

8.2.4. Failure of the ROM chip or corruption of its data

Failure of the ROM chip or complete/partial corruption of its data is a quite frequent occasion in drives using an external ROM chip. It manifests itself as absence of data output to terminal or any activity of the drive when it is powered on, firmware freeze during the first stage of its initialization and errors in its operation. Sometimes ROM damage in classic drives may trigger output of the «LED 13» code.

When data corruption in ROM chip is suspected, you have to desolder the chip and read it in a programmer device. Then you have to analyze the obtained ROM image, verify its checksum, compare it to an identical ROM image from a functional drive. Quite often the firmware remains intact in ROM but additional data stored in it suffers (for example, the FIPS module in 2.5" drives of the M7E and M8E families, see section 8.12), and restoring it makes the drive completely functional.

8.2.5. PCB diagnostics

To detect a PCB malfunction, you can use a compatible board (see *section 9.10* for details on selection of a compatible board). Install a compatible board on the patient drive, then power it on and analyze the terminal log during start. If the drive's behavior in terminal changes, it reaches the ready state or, more likely, terminal messages are related to errors while accessing the service area or mismatch of overlay and ROM versions, it means a PCB malfunction.

Please keep in mind that ROM firmware in Samsung drives may contain adaptive settings of the SA read/write heads as well as the heads map. During initialization a drive also reads and loads overlay modules from the service area, which may differ from the overlays of the donor drive. Therefore, the patient drive will most likely fail to reach readiness with a donor board. For exact and final diagnostics, you will have to solder the ROM chip from the patient drive to donor PCB (in case of drives using external ROM), or load to the donor board the ROM image from the patient drive via terminal or in Safe mode via ATA *(see 5.3.2.2)*. If the ROM image is corrupted or the patient board is lost, you can try to trick the patient drive into accepting the donor board as its own *(see section 9.8)*.

8.3. Spindle motor diagnostics

If a drive with a normal PCB does not spin up the spindle or makes several attempts to spin up and stops (cannot reach the sufficient number of revolutions), then the problem can be caused by broken winding or short-circuit in the motor. The drive in such cases may output to the terminal the «LED 16» code (classic drives) or «LED 1703» (Trinity drives).

To check motor winding, you need a multimeter. Remove the electronics board and check resistance of the common point with three winding points *(see Fig. 8.5.)*. It must be within the range from 1,5 Ohm to 3 Ohm (depending upon specific motor type). Check also the resistance between winding coils, it must be approximately twice higher. Precise resistance values can be identified using a normal HDD of the same family.

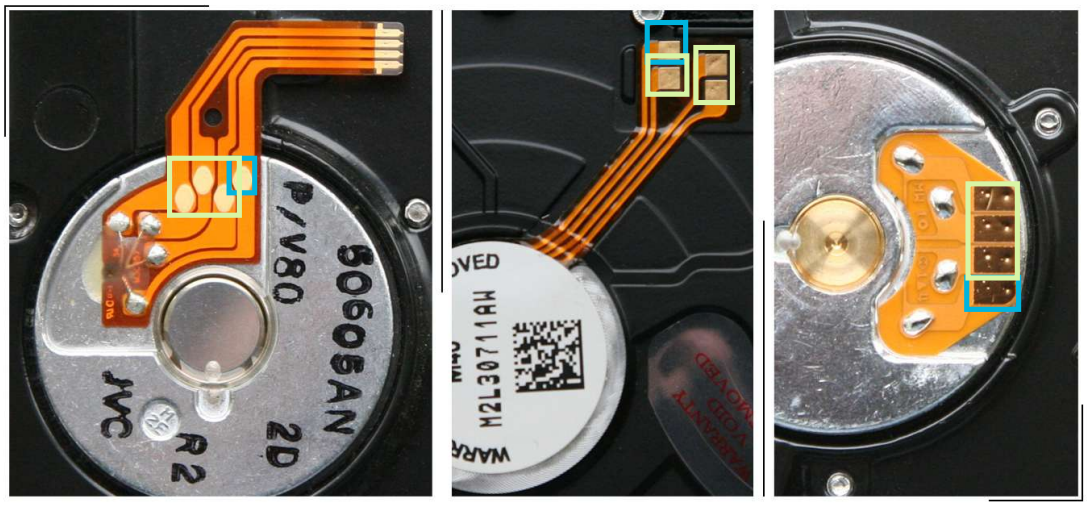


Fig.8.5.

If measurement of the winding resistance in the spindle motor reveals no deviations, then other probable causes preventing motor rotation while the PCB is normal include bearing seizure or stuck heads. The first case is more frequent with 3.5" HDD , the second — in 2.5" HDD. The HDA has to be opened for visual inspection of the positioning system: the heads must be in the parking zone (at the disks clamp), and the disks must rotate freely.

8.4. Analysis of terminal messages

8.4.1. Firmware operation modes

Terminal response – is the string returned by a drive in the terminal window when the Enter key is pressed. Terminal response can also be used to identify the current mode of drive firmware. The following operation modes of classic drives are distinguished:

- ***ENG> (Engine)*** – the standard firmware operation mode. It is the only mode in which a drive can accept commands via the ATA interface.
- ***DBG> (Debug)*** – debugging mode, which can be activated by pressing the Esc key in the terminal window or in emergency order when failures occur in the drive firmware operation. In that mode normal firmware execution is interrupted and the drive switches to waiting for the user commands. Operation via ATA is prohibited in this mode. To return to the ENG> mode, send the «GO» command.
- ***SRV> (Service)*** – debugging mode featuring the minimum set of terminal commands. ATA interface is not supported in this mode. To exit the mode, toggle the drive power supply off and on.
- ***BOOT>*** – in this mode control is passed over to a loader program that works with the main firmware image. The mode has no specific command sets. To exit the mode, toggle the drive power supply off and on.

Firmware of Trinity drives can function in the following modes:

- ***ENG> (Engine)*** – the standard firmware operation mode. It is the only mode in which a drive can accept commands via the ATA interface.
- ***eng>*** – in practical terms the mode is identical to ENG>, lower case letters indicate the set Busy flag in the status register.
- ***DBG> (Debug)*** – debugging mode, which can be activated by pressing the Esc key in the terminal window or in emergency order when failures occur in the drive firmware operation. In that mode normal firmware execution is interrupted and the drive switches to waiting for the user commands. Operation via ATA is prohibited in this mode. To return to the ENG> mode, send the «GO» command.
- ***dbg>*** – in practical terms the mode is identical to DBG>, lower case letters indicate that the Busy flag was set in the ATA status register before switching into this mode.
- ***BOOT>*** – in this mode control is passed over to a loader program that works with the main firmware image. The mode has no specific command sets. To exit the mode, toggle the drive power supply off and on.

8.4.2. Firmware start log

Firmware start log consists of the messages output to the terminal when the drive is powered on. Each output message means a certain operation that firmware performs during initialization. Let us examine a sample start log of a F1_3D drive

```
++ SU                                          // spindle spin-up
MaxPhyHead = 0006                              // detection of the maximum number of heads
RPM at Handoff: 01B4                           // polling of the spindle rotation speed
UtSHOS - Released on 2009/03/25 20:17 by sm4721.lee  // output of firmware-related information
DRAM=32MB SoC=26A3                             // detection of the RAM chip parameters
SHOS-(1AAp3gyM.a38)                            // output of firmware version
L=00000000,00000000
<SpinOn_2>KeepSpinOn!
```

```
RV Circuit Enabled
Temp : 25 degC                                  // thermal sensor readout
SpinOk                                          // necessary rotational speed is achieved
SK C:112362 H:0                                 // test positioning
ServoTable Loaded                               // test positioning
FdtTable Loaded                                 // FdtTable is loaded
Hd:   0 Zn:   0 Avg.:-    185
Hd:   0 Zn:   1 Avg.:      63
PASS
| 21 | SET_MAX  | 3 | 0 |  142 | B98B |        // module reading errors of system heads
| 21 | SET_MAX  | 3 | 1 |  142 | B98B |        // B98B code means mismatch of headers
| 21 | SET_MAX  | 3 | 2 |  142 | B98B |        // n this case modules are not initialized
| 22 | SECURITY | 3 | 0 |  143 | B98B |
| 22 | SECURITY | 3 | 1 |  143 | B98B |
| 22 | SECURITY | 3 | 2 |  143 | B98B |
| 159 | DCO      | 34 | 0 |    0 | B98B |
| 159 | DCO      | 34 | 1 |    0 | B98B |
| 159 | DCO      | 34 | 2 |    0 | B98B |
RecordValid : 00078021                          // successful check of the defect lists structure
No DRM
1.5G Lp00,PwrOnDn
ENG>                                            // standard operation mode is activated
```

Successful switching to ENG> mode indicates that drive firmware has initialized properly and encountered no serious problems. Further we shall examine the firmware start logs and messages typical of specific failures.

8.5. Error messages typical for both HDD architectures

8.5.1. No messages in terminal

Absence of messages in terminal may be caused by the following reasons:

- damaged electronic board;
- malfunctioning or erased ROM chip;
- incorrectly selected drive family or COM port settings.

Make sure that you have selected correctly the drive family *(see section 2)*, COM port settings *(see section 3)* and test the PCB *(see section 8.2)*.

8.5.2. Cyclic errors«1st Gray Err», «1st Sk Err», «1st Vel Err», «No Gray»

These messages may be caused by one of the following reasons:

- one or several malfunctioning heads;
- malfunctioning commutator;
- malfunctioning electronic board.

E.g.:

SpnOk
DAC:+00020
H: +00000
UF: 1. 1st Gray err
H: +00001
SK C: 0000C6E3
ENG>SRV> AP_FSAM
C: 0000006C H: +00000
DAC:+00094
SR : +00000
UF: 1. 1st Gray err
H: +00001
SK C: 0000C66B
AP_FSAM
C: 0000006C H: +00000
DAC:+00094
SR : +00001
UF: 1. 1st Gray err
H: +00001
UF: 3. 1st Sk err
H: +00000
UF: 1. 1st Gray err
H: +00001
SK C: 0000C605
AP_FSAM
C: 0000006C H: +00000
DAC:+00094
SR : +00002
H: +00000
UF: 1. 1st Gray err
H: +00001
UF: 3. 1st Sk err
H: +00000
UF: 1. 1st Gray err
H: +00001
UF: 2. 1st Vel err
…

8.5.3. «Break at 0xYYYYYYYY» 4.18.5 message or spontaneous switch to the DBG> mode during firmware initialization

The message **«Break at 0xYYYYYYYY»**, where stands for the YYYYYYYY breakpoint address appears in case of manual or emergency interruption while executing the drive firmware. In case of emergency interruption a drive switches to the DBG> (or SRV>) mode. A drive may switch to the test mode for one of the following reasons:

- corrupted service area modules;
- mismatch of the overlay and ROM versions;
- corrupted ROM data.

First of all, it is recommended to try obtaining access to the service area using the HT code *(see section 8.10.3);* then, if the attempt fails, use the hot swap procedure *(see section 8.10.4).*

E.g. (T166S):

```
SPW 1.5G LinkOk!5V: 04790
SpnOk
spd: 0000 0000 0000
H: +00000
ADC: 0001
DAC: 9A90
SK C: 0001A41D
ENG>SRV>
SvoTbl Loaded
CL 0000 CM 0035 SL 006F SM FFAD
BD
FdtTbl Loaded

*** Break at 0x000C [from Trap]
000C: FFFF
DBG>DBG>
```

8.5.4. Sudden interruption of the initialization log, firmware freeze

A drive may freeze when its firmware fails to handle an encountered error correctly. Freezing may be accompanied with absence of response to Enter keypresses, spontaneous switching to the DBG> mode or response only after manual switching to the DBG> mode. Firmware failures may be caused by the following reasons:

- corruption of the service area modules;
- mismatch of the overlay and ROM versions;
- corrupted ROM data;
- one or several malfunctioning heads.

First of all, it is recommended to try obtaining access to the service area using the HT code *(see section 8.10.3);* and if the attempt fails, to use the hot swap procedure *(see section 8.10.4).*

E.g.: (T166S):

```
SPW 1.5G LinkOk!5V: 04928
SpnOk
spd: 0000 0000 0000
H: +00000
ADC: 0005
DAC: A292
SK C: 0001AFF2
ENG>SRV>
SvoTbl Loaded
CL 0038 CM 000D SL 013F SM 0198
BD

FdtTbl Loaded
```

8.6. Error messages typical of classic drives

8.6.1. Cyclic «LED 13» message

The message may appear for one of the following reasons:

- all heads are disabled in the drive ROM;
- corrupted ROM data or malfunctioning chip;
- ROM chip does not support the given commutator type;
- malfunctioning commutator.

Typically, these messages indicate a commutator malfunction. To avoid problems related to damaged PCB, you are advised to check the HDD operation with a known good donor board first.

E.g. (T166S):

```
SPW 0000 NoLk
ADC: 0000
SpnOk
spd: 0000 0000 0000
H: +00000
ADC: FFFF
DAC: 6B84
UF 3 1stGrayErr
H: +00001
UF 3 1stGrayErr
H: +00002
UF 3 1stGrayErr
H: +00003
UF 3 1stGrayErr
H: +00004
UF 3 1stGrayErr
H: +00005
WriteSctLog -- buffer not valid
LED 13 0000
LED 13 0000
…
```

8.6.2. Cyclic «LED 16» message

The message may appear for one of the following reasons:

- malfunction of the electronic board (in particular, the spindle motor control chip);
- stuck heads;
- oxidization of the contacts between the controller board and the spindle motor contacts;
- short-circuit fault in the motor coils;
- spindle motor seizure.

E.g. (MANGO):

```
1.5G Limited SPW No Link
IS=+00004
…
IS=+00004
S E:0001
Unload 0000
Sb
LED 16
LED 16
…
```

8.6.3. Cyclic «LED 5B» message («LED B5»)

The message may appear for one of the following reasons:

- corrupted service area modules;
- mismatch of the overlay and ROM versions.

As a rule, in case of this error a drive may reach the ready state if you send to it a **soft reset** command via ATA. If sending a soft reset does not remedy the situation, you have to use the hot swap procedure *(see section 8.10.4)* or obtain access to the service area using the HT code *(see section 8.10.3).*

E.g. (MT1):

```
SPW 1.5G Link Ok!
IS=+00000
SO
H: +00000
Ld
SK C: 0000AF49
ENG>SRV>
SvoTbl Loaded
BD
Sb
LED 5B
LED 5B
…
```

8.6.4. «WriteSctLog -- buffer not valid» message

The message may appear for one of the following reasons:

- corrupted service area modules;
- mismatch of the overlay and ROM versions.
- As a rule, in case of this error a drive may reach the ready state if you send to it a **soft reset** command via ATA. If sending a soft reset does not remedy the situation, you have to use the hot swap procedure *(see section 8.10.4)* or obtain access to the service area using the HT code *(see section 8.10.3).*

E.g.:

```
SPW 1.5G LinkOk!SpnOk
spd:  0000 0000 0000
ADC: FFFD
DAC: 7B89
H: +00000
SK C: 00010154
ENG>SRV>
   SvoTbl Loaded
   BD

   FdtTbl Loaded
Sb
WriteSctLog -- buffer not valid
```

8.6.5. Cyclic «-Tout-Tout-Tout-» message

The message accompanied with the knocking sounds of the actuator hitting the limiting stop, may appear for one of the following reasons:

- one or several malfunctioning heads;
- malfunctioning commutator;
- malfunctioning electronic board;
- corrupted service area modules.

If this message appears, it is recommended to install a known good PCB onto the drive. If the commutator is malfunctioning, the drive start log will not change.

E.g.:

```
SPW 1.5G LinkOk! ADC: 0003
SpnOk
spd:  0000 0000 0000
 H: +00000
 ADC: 0003
 DAC: 7887
Unlatch Tk: 00016BB3

Unlatch Done
ENG>SRV>
  SvoTbl Loaded
  BD
-Tout-Tout-Tout-Tout-Tout-Tout-Tout-Tout-Tout-Tout-Tout-Tout-Tout-Tout-Tout-Tout-Tout
-Tout-Tout-Tout-Tout
```

8.7. Error message typical of Trinity drives

8.7.1. «DEBUG HALT @MDL_RSRC_BufferAlloc()» message

The message may appear for one of the following reasons:

- corrupted service area modules;
- mismatch of the overlay and ROM versions.

To address the problem, use one of the methods available for restoring access to the service area *(see section 8.10).*

E.g. (F3):

```
:*PA VID=0000 PN=0004 Rev=0001- 785x Found
*PA VID=0000 PN=0004 Rev=0001- 785x Found
ChipRev = 63B0
U
S_0
RV En Sensor Circuit
En Shock Sensor Circuit
SO_1
SpinStartUp: mcSpinRPM = 0
RPM at Handoff: 613
Temp : 26 degC
SpinOk
mS1 00000003
SK C:140817 H:0
Loaded FIT ( 0: 0: 1)
CalibTable Loaded. Rev:0x14
Selective MARC NX Loaded
ResoTable Loaded. Rev:0x01
Ovly loaded to 0x0001CD00
Ovly loaded to 0x1005B800
FdtTable Loaded. Rev:0x02
| 19 | RLIST | 2 | 0 | 256 | 1140 |
Reading Serial Num Pass
Up MC
TgtCyl: 2032
Hd: 0 Zn: 0 Avg.:- 241
TgtCyl: 264349
Hd: 0 Zn: 1 Avg.: 100

SVCAL(0080,0000)-->PASS
```

```
| 147 | IN_SITU | 20 | 0 | 836 | 1140 |
>>InsituStart: t=1367, c=26
| 147 | IN_SITU | 20 | 0 | 836 | 1140 |
| 249 | NINSITUL | 45 | 0 | 2 | 1140 |
GeoId = 49, Idx=49
fodstep: 00000064 dgain: 00000041
GeoId = 49, Idx=49
fodstep: 0000006B dgain: 0000004B
GeoId = 49, Idx=49
fodstep: 0000006E dgain: 0000004D
GeoId = 49, Idx=49
fodstep: 00000058 dgain: 00000071
GeoId = 49, Idx=49
fodstep: 0000005A dgain: 0000007D
GeoId = 49, Idx=49
fodstep: 0000005B dgain: 0000007A
rb(e1140 20 0 836 13)
rb(e1140 20 0 836 13)
rb(e1140 20 0 836 13)
rb(e1140 45 0 2 126)
rb(e1140 45 0 2 126)
rb(e1140 45 0 2 126)
>>Flag=0000028B BadHd=0000 dFod=001F 0020 (t=2607 c=26)
[DEBUG HALT @MDL_RSRC_BufferAlloc():10034A2D L0 1005BDB3]
…
[DEBUG HALT @MDL_RSRC_BufferAlloc():10034A2D L0 0000EC17]
Cur_SP=04005D20
FIQ_SP=04005D20
IRQ_SP=04005D20
SVC_SP=04005D20

*** HALT ***
```

8.7.2. Cyclic«LED 1102» message

The message may appear for one of the following reasons:

- failure of the ROM chip or corruption of its data;
- malfunctioning electronic board;
- drive firmware does not support the given commutator type;
- malfunctioning commutator.

Typically, the message indicates a commutator malfunction. To avoid problems related to damaged PCB, you are advised to check the HDD operation with a known good donor board first.

E.g.: (F1_3D):

```
tPSL++ SU
MaxPhyHead = 0006
RPM at Handoff: 01F7
UtSHOS - Released on 2008/03/12 21:21 by jonathan.park
DRAM=32MB SoC=26A3
SHOS-(1AA10b2M.a38)
L=00000000,00000000
<SpinOn_2>KeepSpinOn!
RV Circuit Enabled
Temp : -16 degC
SpinOk
mServoStatus1 00000003
Unlatch Accel TO
```

Vel Parking!
PK_3 C: 0 H:0
Unlatch Accel TO
Vel Parking!
PK_3 C: 0 H:1
Unlatch Accel TO
Vel Parking!
PK_3 C: 0 H:2
Unlatch Accel TO
Vel Parking!
PK_3 C: 0 H:3
Unlatch Accel TO
Vel Parking!
PK_3 C: 0 H:4
Unlatch Accel TO
Vel Parking!
PK_3 C: 0 H:5
Unlatch Accel TO
Vel Parking!
PK_3 C: 0 H:0
Unlatch Accel TO
Vel Parking!
PK_3 C: 0 H:1
Unlatch Fail
Vol Parking!
PK_4 C: 0 H:1
LED 1102
…

8.7.3. «SpinUp Fail» and cyclic «LED 1703» messages

These messages may appear for one of the following reasons:

- malfunction of the electronic board (in particular, the spindle motor control chip);
- stuck heads;
- oxidization of the contacts between the controller board and the spindle motor contacts;
- short-circuit fault in the motor coils;
- spindle motor seizure.

E.g. (F1_3D):

++ SU
MaxPhyHead = 0006
MaxPhyHead = 0006
MaxPhyHead = 0006
MaxPhyHead = 0006
FUtSHOS - Released on 2008/08/12 17:08 by kw208.oh
DRAM=32MB SoC=26A3
SHOS-(1AA13g8M.a38)
L=00000000,00000000
<SpinOn_2>KeepSpinOn!
RV Circuit Enabled
Temp : 25 degC
Vel Parking!
Vol Parking!
Vol Parking!
Vol Parking!
Spin ISR Off at accel1

<SpinAccel
++ SU
MaxPhyHead = 0006
1 RPM = 79
MaxPhyHead = 0006
MaxPhyHead = 0006
MaxPhyHead = 0006
<SpinOnRetry> mCOMSENSRty = 4, mAccelRty = 0, mSpinO
++ SU
MaxPhyHead = 0006
Dac = 102
MaxPhyHead = 0006
MaxPhyHead = 0006
MaxPhyHead = 0006
<SpinOn_4>Report Spin Error!
SpinUp Fail
Vol Parking!
LED 1703
LED 1703
…

8.7.4. Cyclic «LED 1A04» («LED 1Axx») message

The message appears when one or several modules in the service area are corrupted. To make the drive enter the ready state via ATA, you have to use the «Unlocking at «LED 1Axx» error» command *(see section 6.6)*. Further checks should be performed using the SA structure test *(see section 5.3.5.2)*.

E.g. (F3):

**PA VID=0000 PN=0004 Rev=0001- 785x Found*
**PA VID=0000 PN=0004 Rev=0001- 785x Found*
ChipRev = 63B0
U
S_0
RV En Sensor Circuit
En Shock Sensor Circuit
SO_1
SpinStartUp: mcSpinRPM = 0
RPM at Handoff: 605
Temp : 25 degC
SpinOk
mS1 00000003
SK C:121495 H:0
POK
POK
Boot Sector Error! Take a default.
Loaded FIT (0: 0: 1)
CalibTable Loaded. Rev:0x14
Selective MARC NX Loaded
ResoTable Loaded. Rev:0x01
Ovly loaded to 0x0001CD00
Ovly loaded to 0x1005B800
FdtTable Loaded. Rev:0x02
| 19 | RLIST | 2 | 0 | 256 | 1140 |
Reading Serial Num Pass
Up MC
TgtCyl: 2032
Hd: 0 Zn: 0 Avg.:- 257
TgtCyl: 264349
Hd: 0 Zn: 1 Avg.: 86

```
SVCAL(0080,0000)-->PASS
>>InsituStart: t=779, c=26
GeoId = 49, Idx=49
fodstep: 00000067 dgain: 0000004D
GeoId = 49, Idx=49
fodstep: 0000006C dgain: 00000058
GeoId = 49, Idx=49
fodstep: 00000071 dgain: 0000005E
>>Flag=0000028B BadHd=0000 dFod=000D (t=807 c=26)
RecordValid Fail : 0007643D 0007E41D
VOP!
PK_4 C:238004 H:0
VOP!
PK_4 C:238004 H:0
LED 1A04
LED 1A04
…
```

8.8. Malfunctions of the read/write heads

Malfunctions of drive heads or commutator are often accompanied with knocking sounds inside the HDA and specific messages in terminal *(see sections 8.5.2, 8.6.1, and 8.7.2)*. If the reading component of a head or its corresponding channel of the preamplifier fails, the stream of servo data gets interrupted when this head is selected, then the stabilizing and positioning system can no longer hold the head over the track, the entire magnetic heads stack shifts towards the limiting stop and hits against it. It bounces, moves again and hits the stop again. The process can take quite a while.

If head knocking appears during diagnostics, the drive should be powered off immediately because the heads and surfaces get damaged at every hit.

Malfunctions of the magnetic heads stack in Samsung drives can be subdivided into the following types:

- commutator malfunction;
- zero head malfunction[1];
- malfunctions of the non-zero heads;
- logical heads shift.

In cases of commutator malfunction the terminal exhibits continuous attempts to access the heads one by one accompanied with knocking sounds. In such situations access to the service area and data can be restored after MHA replacement only.

E.g.:

```
SpnOk
DAC:-00033
H:  +00000              // current head is set to 0
UF: 1. 1st Gray err     // error accessing the surface
H:  +00001              // current head is set to1
UF: 1. 1st Gray err     // error accessing the surface
H:  +00000
UF: 1. 1st Gray err
H:  +00001
UF: 1. 1st Gray err
...
ENG>SRV>
```

[1] – Zero head is always a system head. In classic HDD it is the only system head, in Trinity HDD first 3 heads are the system ones, but the zero heads is always accessed first.

When a malfunction of the zero head occurs in classic HDD or Trinity drives with a shift of logical heads (see further), its signs are identical to the commutator malfunction. Therefore, when a commutator or zero head malfunction is suspected, it is recommended to try obtaining access to the service area using one of the methods described in *section 8.10.*

Malfunctions of non-zero heads or the zero head in Trinity drives have typically less severe consequences provided there is no shift of logical heads. A drive may reach readiness with slight knocking or output the «LED 5B» error code (in case of logical heads shift in classic drives), or its firmware may freeze during initialization *(see section 8.5.4).* In such situations it is recommended to recover first the data from functional heads using Data Extractor, then replace the magnetic heads stack, if necessary.

Logical heads shift is a situation occurring with some firmware versions. Essentially it means that during initialization firmware performs additional testing of the heads included in the bit map. If the firmware finds a head included in the bit map faulty, it excludes such head from the map. Thus, a shift of logical heads occurs. As a result the drive uses with physical heads above the malfunctioning one wrong adaptive settings becoming unable to receive data from these heads even if they are functional. A shift may cause a drive to change its model to a smaller one and decrease the number of heads in the HDD ID *(see section 8.11).* To retrieve data from the heads above the malfunctioning one, you have to use the hot swap procedure *(see section 9.7).* In Trinity drives you may use editing of the heads map in RAM as a counterpart of the hot swap method *(see section 8.8.1).*

8.8.1. Using the RAM head map editing feature

The «RAM head map editing» feature *(see section 5.3.3.1)* is available for Trinity drives. You can use it for diagnostics or access to the service and user data areas if drive heads are malfunctioning. The method is based on «tricking» the drive initialization procedure by substituting a functional head instead of the malfunctioning one. Of course, the method only works with drives equipped with two or more heads.

- Switch off power supply of the drive and start the Samsung utility *(see section 8.1).*
- Select the «RAM head map editing» command *(Fig. 8.6).*

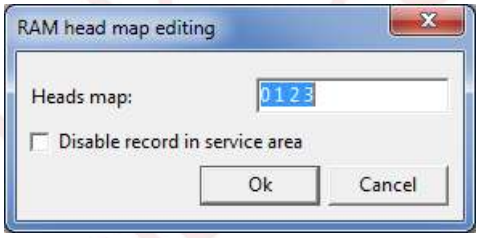


Fig.8.6.

- The exact physical head preventing the drive from starting is unknown in advance, so try replacing all heads with the zero one *(Fig. 8.7).*

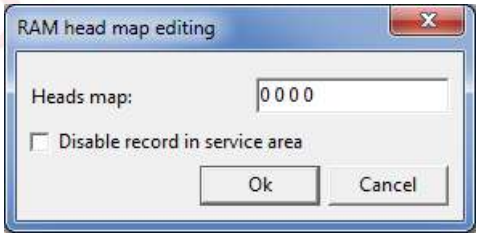


Fig.8.7.

- After you click the confirmation button the utility will display a dialog with an offer to read the ROM image from the drive or load it from a file *(Fig. 8.8).* For convenience, it is recommended to read ROM from the drive beforehand. Then the utility will automatically power on the drive and try to perform initialization. If the drive enters the ready state and returns its HDD ID, the head is functional. Otherwise, take a note marking it as malfunctioning.

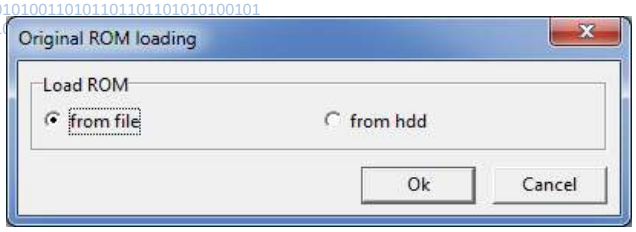


Fig.8.8.

- Repeat the procedure for the system heads 1 and 2 (if any).
- As soon as you find out, which system heads are malfunctioning, you can correct the heads map as necessary. For example, if the zero head is malfunctioning, you can start the drive with the map shown in the *Fig. 8.9.*

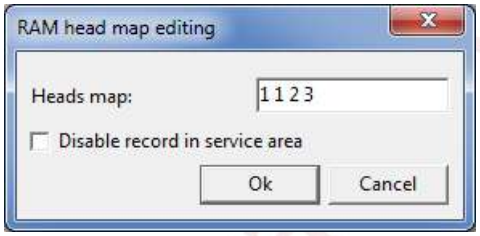


Fig.8.9.

- Start the utility in Normal mode and check the remaining non-system heads (if any) using the heads test *(see section 5.3.5.1)*. Correct the heads map in RAM, if necessary. Perform data recovery in Data Extractor based on the heads map excluding the substituted ones. If necessary, replace the MHA and read the remaining data from previously malfunctioning heads.

8.9. Corruption of the service area modules

Drive behavior during start may differ depending upon specific damaged modules. As a rule, corrupted modules in classic HDD cause the «LED 5B» («LED B5») code output to terminal *(see section 8.6.3)*. In such cases it is sufficient to send a **soft reset** signal to make the drive reach readiness. Trinity drives output a different error code – «LED 1A04» *(see section 8.7.4)*. A drive may output messages about module reading errors together with the error code *(Fig. 8.10)*. To make a drive enter the ready state in such cases, you have to send to the terminal the «LE» command or use the «Unlocking at «LED 1Axx» error» command *(see section 6.6)*. Less often the firmware may just freeze or switch to the debug mode *(see sections 8.5.3 and 8.5.4)*. In these cases you have to use one of the methods available for restoring access to the service area *(see section 8.10)*.

```
*PA VID=0007 PN=0000 Rev=0004
*PA VID=0007 PN=0000 Rev=0 04
nChipRev = 5340U
S_0Shock Sensor Circuit Enabled
SO_1
Init RPM=0
IS=6
CLA #36/61
Handoff RPM=624
SPOK
mS1 00000003
яA1O=7 A1G=460
O=510 S=3
SK C:  4614 H:0
Loaded FIT ( 0: 0: 1)              // FIT table is loaded (cylinder 0, head 0, sector 1)
ServoTable Loaded. Rev: 0x17       // SRVTBL module is loaded
Reso Table Loaded, Rev:0x00000001  // RESO_TBL module is loaded
```

RROTable Loaded *// RRO_TBL module is loaded*

| 13 | GEO_TBL | 0 | 0 | 115 | 1140 | *// error loading the GEO_TBL module (cylinder 0, head 0, sector 115), error code 1140 (UNC)*

| 13 | GEO_TBL | 0 | 1 | 115 | 1140 |
| 13 | GEO_TBL |31 | 0 | 115 | 1140 |
| 13 | GEO_TBL |31 | 1 | 115 | 1140 |

| 115 | MOVLY001 | 1 | 0 | 10 | 1140 | *// error loading module MOVLY001 (cylinder 1, head 0, sector10) , error code1140 (UNC)*

| 115 | MOVLY001 | 1 | 1 | 10 | 1140 |
Overlay file read bad

Fig.8.10. Corruption of GEO_TBL and OVERLAY modules in Trinity drives.

To check the modules, use the SA structure test *(see section 5.3.5.2).*

Please keep in mind that most service area modules in Samsung drives have no checksum; therefore integrity is identified by successful module reading and match of its header to the standard one. The importance of header mismatch at that is determined by the module importance. The following types of module corruption may be distinguished:

- corrupting record;
- complete module erasure or corruption of its header;
- partial erasure of the module body.

A power failure or HDD firmware failure may cause the settings of the write heads to change while recording a module so that the drive will be unable to read the data during the next start, and a so-called «soft bad» appears in the module location. Generally such problems are typical of modules, which are frequently overwritten, such as S.M.A.R.T. modules and ALIST or its header.

Complete module erasure or corruption of its header occurs when a failure in firmware operation causes corruption of the buffer content to be written or an arbitrary data block gets accidentally recorded to the service area. S.M.A.R.T. modules, translator, defect lists are the objects that typically suffer from these situations.

Partial erasure of module body is caused by the same reason as complete erasure. However, unlike two previous corruption types, it cannot be revealed by a check of the service data structure and therefore represents the most complicated case for diagnostics. To identify this problem, you need to know the module structure. Objects that suffer from such corruption include translator modules in classic drives (zone translation table in the CONFIG module). You can reveal corruption of the translator and defect list modules indirectly by using the tests «Table of zone translation» and «Defect list report». In the first case you have to pay attention to the structure of the translation table *(Fig. 8.11).*

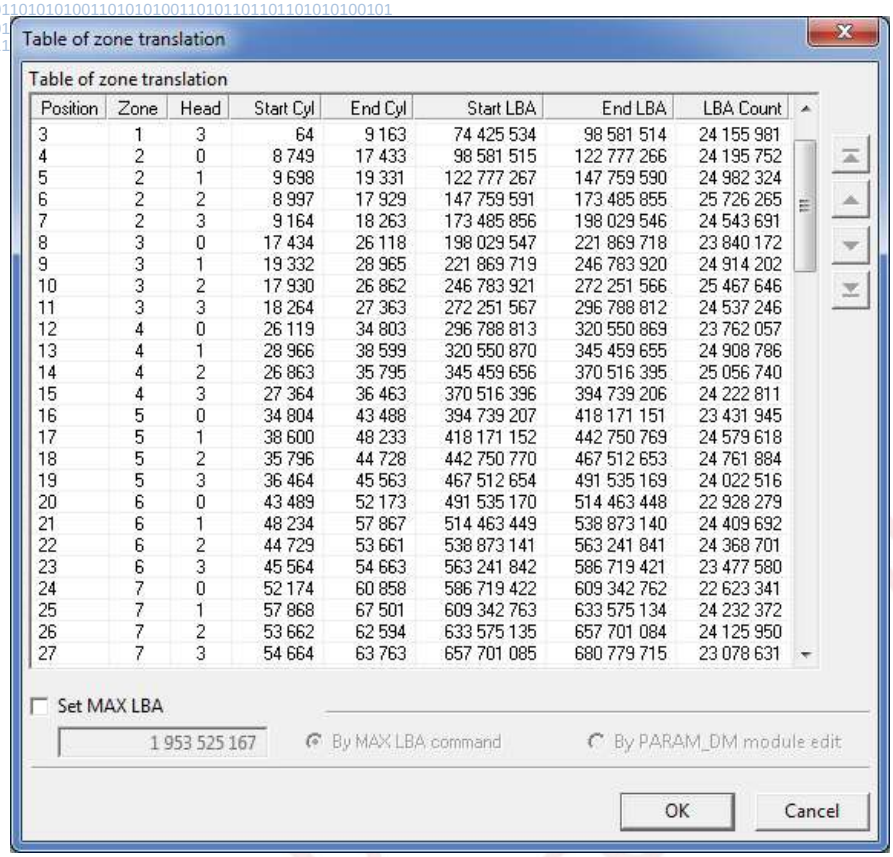


Fig.8.11.

Heads and zones should interchange. There cannot be two different records containing the same head and zone. A few zones following in succession may share the same head, but within reasonable bounds (not the entire side). Each zone must contain several million LBA, which should follow successively from the first record to the last. In the second case you have to note the results of automatic list checks output to the report log. Corruption is indicated by records of non-existent heads and mismatching number of records in the actual table and its header.

The restoration methods for some modules are described *in Chapter 9.* Running the burn-in test is also a way to restore the drive in case of its repair *(see section 9.11).*

8.10. Gaining access to the service area: methods

HDD firmware may freeze during initialization or the ATA interface may be blocked in cases when firmware modules or data in ROM are corrupted, or the read/write heads are damaged. Let us examine the methods that can be used to make the HDD reach readiness and obtain access to the service area.

8.10.1. Achieving readiness in terminal during the first stage of firmware initialization

If drive firmware freezes or the drive after a certain initialization stage keeps outputting to the terminal messages that block access or cause errors in data transfer via terminal, you can try to make the drive reach readiness in terminal by following the procedure below.

- Turn off drive's power.
- In the Samsung utility, go to the Terminal tab.
- Press and hold down the Esc key.
- Power up the drive. The drive will return a few strings to the terminal and switch to the DBG> mode *(Fig. 8.12.).*
- Once the «DBG>» line appears, you can release the Esc key.
- If «DBG>» has not appeared, if the drive froze or started knocking, repeat the procedure again.

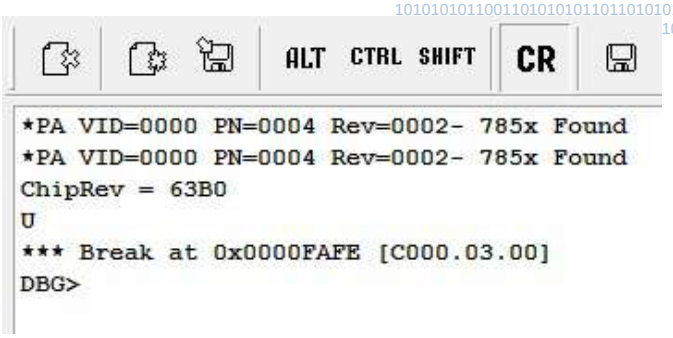


Fig.8.12.

Attention! During this initialization stage you can only work with the PCB: read/write ROM, and also load burn resources containing no overlays *(see section 9.11.1)*.

8.10.2. Safe mode

Safe mode – is a mode of drive operation via ATA without its initialization with the data from the service area.

Attention! Safe mode is only supported in classic drives; it can be used as an alternative to access through the terminal. In this mode you can record the ROM and Burn resources containing no overlays. Terminal is blocked in safe mode.

To start a Samsung 3.5" in that mode, you have to set three jumpers: Master(MS), Slave(SL), Cable select(CS), *Fig. 8.13.*

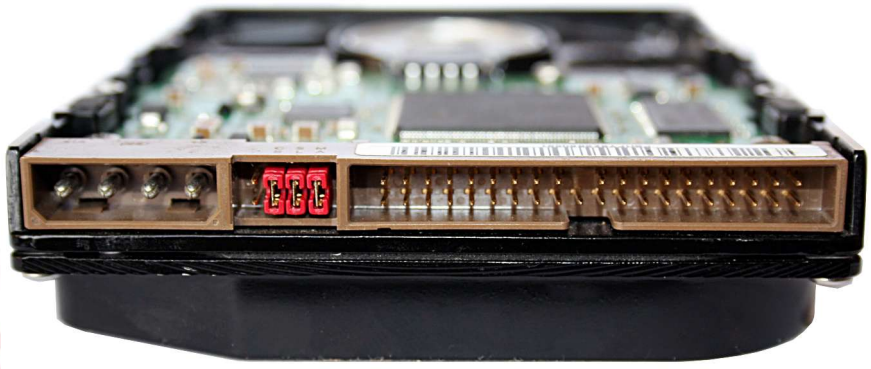


Fig. 8.13. Jumper settings on the drive.

STORM2, STORM2_G, T166, TRIDENT3, and PARAGON drives use a different configuration of the jumpers. To start these drives in Safe mode, the jumpers have to be set as shown in *Fig. 8.14.* In some cases it is sufficient to set a jumper over the leftmost pair of pins (terminal contacts) to start a drive in Safe mode.

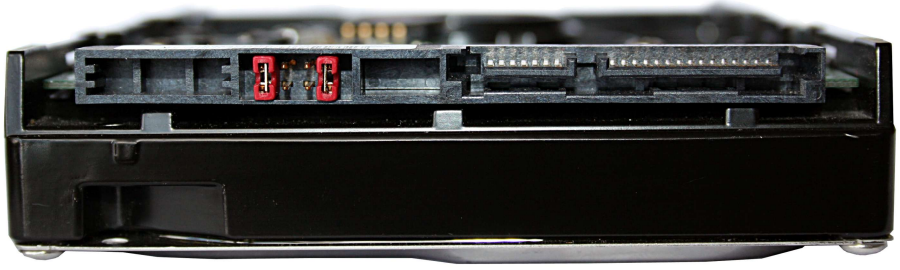


Fig.8.14. Jumper settings on the drive.

To start 2.5” PATA drives in Safe mode, you have to use the PC-2” adapter. Adapter jumpers should be configured as shown in *Fig. 8.15.*

2.5” SATA drives can be started in Safe mode by setting two jumpers over the COM port of the drive *(Fig. 8.16).*

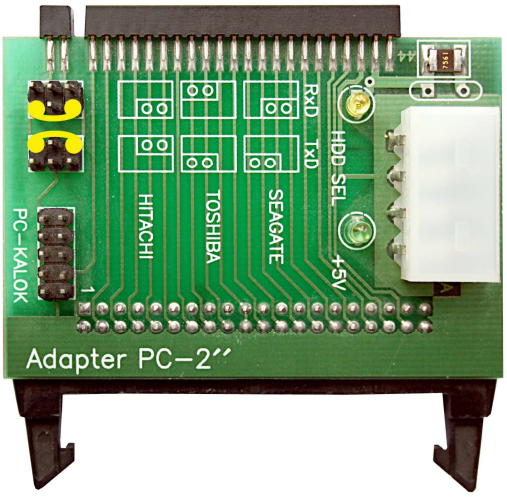


Fig. 8.15. PC-2” jumper settings.

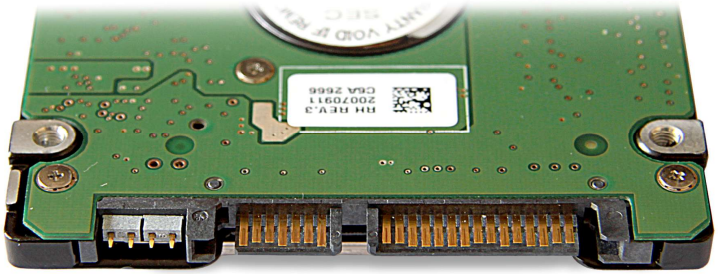


Fig. 8.16. Jumper settings for 2.5” SATA drives.

After power-up, the drive will report on readiness but it will not spin up the spindle motor.

Attention! In order to work with a Samsung HDD functioning in Safe mode, you should set the Cable Select jumper in the following menu: Tools → Cable Select management → */specify the HDD port/.*

8.10.3. Obtaining access using the H/T (FFlash, Burn) code

Burn resources *(see section 9)* are intended for drive testing and creation of the system area «from scratch»; therefore, they are more tolerant to various errors while reading/writing the service modules and accessing the heads. You can successfully use them to obtain access to the service area (and sometimes even user data area) in situations, when the Main Code does not allow that.

Be sure to select for recording one of the following resources containing no overlays:

- ***H/T Code*** – for VANGO, VANGOPLUS, PANGO, VELOCE, PALO, RUBICON, P80A, MAGMA, M40S, M60(S), M80(S), MANGO, M5_P1, M6S_2D, and MT1 drives.
- ***FFlash Code*** – for POSEIDON, DELPHI, CAESAR, P80M, TRIDENT, T166(S), STORM2, STORM2_G, TRIDENT3, and PARAGON.
- ***Burn Code*** – for V11P, VICTOR, PUMA, VICTORPLUS, VERNA, VERNALITE and all Trinity drives.

The procedure of Burn resource loading for testing is as follows:

- Make the drive report readiness via ATA or the terminal *(see sections 8.10.1, 8.10.2).*
- Read and save the dump of drive ROM.

- Select the «Write BURN resources to HDD» command *(see section 5.3.4.2)* and specify the burn resource compatible with the drive model *(Fig. 8.17)*.
- Deselect all additional loading options, leave the heads map unchanged. If you are recording the resource through terminal , enable the option to «Download via terminal» *(Fig. 8.17)*.
- Write the selected resource to the drive.
- Turn off drive's power.
- Remove configuration jumpers (if recording is performed in Safe mode).
- Power up the drive.
- Some classic drives may set the busy flag, then turn off the ATA registers in a few seconds. It means that in a couple of minutes the drive is going to start Hardware test, which will begin building the service area. Do not allow the Hardware test to start because it will make access to user data impossible; therefore, when the registers go off, immediately send the soft reset signal to interrupt the procedure. If a drive does not reach readiness for a long while after it is powered and does not turn off the registers, you can try sending the soft reset signal to it, too.

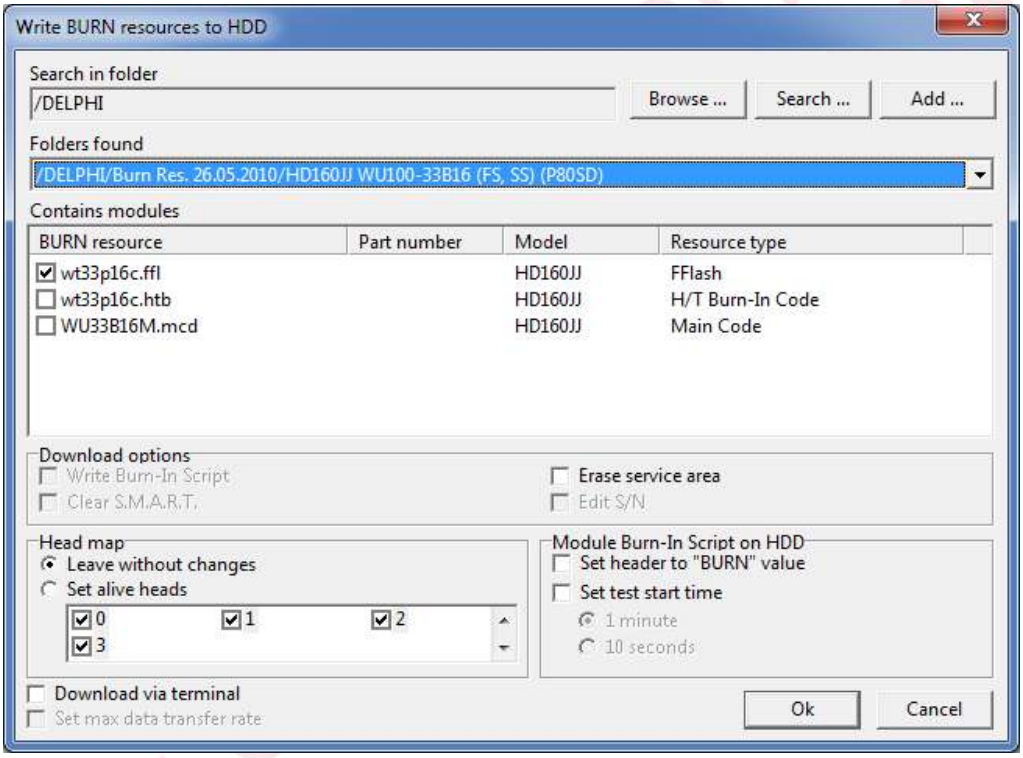


Fig.8.17.

- If a drive has reported readiness via ATA, you can proceed to the diagnostics of malfunctions; otherwise you need to analyze the drive behavior and terminal log. If attempts to access the heads result in drive knocking or switching to the busy state, it may indicate MHA malfunctions. If the drive outputs the «LED 13» code, check if a proper burn resource is selected and test the PCB.

8.10.4. Hot swap

Hot swap for accessing the service area is a simplified version of the general hot swap procedure (see section 9.7)

The procedure requires a drive of the same family using the same heads map, compatible controller board and firmware. Most PCBs and firmware versions of classic drives are compatible within their respective drive families. Compatibility of electronic printed circuit boards and firmware in Trinity drives can be identified using Platform Id *(see section 5.3.2.4)*, which should be identical in compatible drives.

Hot swap procedure:

- Connect the donor drive to the suite.
- Turn the power on and start the Samsung utility.
- Send the sleep command.
- Carefully remove the PCB and install it onto the patient drive.
- Perform test reading of modules from the «Modules table» using different heads *(see section 6.1)*, monitoring the drive behavior in terminal.
- If the modules have been read successfully, restart the utility and proceed to the drive diagnostics. In case of failure, try to analyze the terminal log and identify the cause of such behavior.

8.10.5. Head map editing in RAM

The procedure of RAM head map editing is described in detail in *section 8.8.1*.

8.11. Incorrect detection of drive parameters

Incorrect detection of drive parameters will be further understood as the following situations:

- Incorrect detection of drive capacity.
- Incorrect detection of the number of heads in a drive.
- Incorrect detection of drive model.
- Garbled characters in identification data.

Let us examine each of the situations closely.

8.11.1. Incorrect detection of drive capacity

Detection of smaller than actual drive capacity

Possible malfunction causes:

- A jumper restricting drive capacity is set (if HDD capacity is detected as 32 Gb).
- Connected terminal adapter bridged contacts and acted as a configuration jumper.
- Drive capacity is restricted by the maximum LBA setting.
- «Garbage» in configuration modules responsible for maximum LBA setting.

Try changing the max LBA settings using the «Tools» → «HDD» → «Set max LBA» command. In classic drives, as well as F1_3D and F2_EG drives use filling the SET_MAX module with zeroes and recording it for all heads. In F1_3D and F2_EG drives additionally check the content of the DCO module, which should be empty. Capacity of other Trinity drives can be changed in the HDD ID editor *(see section 5.3.5.10)*.

Detection of larger than actual drive capacity

Possible malfunction causes:

- Burn- (FFlash-, H/T-) Code is written to the drive.
- «Garbage» in configuration modules responsible for maximum LBA setting.

As a rule, when burn code is written to a drive, such device recognizes itself as the senior model in its family or detects maximum capacity in the family. Access to the user data area in a drive with written burn code is often also impossible. To restore access, you have to pick and write to the drive a suitable Main Code (*see section 9.11.2* for details on selection of burn resources).

8.11.2. Incorrect detection of the number of heads in a drive

Larger number of heads may be detected in a drive when senior models are configured and labeled as junior models for marketing purposes with restriction of their capacity. During repair of such drive or selection of a donor drive for head replacement, please keep in mind that in fact you are working with a senior model.

Smaller number of heads may be detected in a drive, when one or more heads are malfunctioning. Logical heads shift is possible in such cases *(see section 8.8).*

8.11.3. Incorrect detection of drive model

This may be caused by the following reasons:

- One or several malfunctioning heads.
- Burn- (FFlash-, H/T-) Code is written to the drive.
- «Garbage» in configuration modules responsible for maximum LBA setting.

The latter is typical exclusively of Trinity drives. Model change may be caused in these drive families by corruption of the 9D PARAM_DM or 09 BRSLT modules.

Malfunctioning heads may cause a drive to recognize itself as a junior model *(see section 8.8).*

8.11.4. Garbled characters in identification data

The problem can be caused by the following reasons:

- Damaged interface connector on the drive's PCB.
- Damaged adapter used to connect the drive to PC-3000 (PC-3000 PATA-SATA, PC 2'').
- Damaged interface cable (PATA, SATA).

The adapter and cable have to be checked using a known good HDD. If the on-board interface part is malfunctioning, you have to identify the damaged line. To do that, you can use the special «Bus test» and the «Sector buffer test» in the universal utility. The first test checks the D0-D7 bus, the second – D8-D15. Collected data will provide sufficient information to detect the damaged Dx line.

8.12. ROM data integrity check

Absence of drive response when it is powered and firmware freeze during early stage of its initialization may indicate corruption of the data in ROM chip.

First of all, you have to make the ROM dump. To do that, desolder the ROM and read it in a programmer device (in drives using an external ROM chip). If the drive firmware freezes, you can try making the drive reach readiness via terminal *(see section 8.10.1)* and read ROM using the Samsung utility.

Integrity of ROM data is determined by the checksum match and intact condition of the FIPS module (in Trinity drives only). ROM checksum in classic drives is calculated as the sum of all double-byte words. When ROM reading is performed via terminal, its checksum is verified automatically. To verify the dump checksum manually, you have to use the binary editor (installed as a part of the PC-3000 suite), having enabled the Samsung utility plug-ins in its settings *(Fig. 8.18).*

Then you have to select the dump data in the Hex editor ([Ctrl]+[A]) and use the «Words sum (2 byte)» plug-in *(Fig. 8.19).* Checksum of an intact dump must be 0.

ROM dump calculation for Trinity drives is more complex. Similarly to classic drives, the ROM dump checksum is verified automatically, when read via the terminal equipment. To verify a dump manually, use the «View information about ROM dump» feature *(see section 5.3.2.4).* A functional ROM must pass successfully both verification of the firmware checksum and the FIPS module checksum *(Fig. 8.20).*

Trinity drives often suffer from corruption of the FIPS module checksum, not the entire firmware. This problem is especially frequent in 2.5" M7E and M8E drives. To restore the drive functionality in that case, it will be sufficient to replace in the read dump the module data with FIPS data from another drive belonging to the same family. Offset of the FIPS module and its size can be identified using the results produced by the same «View information about ROM dump» command *(Fig. 8.20).*

Firmware checksum corruption in classic Samsung drives or Trinity drives cannot be repaired. In that case you have to replace the native firmware with a donor copy or a compatible firmware version from the list of burn resource. To do that, first restore the PCB functionality, for example, by overwriting its ROM in a programmer device with a ROM copy from donor drive, then follow the procedure described in *section 9.8* to make the drive use this board.

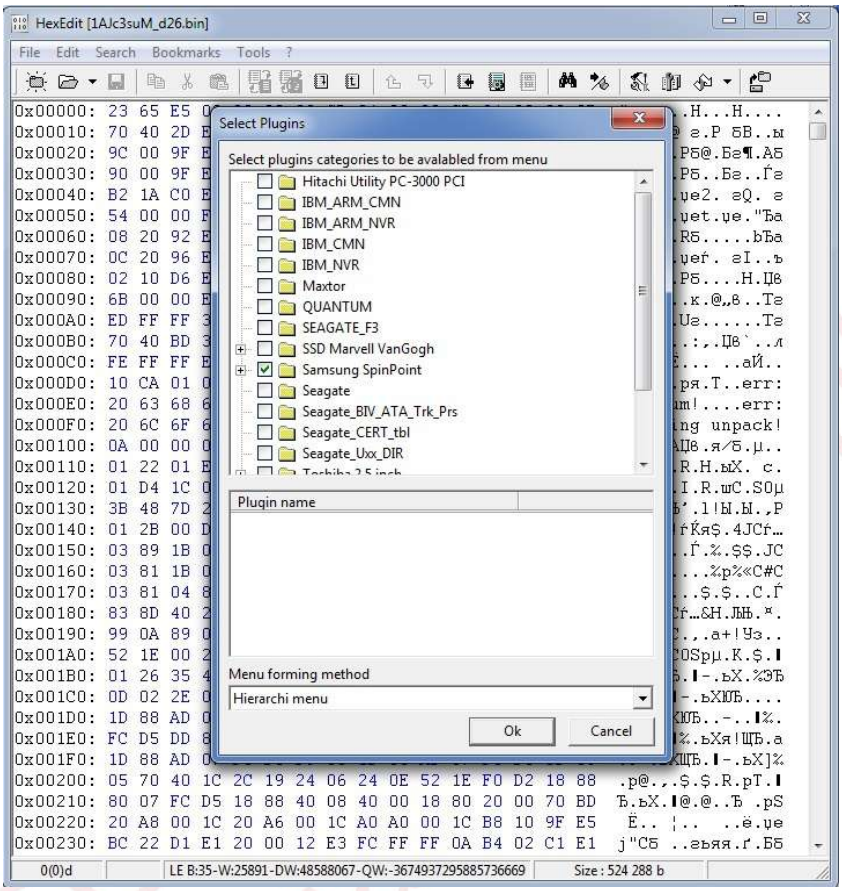


Fig.8.18.

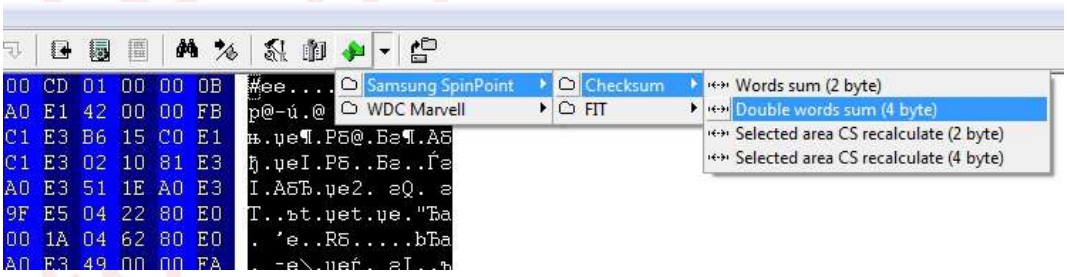


Fig.8.19.

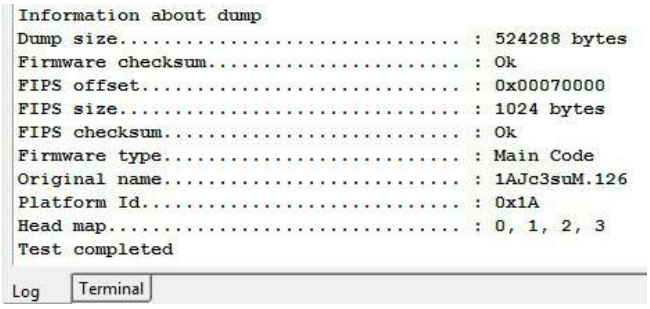


Fig. 8.20.

9. Repair of Samsung drives

9.1. About restoration of firmware modules

Before you start the procedures for restoration of firmware modules, please note and keep in mind that Samsung drives use several copies of the service area corresponding to different drive heads. Module copies may be intact, then it will be sufficient to rewrite a module from its copy to the system head. Composite module reading can considerably decrease the list of damaged modules *(section 5.3.5.3)*. Burn test *(see section 9.11)* is another method available for restoration of corrupted modules, but it is destructive for the data.

Let us examine the methods for restoration of some damaged modules, which pose no danger for the user data. Before you begin, make sure that the drive heads are able to perform successful recording *(see section 5.3.5.1)*, and that there are no bad blocks other than soft bads in the locations of damaged modules (which overwriting cannot fix).

9.2. Restoring the S.M.A.R.T.

When modules of the S.M.A.R.T. subsystem get damaged *(see section 7.7)* its functionality can be restored using the following methods:

- «Clear S.M.A.R.T.» test *(see section 5.7)*.
- «A-LIST clearing» if the ALIST or ALISTHDR modules are corrupted *(see section 5.6.3)*.
- Overwriting of the modules with copies from another drive of the same family using an identical firmware version.

In the latter case please note that ALIST or ALISTHDR may contain the table reflecting distribution of reassigned sectors among zones. If the number of heads in the patient and donor drives is different, recording ALIST or its ALISTHDR header module may cause errors in the firmware operation.

9.3. Restoring the defect list modules

Complete restoration of corrupted defect list modules is impossible, but there are certain techniques that allow restoring a portion of damaged modules using the defect records from other defect lists. Let us examine some of these methods.

9.3.1. Restoring SLIST and TLIST

If the SLIST module gets corrupted, it can be restored completely using the information from the TLIST and DLIST modules. To do that, use the «Rebuild S-LIST» command *(see section 5.6.5)*.

If the TLIST module gets corrupted, it can be restored completely using the information from the SLIST module. To do that, use the “Rebuild T-LIST” command *(see section 5.6.6)*.

If more than one module gets corrupted, information of the defect lists cannot be fully restored, but you can access the raw data by restoring the templates of the SLIST or TLIST modules. To do that, you have to use the defect list editor *(see section 5.6.2.1)*:

- Open the defects editor («Tools» → «Defect list editor»).
- Select in the menu the command to «Create a new defect list» ([Ctrl]+[N])
- In the table creation dialog, select «PCHS» as the defect list type.
- If one/several modules of SLIST, TLIST, or DLIST are intact, you can add their defect records into the created empty table using the corresponding context menu.
- Select in the context menu the command to «Save defects into HDD».
- Wait for the recording of defect lists to complete and switch the drive power supply off and on again.

During data recovery please keep in mind that when an incomplete set of defect lists is used, the data may get shifted to lower LBA.

9.3.2. Restoring ALIST

When the ALIST module or its ALISTHDR header gets corrupted, the information about reassigned sectors stored in it cannot be restored, but you can restore the module template using the «A-LIST clearing» command *(see section 5.6.3)*.

9.3.3. Restoring MLIST

Information stored in the module cannot be recovered after its corruption but Samsung drives typically have no defects in the service area and therefore MLIST and MLISTHDR can be copied from another drive belonging to the same family.

9.4. Restoring the overlay modules

Overlay modules are restored by replacing the drive firmware. To do that, you have to write to the drive a compatible Main Code *(see section 9.11)*, or copy the «overlays module + ROM» combination from a drive with a compatible firmware version. In the latter case you have to overwrite the overlays module first and then ROM contents.

9.5. Restoring the translator modules

Restoration of the SLIST, TLIST and ALIST modules is described in the «Restoring the defect list modules» section *(see section 9.3)*. UNITABLE, CONFIG, CONFIG2 and PARAM_DM modules can be restored partially only; during the procedure loss of information about the order of zones translation and some drive configuration settings is likely. To perform the restoration, you need a UNITABLE (CONFIG, CONFIG2, PARAM_DM) module from a drive belonging to the same family and using the same number of logical heads and sector size. The latter requirement only makes sense for Trinity drives, because their line of models includes drives using Advanced Format and traditional format (M7E, M8E). The algorithm looks as follows:

- Overwrite the original corrupted modules with the ones copied from the donor device.
- Open the defects editor («Tools» → «Defect list editor»).
- Select in the menu the command to «Create a new defect list» ([Ctrl]+[N])
- In the table creation dialog, select «PCHS» as the defect list type.
- Use the context menu to add to the created empty table the defects from TLIST and DLIST.
- Select in the context menu the command to «Save defects into HDD» and wait for the procedure to complete.
- Toggle HDD power supply and read the HDD ID.

9.6. Restoring the configuration modules

For the SET_MAX, SECURITY and DCO modules it is sufficient to overwrite the original modules with zeroes; however, information about set passwords and max LBA may get lost in that case.

To restore SNTBL, the module has to be copied from a drive belonging to the same family, the procedure will change its serial number and P/N to those of the donor drive. You can restore the original S/N using the «Edit S/N» feature *(see section 5.3.5.9)*, or in the HDD ID editor *(see section 5.3.5.10)*, P/N can be restored in the hex editor, if necessary.

The PROFILE module can be copied from a drive using the same or a similar firmware version, the procedure may cause the loss of some configuration settings, which are not essential for the data.

Partial restoration of the CONFIG module is described in *section 9.5*.

9.7. Hot Swap for restoration of access to data

Data recovery tasks sometimes employ the Hot Swap technique. The procedure is necessary if a drive fails to initialize and reach readiness when power supply is switched on while information in terminal does not indicate heads malfunction, or when the electronic board is not functioning properly. In that case you can try the Hot Swap procedure to restore access to the service information and user data.

Purpose of the procedure: to check the service information and try to restore it in case of errors in the service area: to copy the required modules and repeat the Hot Swap procedure in case of a malfunctioning electronic board and the need to access user data. You can also use Hot Swap if restoration of corrupted modules fails, but they are not required during Hot Swap (all modules involved in Hot Swap must contain no data corruptions).

It is necessary to use «native» modules for the drive in question because Samsung HDD use a dynamic translator rebuilt from those modules every time a drive is powered on.

The procedure requires a drive of the same model with the same heads map!

Hot Swap procedure:

- Switch on the power supply of the donor drive, start the utility and send the «Sleep» command after initialization.
- Carefully remove the electronics board from the donor drive and mount it on the HDA of the patient drive.
- If this drive family uses its own modules table in the service area (02 FIT module), then the location, sizes or the number of modules in the patient and donor drives are likely to differ. Therefore, you will have to use the «Read modules» functionality and read the 02 FIT module from the drive. Then open the «Utility status» menu and load the modules table from the read file.
- Start the «Read modules» procedure and read from the drive all modules except for some large modules containing logs.
- Switch off the power supply and install the board back to the donor HDA.
- Write to the donor all modules from the patient drive except for the OVERLAY module and the modules containing various logs (ELOG, RCOLOG, DLIST, P60CODE, etc.). The log modules can be rewritten, but they do not participate in drive functioning and thus they will not affect the data recovery procedure. Modules should be written to the donor drive in accordance with the modules table of the patient (step 3).
- Switch the power of the donor drive off and on again.
- Send the «Sleep» command and again install the donor PCB onto the patient HDA.
- Start data recovery from the patient drive. Power should not be toggled during the procedure and no initialization commands should be sent.

Наборы модулей, необходимых для Hot Swap

Drive family	Modules
V11P, VICTOR, PUMA VICTORPLUS, VERNA VERNALITE	"UNITABLE" "SLISTHDR" (except for V11P and VICTOR drive families) "SLIST" "TLIST" "ALIST"
PALO,PANGO, VANGOPLUS, VELOCE, RUBICON, P80A, P80M, DELPHI, POSEIDON CAESAR	"06 CONFIG" "0D GEO_TBL" "10 SLISTHDR" "11 SLIST" "12 TLIST" "13 ALIST" "5D CONFIG2" (if present in the modules directory) "62 ALISTHDR" (except for the PANGO, VANGOPLUS, VELOCE, RUBICON, P80A drive families)

TRIDENT T166(S) STORM2(S166) TRIDENT3(S250)	"05 SRVTBL" "06 CONFIG" "0C ARCOTBL" "0D GEO_TBL" "10 SLISTHDR" "11 SLIST" "12 TLIST" "13 ALIST" "17 SRVTBL2" "18 ARCOTBL2" "5D CONFIG2" "62 ALISTHDR" "6E 10SOFS" "71 VFY_PATT" "A0 FOD_NRRO"	"A1 FOD_HSC" "A2 HSC_DT" "A3 HSC_CYL" "A4 IN_SITU" "A7 FOD_HRLR" "B3 AVSCAN" "9E HSC_DT" "9F HSC_RST" "80 SCT_DATA" "9B HSC_RST" "9C FOD_NRRO" "9D FOD_HSC"

In the last group a mismatch of module names, their identifiers and even optional presence of these modules are possible. In that case you can try using just the modules with matching names or identifiers or use all modules except for «19 OVERLAY», log modules and other modules related to the Burn test.

Attention! During Hot Swap the OVERLAY module must not be overwritten because it contains a part of firmware code and must match the firmware in ROM at the time when power is switched on.

9.8. Configuring a drive to accept a donor board

Quite often a drive with a damaged PCB requires a donor board. The procedure of configuring a non-native board for such purpose may also be useful during work with USB drives, when they need to be connected to the PC-3000 controller. You need a compatible electronic board for the procedure (*see section 9.10* for details on selecting a donor with a compatible board). Let us examine several potential cases.

A donor board and an intact image of native ROM from the patient drive are available:

- Read the original ROM from the donor board in the terminal and save for recording it back later.
- Solder the ROM chip of the patient drive (provided it has a functional external ROM) or copy the patient's ROM in terminal or Safe mode to the donor board.
- Install the donor board onto the patient HDA.
- Perform diagnostics of other possible malfunctions, if necessary *(see section 8.10.3)*.

A donor board and a compatible set of burn-in resources is available:

- Read the original ROM from the donor board in the terminal and save for recording it back later.
- Install the donor board onto the patient drive and use the procedure for «Obtaining access using the H/T (FFlash, Burn) code» *(see section 5.3.5.1.)*.
- Read and save the modules from the patient drive.
- Make sure that the read/write heads are functional *(see section 5.3.5.1)*, check the service data structure *(see section 5.3.5.2)*, make sure there are no corrupted modules, restore damaged modules, if any.
- Write to the drive Main Code from the same set of resources.
- Toggle HDD power supply.
- Restart the Samsung utility.

A functional donor drive with a compatible PCB is available:

- Use the donor drive to perform the Hot swap procedure to restore access to the service *area (see section 8.10.4)*.
- Read and save the modules from the patient drive.

- Make sure that the read/write heads are functional *(see section 5.3.5.1)*, check the service data structure (see section 5.3.5.2), make sure there are no corrupted modules, restore damaged modules, if any.
- Replace the OVERLAY module (in classic HDD) or the MOVLY001 module (in Trinity HDD) of the patient drive with a corresponding module from the donor drive.
- Toggle HDD power supply.
- Restart the Samsung utility.

9.9. Connecting USB drives via SATA

Sometimes you may have to connect a USB drive to a PC-3000 controller in the absence of a compatible donor board with the SATA interface support.

USB Samsung drives are subdivided into two types:

- Drives with the USB-SATA bridge integrated in the system controller.
- Drives with the USB-SATA on-board bridge installed as a separate chip.

HDD of the first type include most of 1.8” USB drives *(Fig. 9.1)*, the second type includes all Samsung 2.5” USB drives and some of 1.8” models *(Fig. 9.2)*.

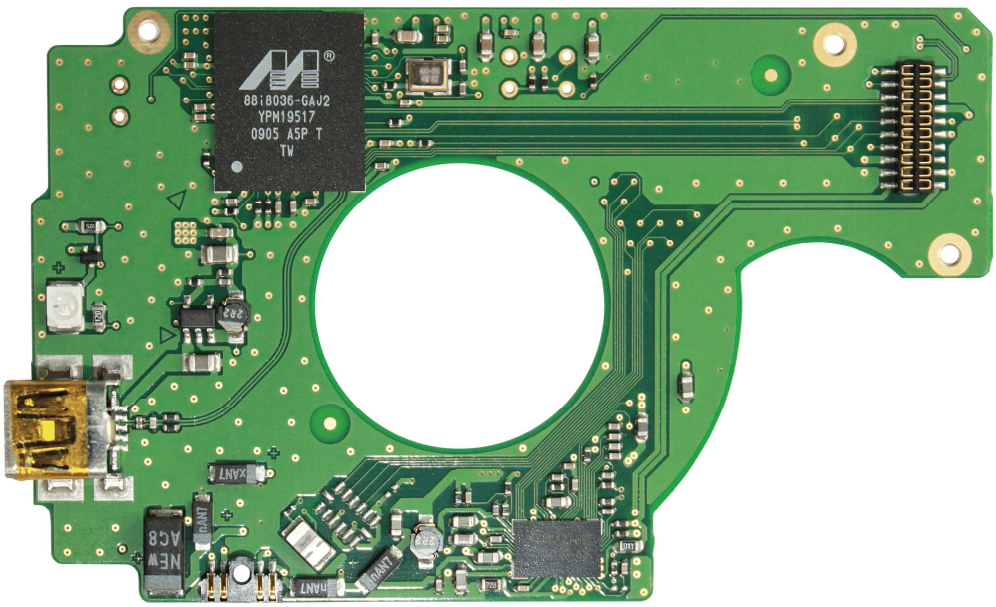


Fig.9.1. N2B 1.8” PCB. USB-SATA bridge integrated in the controller.

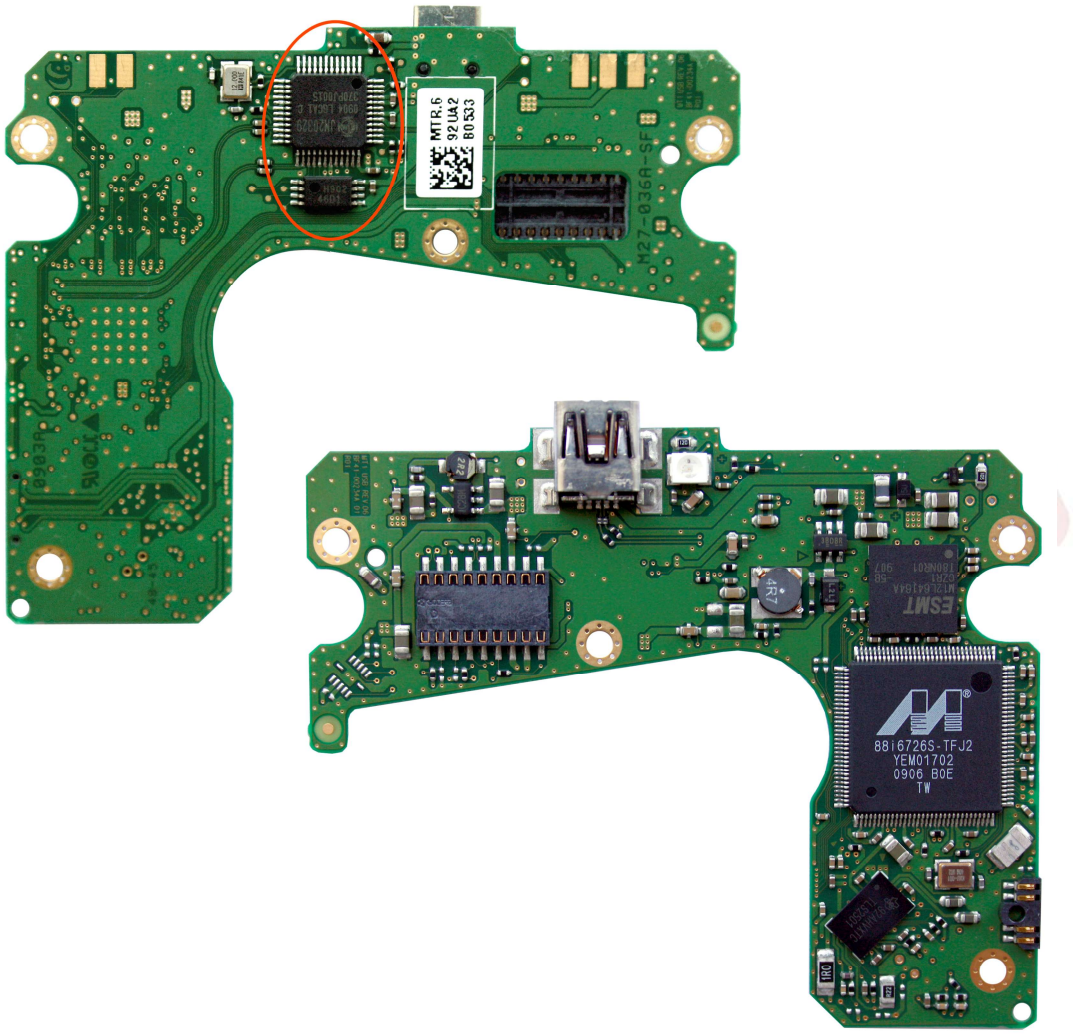


Fig.9.2. MT1 PCB. USB-SATA JMicron JM20329 bridge with NV-RAM is installed on the external side of the PCB (to the left).

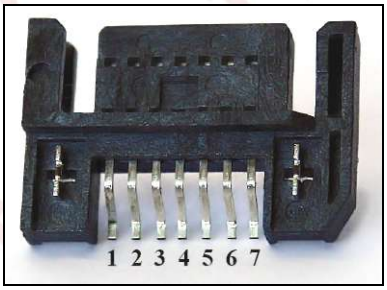


Fig.9.3. SATA connector pinout.

Pin	Purpose
1	Ground
2	A+(Transmit)
3	A-(Transmit)
4	Ground
5	B-(Receive)
6	B+(Receive)
7	Ground
-	L-key

SATA connector may be soldered for the second HDD type only. SATA connector *(Fig. 9.3)* must be soldered in the location of 4 capacitors connecting the USB-SATA bridge with differential pairs from the controller. The capacitors must be desoldered in advance. Below you can find the SATA pinouts for some boards, numbers indicate the corresponding contacts of the SATA connector.

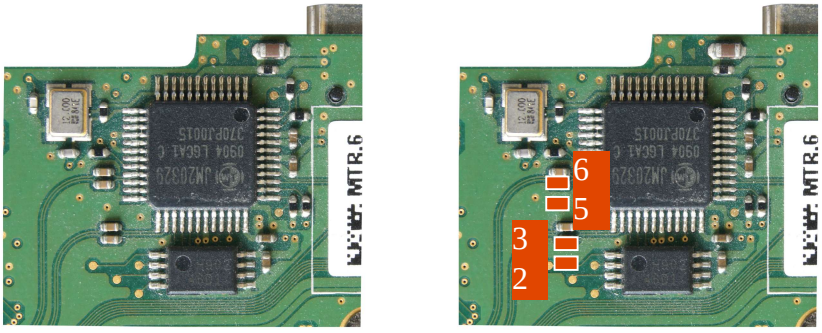


Fig.9.4. SATA pinout scheme for the MT1 drive family.

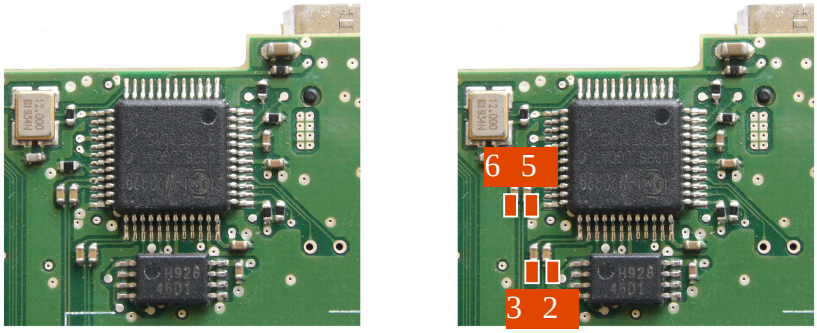


Fig.9.5. SATA pinout scheme for the M7S2 drive family.

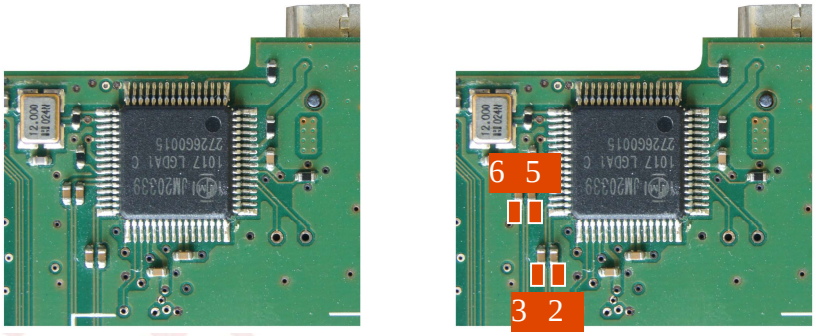


Fig. 9.6. SATA pinout scheme for the M7E drive family.

9.10. Donor drive selection

V40, P40, V40P, VL40, and V60 models of Samsung drives bear a side label with letter code *(Fig. 9.7)*. The fourth letter in the code means the manufacturer of heads used in a HDD: xxx**R**x – **R**EAD **R**ITE; xxx**S**x – **S**AE; xxx**A**x - **A**LPS. It is important during donor selection for replacement of the magnetic head assembly and firmware selection for ROM. The third letter in the code means platter manufacturer: xx**M**xx – **M**CC; xx**T**xx – **T**RACE; xx**S**xx – **S**DK.

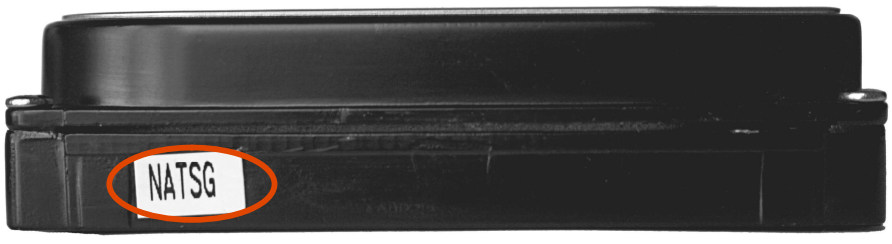


Fig.9.7. Letter code on side label.

In the range starting with PANGO, PALO, MAGMA, P80M, DELPHI and other drive families (maximum size 160 GB, maximum number of heads: 4) to the POSEIDON drive family (maximum size 250 GB, maximum number of heads: 4) the donor drive is identified by other letters on the HDA label following the P\V abbreviation *(Fig. 9.8)*. Two variants are possible: P\V: xS, P\V: xA. The second letter must match. The P\V: xA variant has ceased to appear on manufactured drives. In TRIDENT(T133(S)), T166(S), M60(S), M80(S), M5S, STORM2, TRIDENT3 and newer drive families the heads code is not indicated on HDA labels.

Fig. 9.8. Letter code on HDA cover.

Since the manufacturer started using in older drive families S(SAE) heads only and considering the Samsung resource tables (which earlier distinguished firmware versions depending upon head types), one can conclude that the heads from just one vendor are used in the drives, and so any drive of the same family with the same heads (map) can be used as a donor.

There are multiple cases of successful use of a magnetic heads assembly from another drive family with the same density, for example: «patient» Palo (160GB/4 heads) drive and «donor» Delphi (160GB/4 heads) drive.

If there is no drive with a compatible heads map, you can use a MHA with a full set of heads – 4 or 6 (for T133, T166). The drive will not use extra heads in such case.

In cases, when you are replacing the magnetic heads assembly (MHA) you should use the letter codes as a guideline, i.e. **the letters indicating the heads manufacturer must match**.

When replacing the PCB on classic Samsung drives you are advised to use boards with the same version. However, it is allowed to use other versions for all boards except MAGMA family. Successful board swap on Trinity drives requires a match of «Platform Id» between the patient and donor devices. You can check the Platform Id using the «View information about ROM dump» feature *(see section 5.3.2.4)*.

PCB photographs can be found in the *Appendix 1, chapter 10*.

9.11. Launch BURN-In tests

9.11.1. Types of Burn resources

The set of test microprograms and modules necessary to pass the Burn test as well as the Main Code portion of a drive's firmware corresponding to that set will be further referred to as Burn resources. The Burn In test is intended to build the service area, configure adaptive settings, scan the surface and reassign defects. Burn-In test is the factory procedure specifically used for the greater part of drive fine-tuning and diagnostics. Let us examine the purpose of some burn resources, which you may encounter in these sets:

Main Code – main portion of the drive firmware; the resource typically contains overlays.

H/T Code – auxiliary test microprogram used to disable heads, check drive components, perform approximate configuration of adaptive settings and build the service area «from scratch». Resources of this type contain no overlays.

Burn Code – the main test microprogram used to test the drive components and generate translator modules, it may contain overlays.

H/T Burn-In Code – the main test microprogram used to test the drive components and generate translator modules. Its difference from Burn Code is in the fact that it combines the functions of H/T Code and Burn Code. H/T Burn-In Code of classic drives always contains overlays, in Trinity drives the H/T Burn-In Code contains no overlays.

FFlash – is an auxiliary test microprogram, its difference from H/T Burn-In Code is in the absence of overlays. It is used to disable drive heads, for partial building of the service area or obtaining access to the service area before the Burn test begins.

Overlay (Burn overlay) – the code portion of the main test microprogram written to disk surface. Burn overlay of classic drives is stored in the OVERLAY module, Trinity drives store it in the BOVLY001 module. Please note that Overlay presence among resources indicates that the image of the main Burn Code or H/T Burn-In Code contains no overlays.

Burn-In Script – the module containing a script for the main test microprogram with the list of procedures performed during the Burn-In test and their parameters. Burn-In Script in classic drives is stored in the BISPT modules, Trinity drives store it in the BINEWSCR module.

Geometry Script – a set of geometry parameters used by the main test microprogram while generating the zone allocation table. Classic drives have no such resources because their content is integrated in the main test microprogram. The script is stored in the GEO_00 module.

Apart from the above resources, you may encounter resources with the «Downsize» prefix, for example, Downsize Burn Code, Downsize Main Code, Downsize Geometry Script. Downsize code is intended for model downsizing[1]. Technically the task is accomplished by decreasing SPT within a zone and elimination of tracks with the highest error count. Some drives instead of special DS firmware feature an opportunity to set before the Burn-In test a special «Downsize» flag, which will force creation of a DS model. Sometimes a DS model may be produced by a Burn-In test automatically. That may happen when the test completes with a failure, then the drive restarts and passes the DS test successfully.

The «5400 rpm» label of some resources intended for testing of Trinity drives indicates that testing a drive with such resources will produce a model with lowered rotational speed of the spindle motor – 5400 rpm.

9.11.2. Selecting the necessary set of resource data

Resources of Burn tests for Samsung drives can be found on the CD supplied with the kit of PC-3000 or in updates available through personal accounts at our technical support server (see the Resources\Samsung\Burns folder). In order to use the resources, open the database window: «Tools» → «Database» and import the required set of resources. If you have resources created in earlier PC-3000 version (ver. 2.xx), you can use the PCDBMigration utility to convert them to the new database format.

In order to launch testing, Burn Code has to be written to a HDD. After searching through the database *(see section 5.3.4.2)*, you will have to determine which of the found files must be written to drive.

For V11P, VICTOR, PUMA, VICTORPLUS, and VERNA drives the utility may find several folders containing resources. The name of the source folder containing Burn Code must correspond to the letter code on the drive's side label *(see Fig. 9.7.)*. It means that if the utility has found folders «PUMA/Burn Resources 01.06.2005/SP4002H/XXXR» and «PUMA/Burn Resources 01.06.2005/SP4002H/XXXS» for a SP4002H drive with QUMSC code on label, you should select the second one.

In newer drives the resources are distinguished by the four initial digits of drive P/N (*Fig. 9.8*, P/N code) and additionally by the model, firmware version, manufacturer of the heads and platters (*Fig. 9.8*, P/V code). To select the necessary resource, you have to search the database first by the P/N, and if the search returns nothing, by model *(see section 5.3.4.2)*. To select the most suitable resource from the obtained list, you have to use as guideline the firmware version, which may be indicated in the name of the resource folder immediately after the model name (or P/N), and two letters of the P/V code, which may follow in brackets). It is recommended to use resources with firmware version that is not lower than the current HDD firmware version, and P/V code (if it is specified in the folder name) must match the P/V code of the target drive.

Attention! You are advised to test Trinity drives with the resources recommended for drives with the given P/N only. Using incompatible resources may cause breakdown of the magnetic heads stack.

Please also keep in mind during selection of resources if a model is downsized. When dealing with a DS model, use the Downsize Burn Code as the main testing microprogram or enable the «Downsize» flag in the Burn launch settings *(see section 5.3.4.2)*. «Downsize Burn Code» must also be selected in case, if a drive has finished Burn test before that with an error caused by overflow of defect lists. Then launch of «Downsize Burn Code» will «reduce» the drive to a «Downsized» model.

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[1] – DS models are drives using recording density that is lower than the standard rating value declared for that drive family by the manufacturer. For example, SP0612N (60 Gb, 2 heads) is a downsized model of SP0812N (80 Gb, 2 heads), SP0802N with three enabled heads is a DS model of SP1203N, HD753LJ (750 Gb, 6 heads) is a DS model of HD103UJ (1000 Gb, 6 heads).

VANGOPLUS drives are «Downsized» models of PANGO drives; therefore, only «Downsize» codes exist for the former. If the utility fails to find a folder with resources for a drive belonging to that family, you may try looking for it in the folder of PANGO drive family and use «Downsize» codes from it.

9.11.3. Test loading and performance procedure

Warning! Launch of Burn-In test or H/T test will destroy user data!

Before you rewrite the resources and launch testing, you should back up the drive's modules and ROM. You are advised to prepare a separate power supply unit to power the drive during the test, because it may take from 6 hours to 2 days and more (depending upon the HDD condition).

If the set of resources for a HDD includes HT code, you are advised to perform additional testing and Burn-In test configuration *(see section 9.11.4).*

For V11P, VICTOR, VICTORPLUS, VERNA, VERNALITE, VANGO, VANGOPLUS, PANGO, VELOCE, PALO, MAGMA, M40S, RUBICON, and P80A drive families the following steps are required before test launch:

1) Write the following BURN resources to the drive *(see section 5.3.4.2):*
   - «BURN-IN Script» (if the script is not available in the database, you should edit manually the module header changing it from END to BURN);
   - «Overlay» (necessary for VERNA, VERNALITE, and VANGO only);
   - «Burn Code» or «Downsize Burn Code».
2) Switch the drive power supply off and on again.

For POSEIDON, DELPHI, P80M, TRIDENT, PARAGON, T166(S), STORM2, STORM2_G, TRIDENT3 drive families the following steps are required before test launch:

1) Write the «FFlash» firmware to HDD before testing.
2) Switch the drive power supply off and on again.
3) Edit the «BISPT» module header (Burn test script) changing it to BURN (instead of END, FAIL or CONT).
4) Write to HDD the «HTBI Code» firmware.
5) Switch the drive power supply off and on again.

To produce a full-sized 7200 rpm model of a Trinity HDD, the following steps are required:

1) Write «HTBI Code».
2) Switch the drive power supply off and on again.
3) Clear the service area.
4) Switch the drive power supply off and on again.
5) Write the «Burn-In Script».
6) Write the «Geometry Script».
7) Write the «Downsize Geometry Script» (optional).
8) Write the «1K Geometry Script» (optional).
9) Send the command to run Burn-In test.

Note 1: If drive testing reveals too many defects, and «Downsize Geometry Script» is loaded, it will be used automatically to downsize the model.

Note 2: Some sets have the «Downsize Geometry Script» integrated into the «Geometry Script». If such sets are used, the drive model may change after the test to a downsized model.

To produce a downsized 7200 rpm model of a Trinity HDD, the following steps are required:

1) Write «Downsize Burn Code».

2) Switch the drive power supply off and on again.

3) Clear the service area.

4) Switch the drive power supply off and on again.

5) Write the «Burn-In Script».

6) Write the «Downsize Geometry Script».

7) Write the «1K Geometry Script» (optional).

8) Send the command to run Burn-In test.

To produce a full-sized 5400 rpm model of a Trinity HDD, the following steps are required:

1) Write the «HTBI Code (5400 rpm)».

2) Switch the drive power supply off and on again.

3) Clear the service area.

4) Switch the drive power supply off and on again.

5) Write the «Burn-In Script (5400 rpm)».

6) Write the «Geometry Script (5400 rpm)».

7) Send the command to run Burn-In test.

Note: 5400 rpm drives have no downsized models.

Classic drives begin the test in 5 minutes after the power switch. During the wait interval and testing all status registers are off. If you send a soft reset signal during that period, the drive will switch to «ready» status and will be able to access its service area (switch power off and on again to restart the test). If a drive has immediately reached readiness, then the BURN-IN Script is empty or its header is: «END» or «FAIL». An error during Burn Code recording is also possible.

Trinity drives begin the Burn-In test immediately after the terminal command to start the test is sent. The command can be sent manually («Tests» → «Service information» → «Work with BURN» → «Run Burn-In test»), or automatically while loading the resources from the database *(see section 5.3.4.2)*. **The drive does not turn off the registers during test** and remains in pseudo ready state. If the drive receives an arbitrary ATA command during test, Burn-In test will complete with the «LED 2308» error (Firmware Assert). Therefore you are advised to disconnect the SATA cable prior to starting the test. To interrupt the test, you have to toggle the drive power supply and send the soft reset signal. To continue Burn-In test, use the terminal to send the command to resume testing («Tests» → «Service information» → «Work with BURN» → «Resume Burn-In test»). You can also resume the Burn-In by switching the drive power off and on again. After 5 minutes the drive will resume from the step where it has been interrupted.

Note 1: The SATA cable must be disconnected before starting the Burn test. Hot disconnection of the cable during the test will be perceived by the drive as a soft reset signal. It will interrupt the Burn-In test then.

Note 2: If the Burn-In test of a Trinity drive gets interrupted before step 70 (HT test), the entire testing procedure will have to be restarted from the beginning. Since step 70 (Burn test start) the drive saves the results of performed tests in the 9A BINEWSAV module, and after the power is switched off and on (or a command to resume test is received) the testing procedure automatically continues from the step, where the test has been interrupted.

Note 3: If after the power supply switch the testing procedure does not resume for a long while, you have to send the command to resume Burn-In test manually. To do that, first send via ATA ([F7]) or the terminal ([Ctrl]+[Alt]+[4]) the «Soft reset» command, then — the command to resume testing.

If you connect a HDD to terminal during test, you can notice that the drive outputs a message when it launches each test and performs certain operations. Some of the messages look like the following:

BStep 00003 (Cmd 0024) :
BStep 00004 (Cmd 0069) :
BStep 00005 (Cmd 0069) :
BStep 00006 (Cmd 0069) :
BStep 00007 (Cmd 0069) :
…
BStep 00025 (Cmd 001C) : Test head : 00Test zone : 07Agc : 0508Agc : 00A1Asc: FFF2Test head : 01Test zone : 07Agc : 0406Agc : 0080Asc: 0007
BStep 00026 (Cmd 0010) :
…

In case of PATA drives, you can monitor the test progress and completion using an auxiliary connected LED. The LED must be connected to pin 39 of the IDE connector and +5V power line *(see Fig. 9.9).*

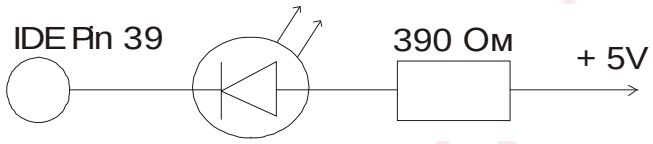

Fig.9.9. Connecting an external LED to monitor HDD self-testing progress.

You can conveniently observe test progress if you launch the utility in «Burn Test monitoring» *mode (see chapter 4)* or open its window and start monitoring using the menu: «Tools» → «Utility extensions» → «Burn test [Ctrl]+[Alt]+[2]» *(see section 6.3).* However, that mode does not reflect the test progress in SATA drives.

After test completion, the drive must stop the spindle and start continuous blinking with the LED. Test completion can also be easily identified in terminal, where the drive constantly outputs «LED 00 0000» strings – «LED» means the blinking mode, "00" – positive result code, other values mean an error. In monitoring mode the «Stop condition» field will contain completion code and its description instead of «No Value» string.

If the drive does not stop the spindle and does not demonstrate any other signs of test completion for a very long period (more than 48 hours), you can interrupt the test. To do that, you will have to switch HDD power supply off and on again and send a soft reset signal to drive; then you can check test status using the BISPT module header. If the header is CONT, the test must be resumed (power should be switched off and on again without a reset signal), if it is END – test has been completed successfully, FAIL means that the test has been terminated because of errors.

After successful completion of the testing procedure you should switch off and on again HDD power supply, and write to ROM «Main Code» or «Downsize Main Code» or «Main Code (5400 rpm)» depending upon the Burn Code loaded before test, i.e. for «Downsized» models you should load «Downsize Main Code». After loading, switch the drive's power supply off and on again – now it is ready for work.

Note 1: Downsize Main Code for Trinity drives does not exist. After running the Downsize Burn Code, the Main Code firmware must be written.

Note 2: After the BURN test completes on a drive belonging to the TRIDENT or earlier families, S.M.A.R.T. initialization may fail to follow. In that case you will have to initialize S.M.A.R.T. manually using the command: «Tests» → «Reset S.M.A.R.T.».

Note 3: If the service area has been cleared before the test is started, the serial number of the drive will be lost. The HDD will recognize itself by P/N instead. You can restore or alter the serial number using the «Edit S/N» feature or by overwriting the 07 SNTBL module saved earlier. After serial number editing you have to switch the HDD power supply off and on again and read the HDD ID.

If the test completes with an error, writing the «Main Code» is not allowed, because the drive may stop responding to requests. Open the report on Burn test results (the «Tests» → «Service information» → «Work with BURN» → «BURN TEST RESULT REPORT» menu) and analyze probable causes of the failure. If the test has been launched with a «Burn-In Script» file from a resource folder, you may try launching the test again with the original Burn-In Script file of the drive saved before test start. To do so, write the BISPT module to HDD, load it for viewing in modules table, modify its header changing it to BURN, switch drive's power off and on again – the test will restart from the beginning.

If the test has been launched with the original Burn-In Script file, try running the test with a «Burn-In Script» file from the corresponding resource folder. If defect lists in a HDD are filled up, you may try running a «Downsize» test

(recording «Downsize Burn Code»). The original «Burn-In Script» file in a drive usually contains a function for switch to a «Downsize» model, i.e. during test the drive may read «Downsize Burn Code» from the P60CODE module (for PALO) or from module P40CODE (for PANGO), write it to ROM and continue testing. If the model name in ATA ID has changed after test completion to the name of a junior model, then you should write to it «Downsize Main Code» instead of the «Main Code».

9.11.4. Service area check using H/T (FFlash, Burn) code and heads map modification in ROM

VANGOPLUS, PANGO, VELOCE, PALO, MAGMA, RUBICON, and P80A drives contain H/T code, i.e. code for launch of SA test and drive preparation for a Burn-In test. During this test a HDD verifies SA surface, clears all results of earlier tests, resets the lists of defects in user data area, adaptive parameters of the user data area and edits other modules. HT test has another valuable feature – it checks the validity of commands and their parameters in the Burn test script module and adjusts the parameters of some commands for a specific drive. The BISPT module header after that test can be changed to «BURN» (depending upon the HT Code content). During HT a drive also partially checks the user data area and that step affects the result of test completion.

You can also use the microcode to gain access to the SA, when it is not allowed by the «Main Code» or «Burn Code». To do so, you should make the drive report on readiness *(see sections 8.10.1 and 8.10.2) and* write «H/T Code» to it *(see section 8.10.3).* After you switch the power off/on, send a soft reset to prevent the test from starting. A drive with loaded HT code executes the commands reading/writing the SA surface in the mode, which allows HDD to ignore a number of errors.

To launch a HT test, load the «H/T Code» to HDD (please see *section 9.11.2* for details on resource selection), switch the power supply off/on, and the test will start in five minutes. It will last 20-60 minutes. You can identify the completion of that procedure by the blinking LED or by the LED NN XXXX code in terminal, where NN stands for test completion code.

Warning! Testing is forbidden if you need to recover data from a HDD!

POSEIDON, DELPHI, P80M, and TRIDENT drives use FFlash instead of H/T code. If you record FFlash to a drive, then test launch will require changing the script header to BURN or clearing the script module altogether. That test is quite fast; it recreates system modules. After the test HTBI code should be written. FFlash and HT Code for Trinity drives do not exist. To check the service data integrity in such cases you can use HT Burn In Code.

In order to modify the heads map (disable heads using software means), you should write to a drive H/T Code or FFlash code having set the required heads map *(see section 5.2.3.2),* and launch the test. To do that, the following steps are required:

1) Change the script header to BURN or clear the script module.
2) Write to the drive HT or FFlash code with the defined heads map.
3) Switch the drive power supply off and on again. Wait for test start and completion watching the terminal.
4) After test completion, switch the drive power supply off and on again, send a soft reset signal, write Burn Code or HTBI Code and start the main self-test routine.

To modify the heads map in the ROM of Trinity drives, no additional testing is necessary. The heads map will be changed to the required map while running the Burn-In test.

Warning! Some Burn resources feature the algorithm for detection and automatic disabling of heads having problems. If drive testing reveals a large number of defects associated with one of the heads, that head can be disabled automatically. Resources with an internal algorithm for detection of heads with problems are most frequent among Trinity drives.

10. Appendix 1. Photos of control boards Samsung HDD

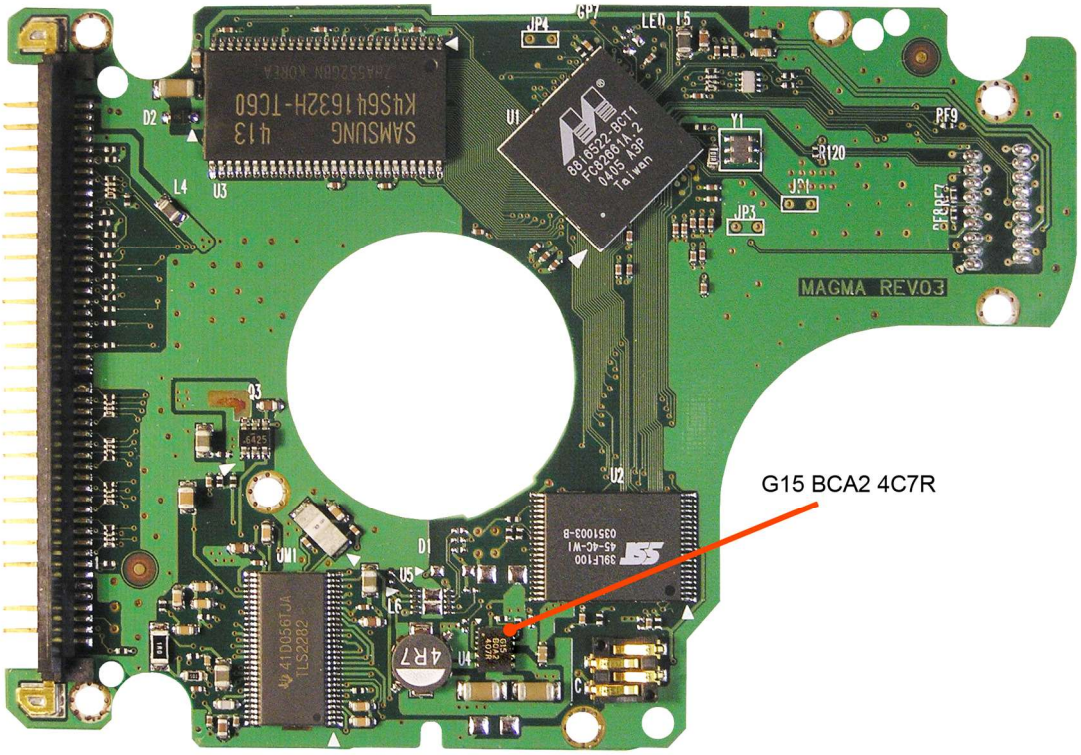

Fig.10.1. Control board in MAGMA (REV.03) drive family.

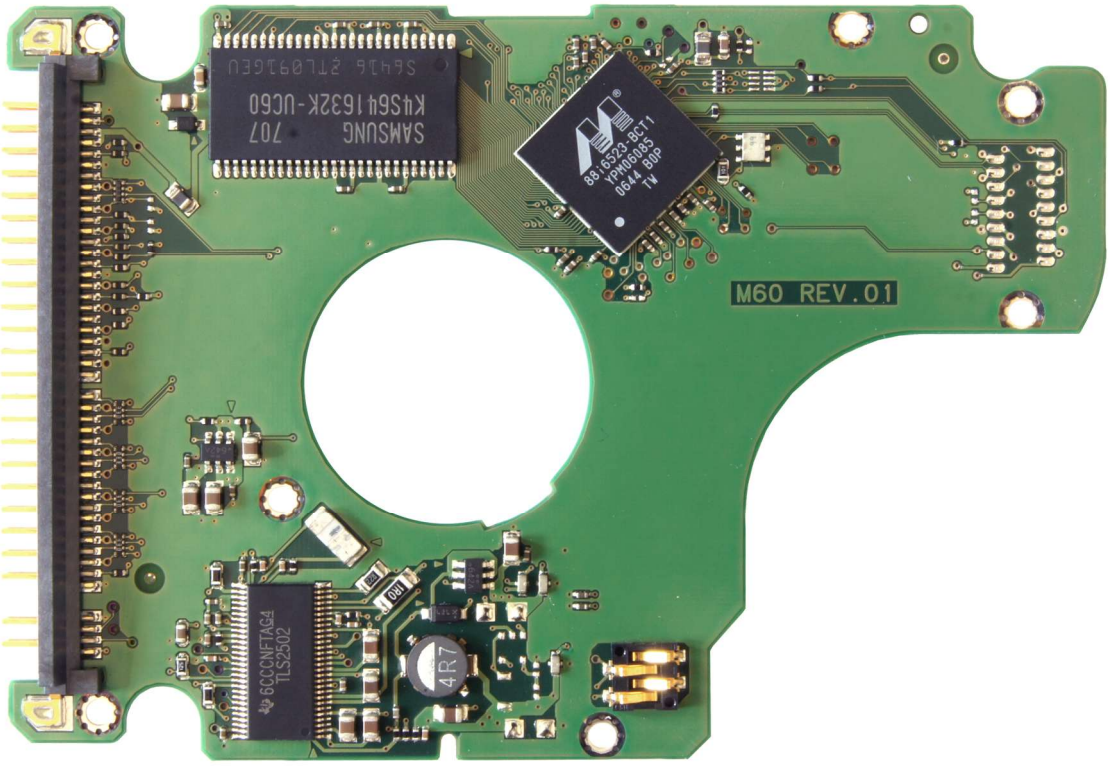

Fig.10.2. Control board in M60(S) and M80(S) drive family with PATA interface (REV.01).

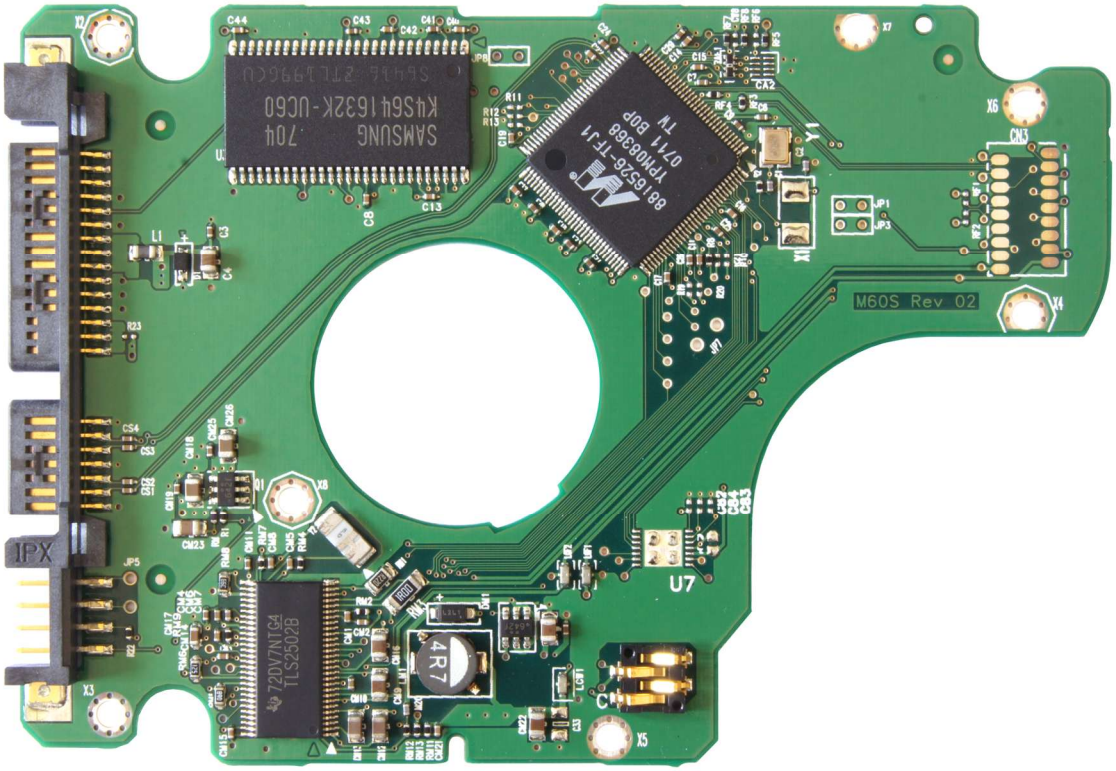

Fig.10.3. Control board in M60(S) and M80(S) drive family SATA interface (REV.02).

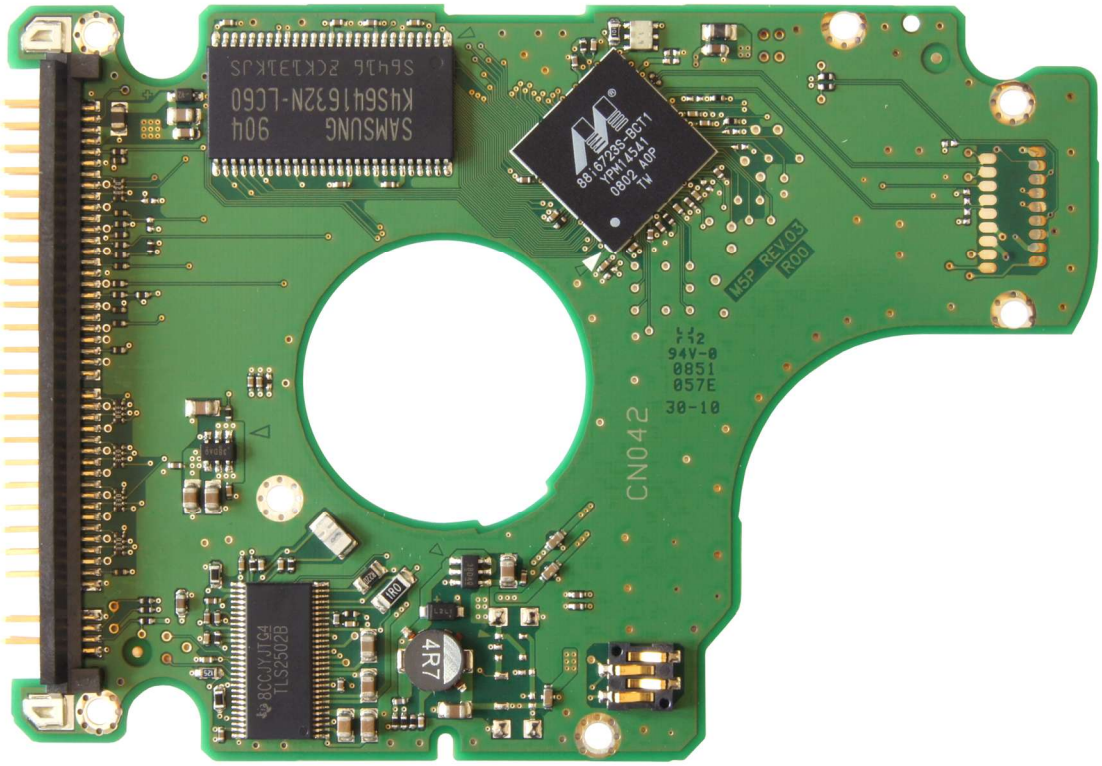

Fig. 10.4. Control board in M5_P1 drive family (REV.03)

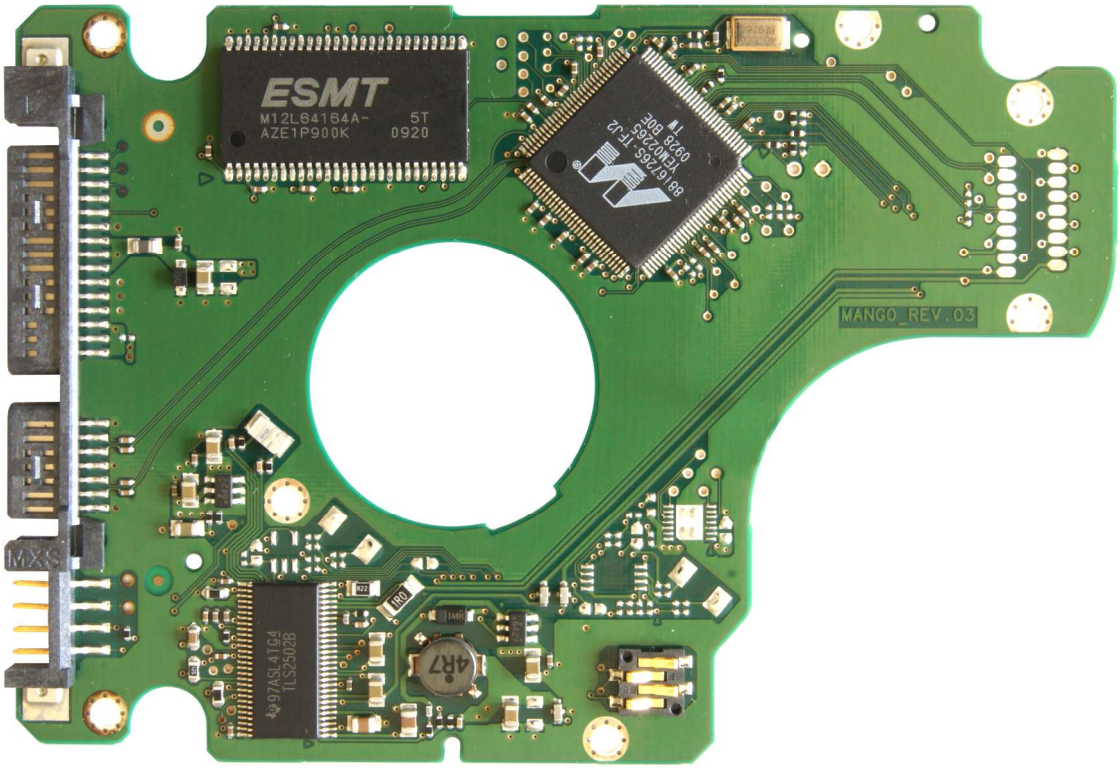

Fig.10.5. Control board in MANGO and M6S_2D drive family (REV.03).

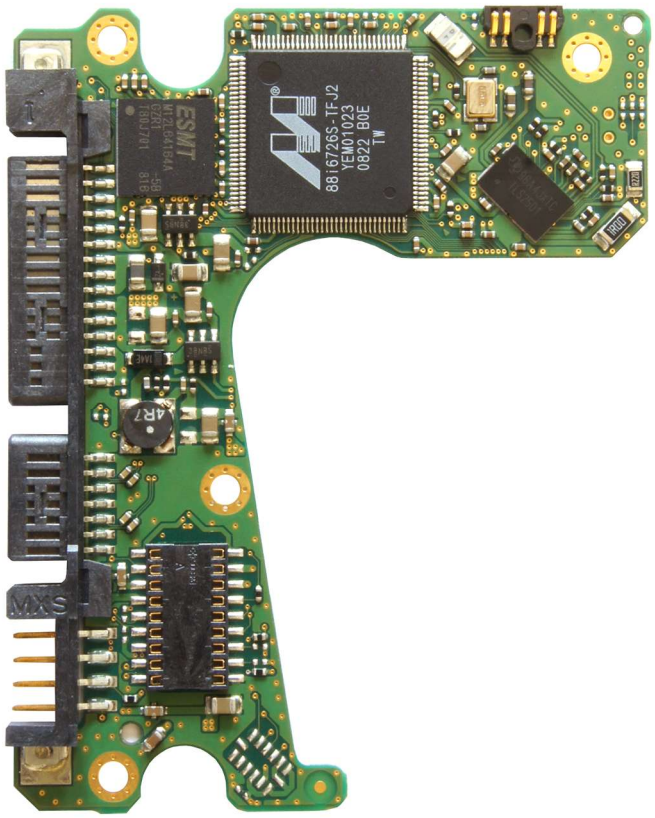

Fig.10.6. Control board in MT1 drive family (REV.03).

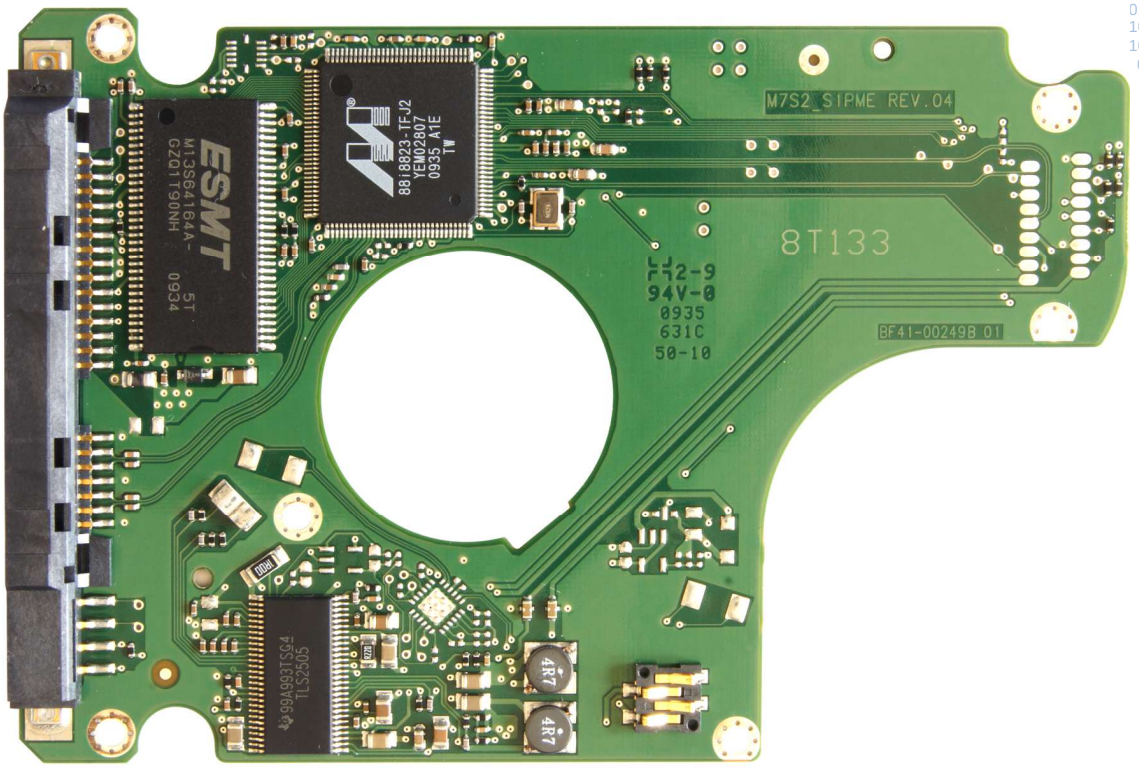

Fig.10.6. Control board in M7S2 drive family (REV.04).

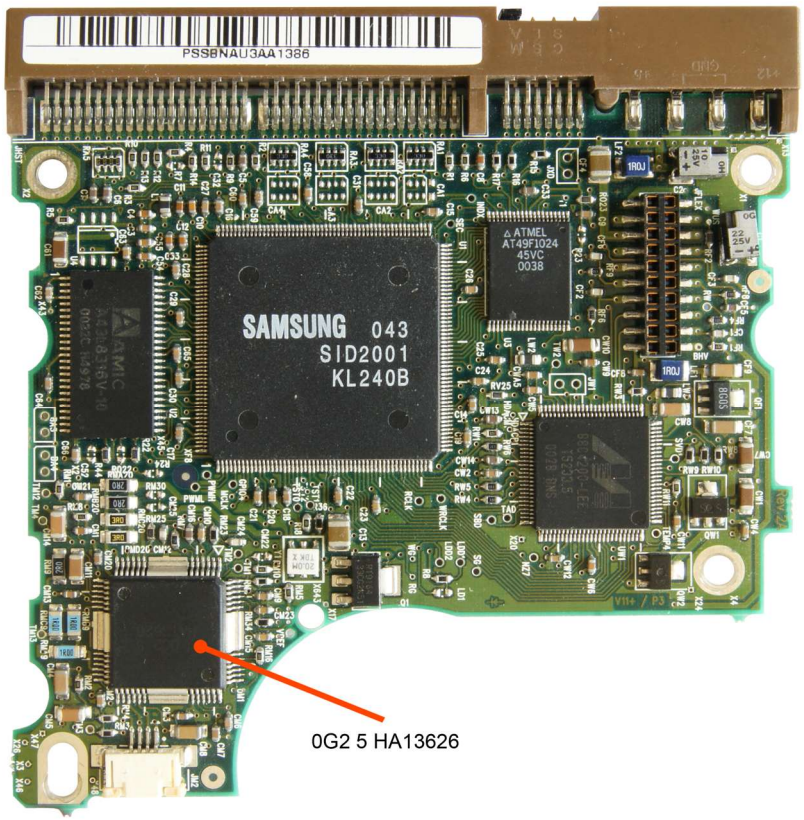

Fig.10.8 Control board in M7S2 drive family (REV.04).

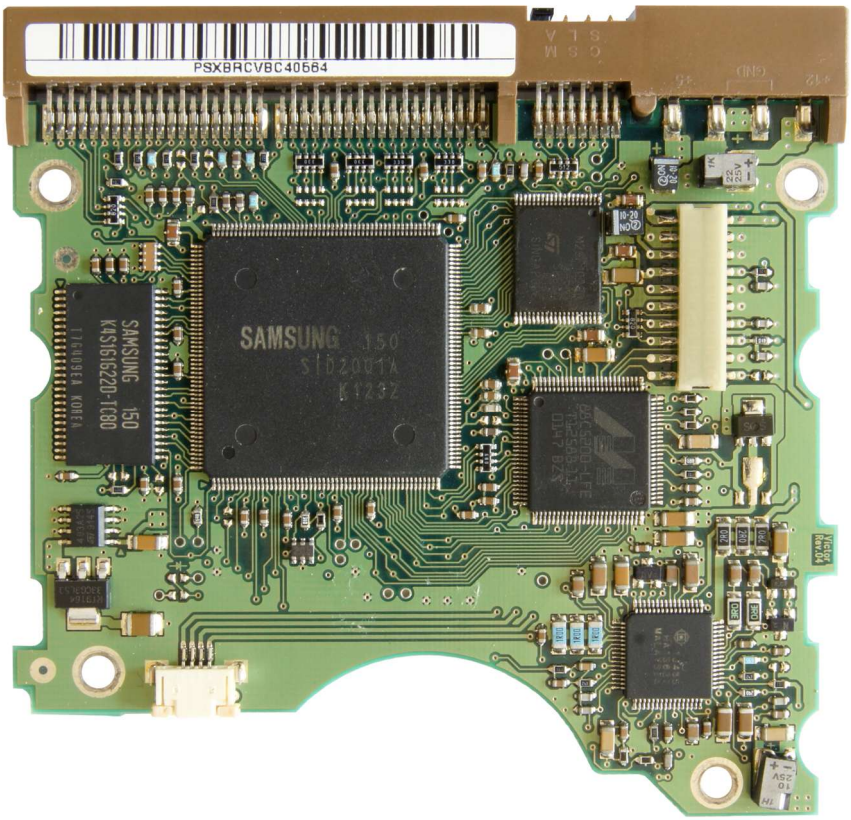

Fig.10.9. Control board in VICTOR drive family (REV.04).

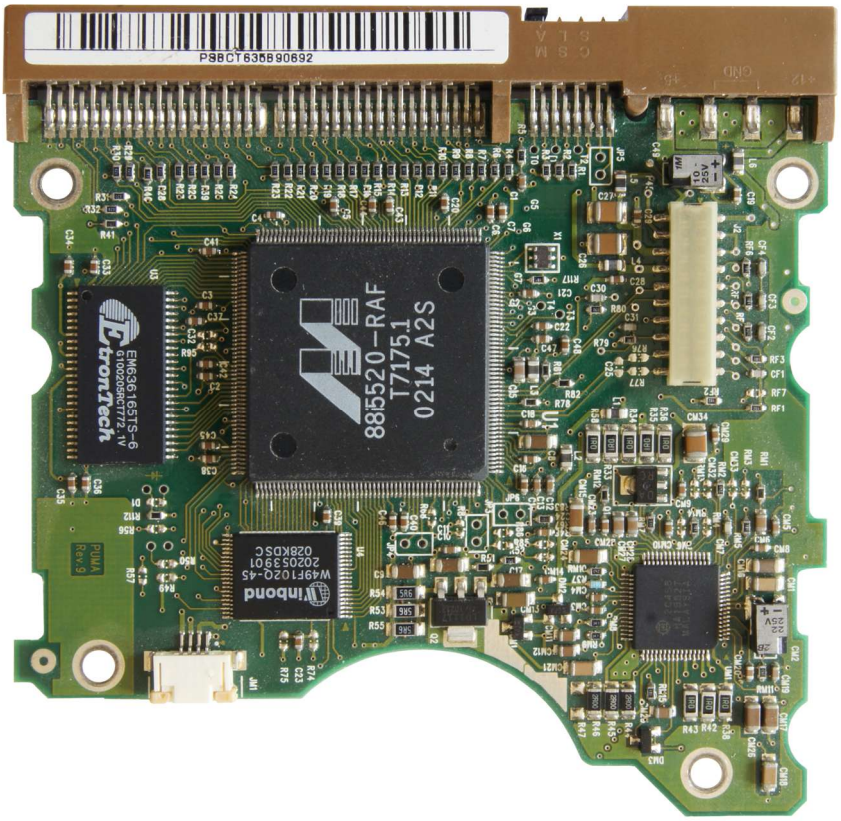

Fig.10.10. Control board in PUMA drive family (REV.09).

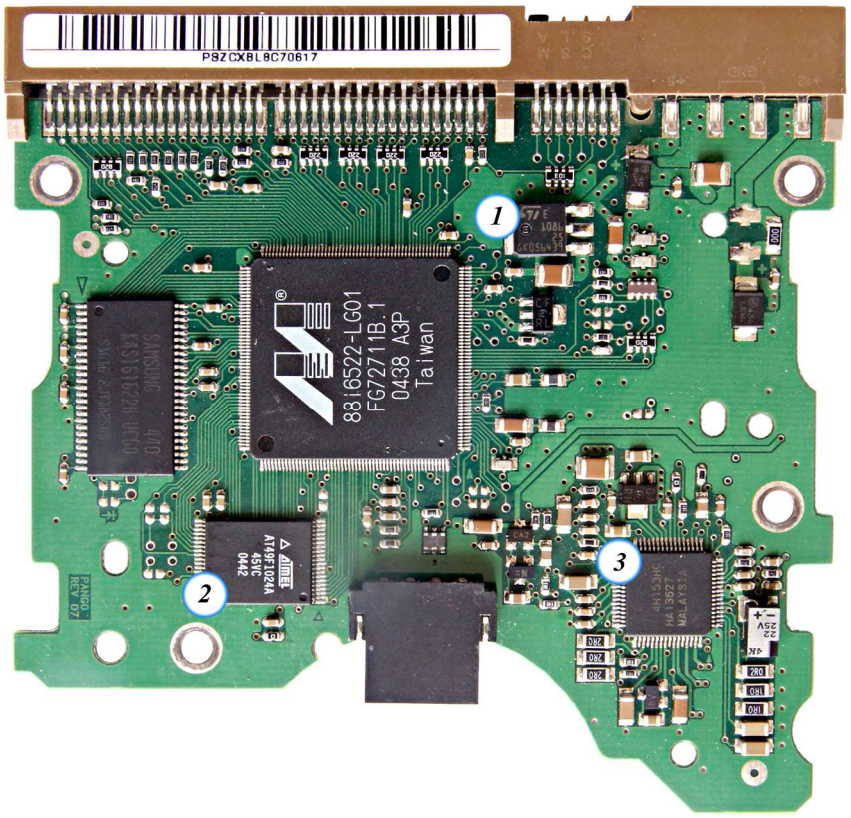

Fig.10.11. Control board in VANGOPLUS and PANGO drive family(REV.07)

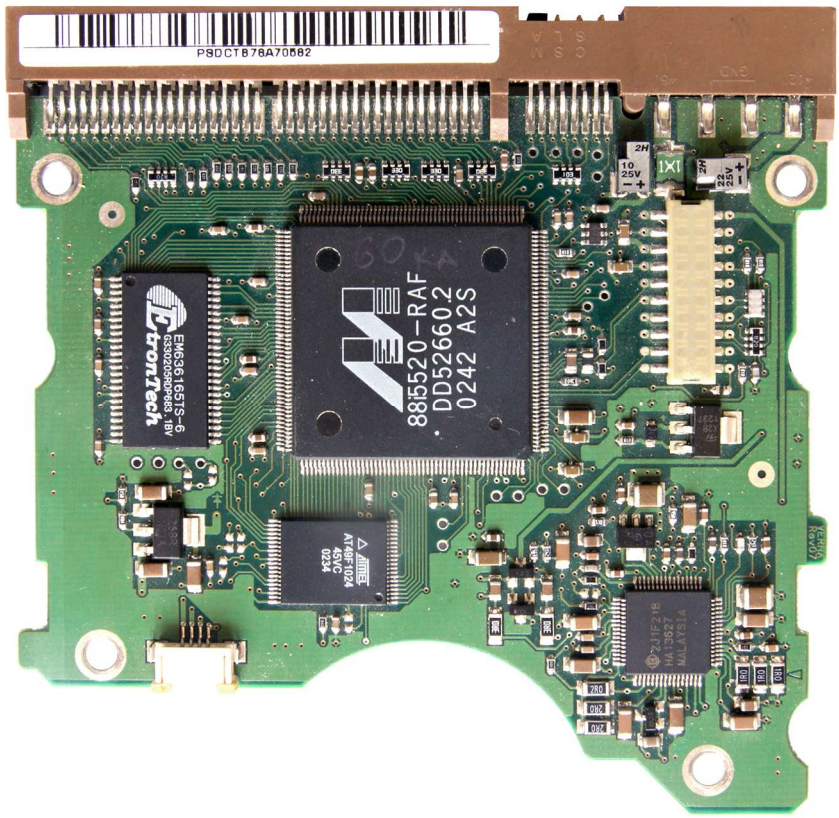

Fig.10.12. Control board in VERNA and VERNALITE drive family (REV.07).

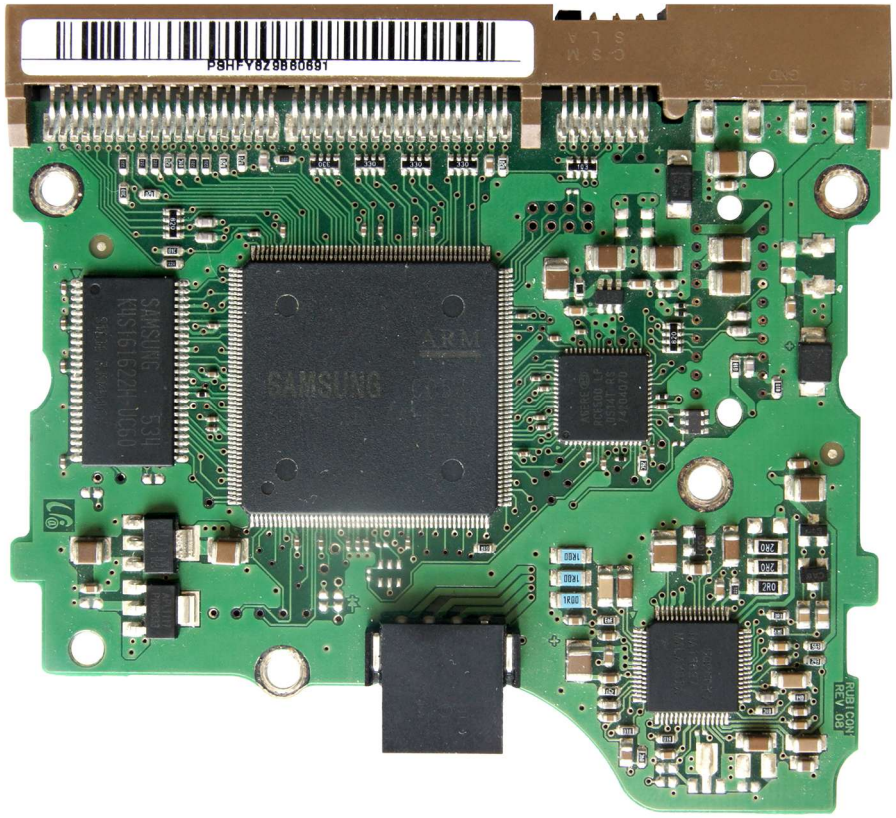

Fig.10.13. Control board in RUBICON drive family (REV.08).

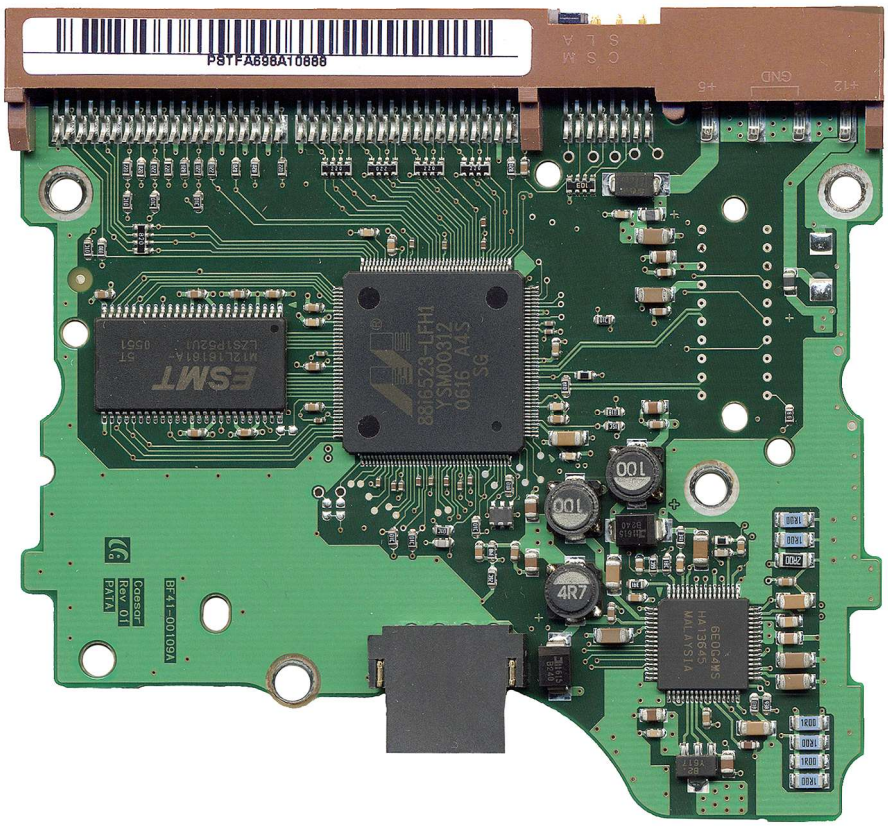

Fig.10.14. Control board in CAESAR drive family (REV.01).

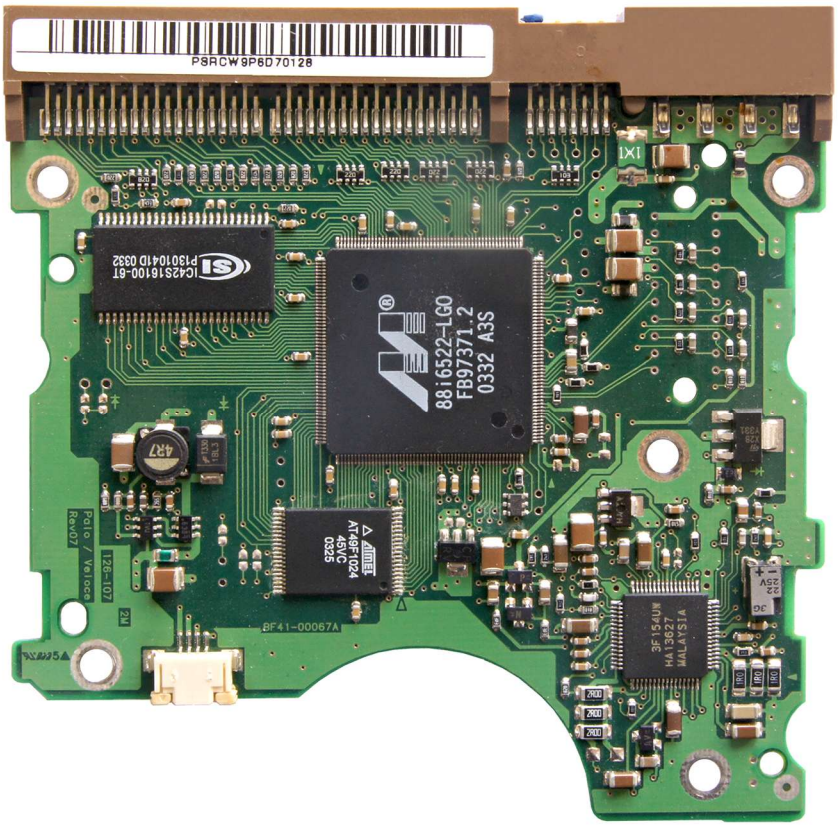

Fig.10.15. Control board in VELOCE and PALO drive family with PATA interface (REV.07).

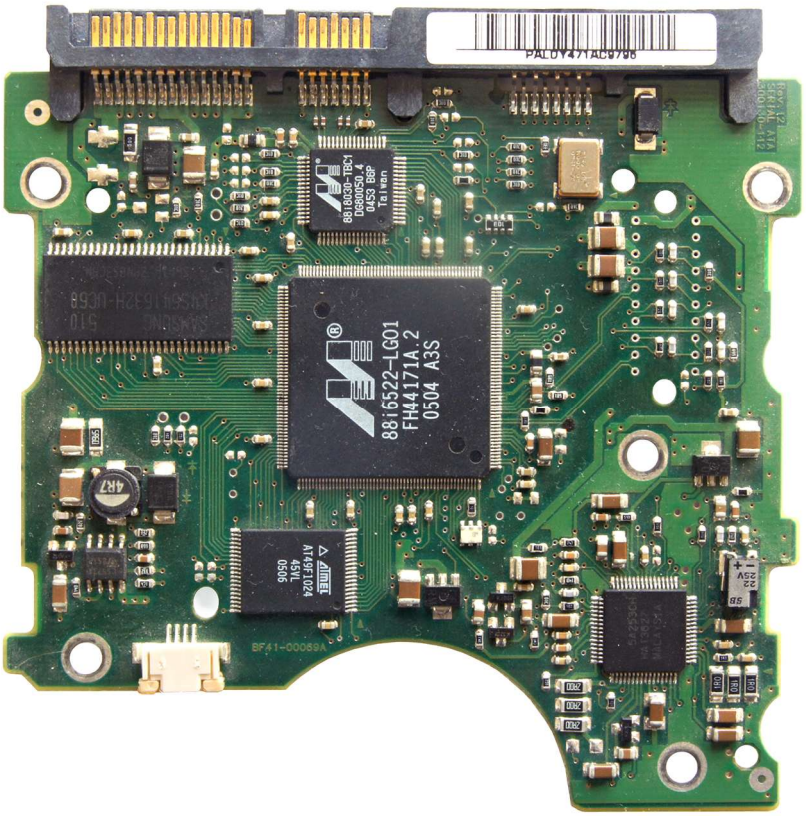

Fig.10.16. Control board in PALO drive family with SATA interface (REV.12).

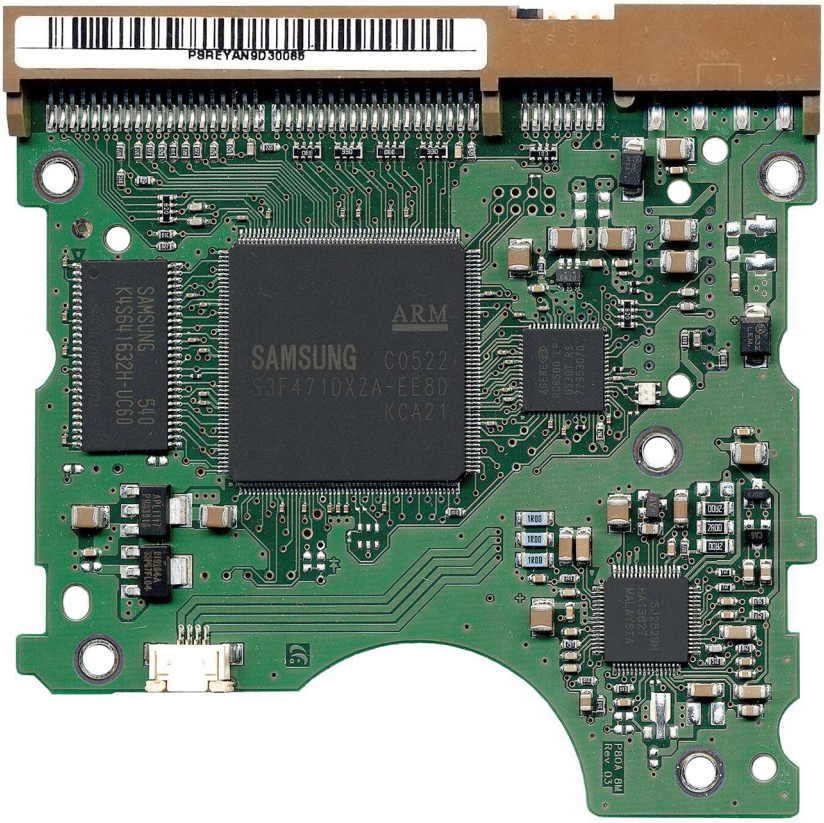

Fig.10.17. Control board in P80A drive family (REV.03).

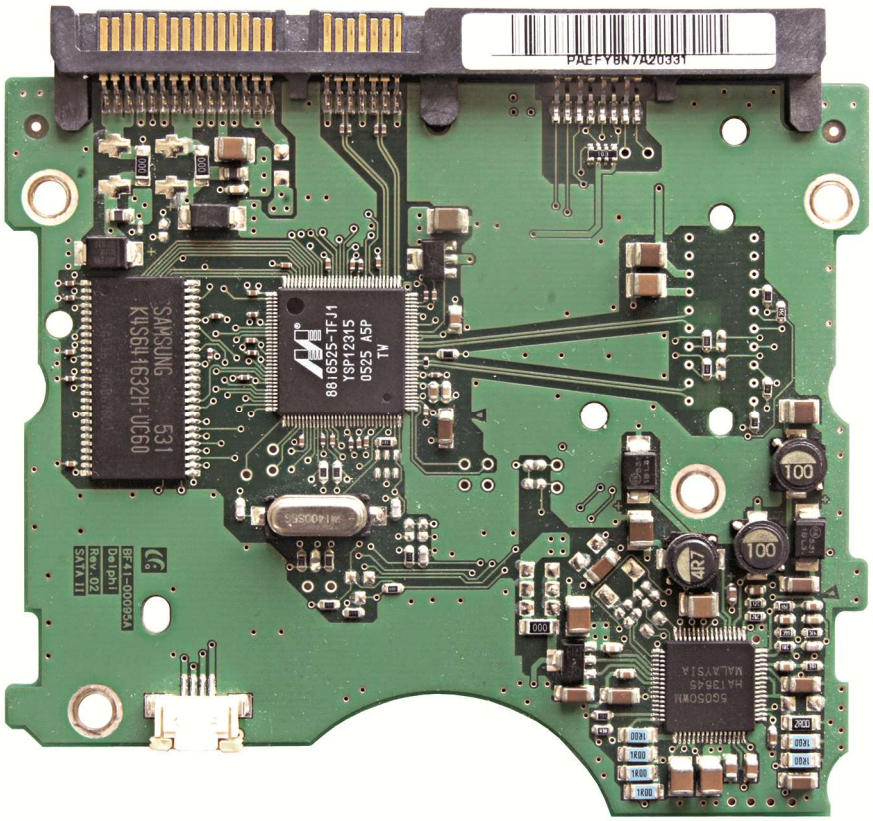

Fig.10.18. Control board in DELPHI drive family (REV.02).

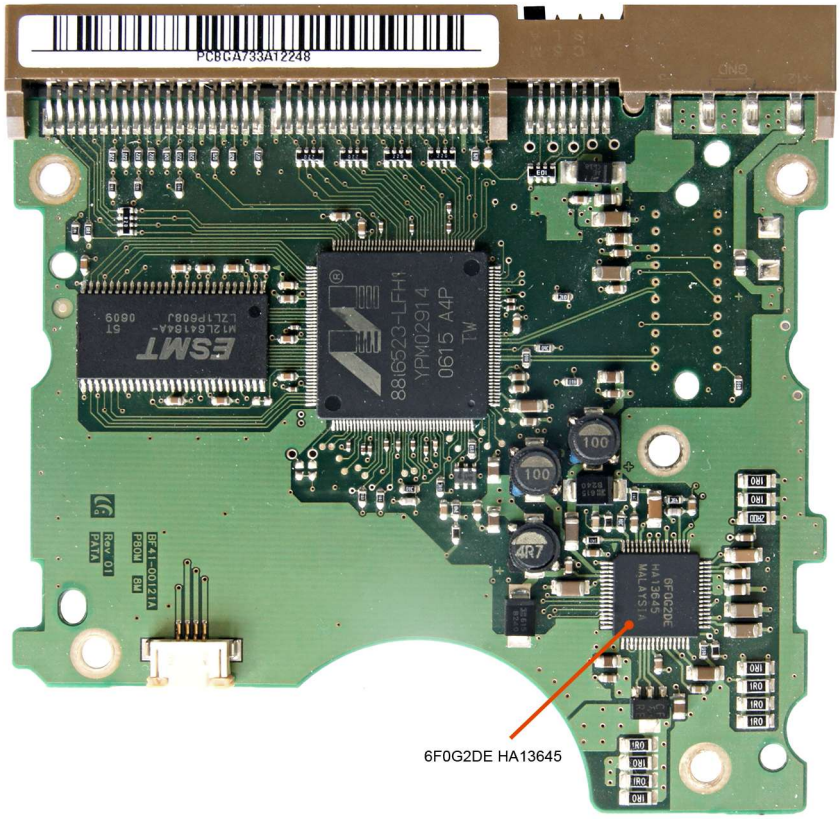

Fig.10.19. Control board in P80M drive family (REV.01).

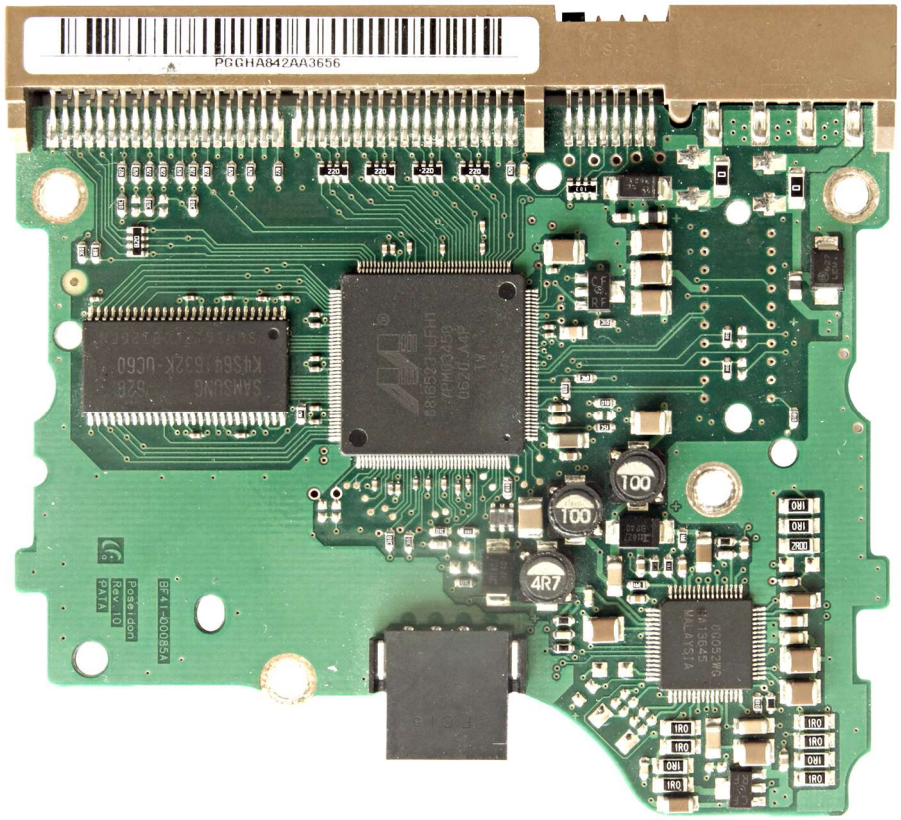

Fig.10.20. Control board in POSEIDON drive family with PATA interface (REV.10).

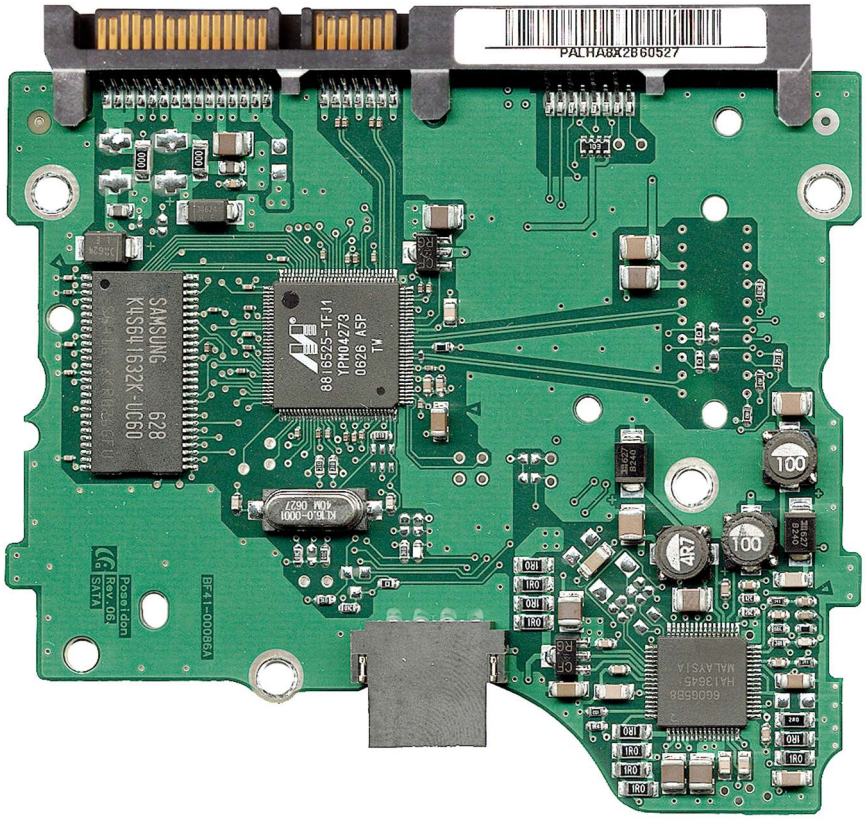

Fig.10.21. Control board in POSEIDON drive family with SATA interface (REV.06).

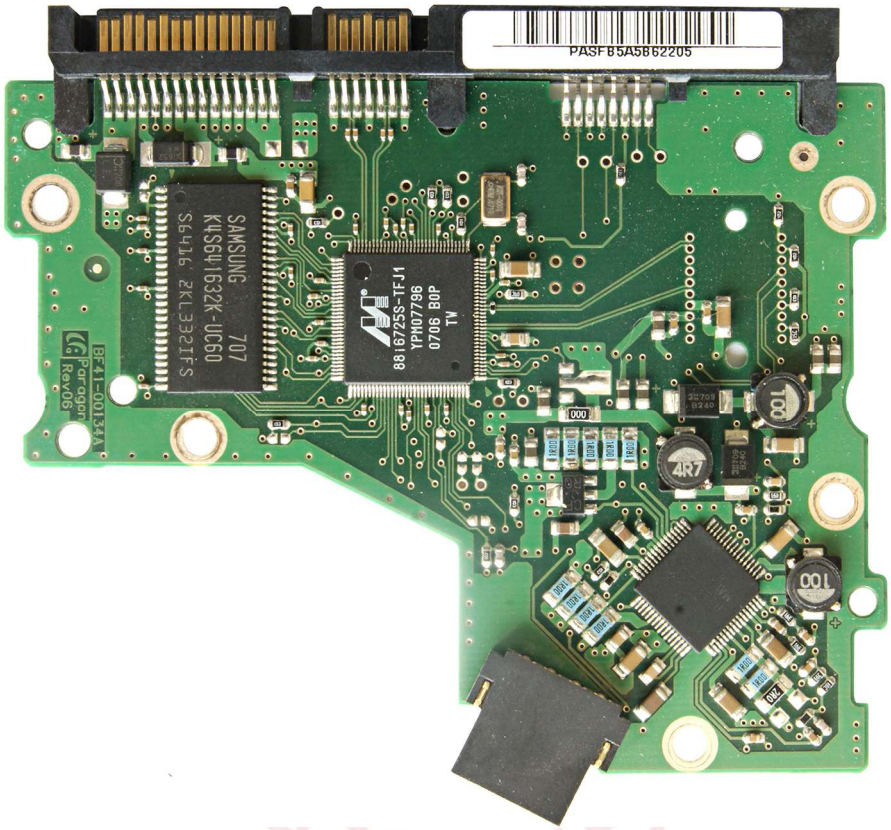

Fig.10.22. Control board in PARAGON drive family (REV.06).

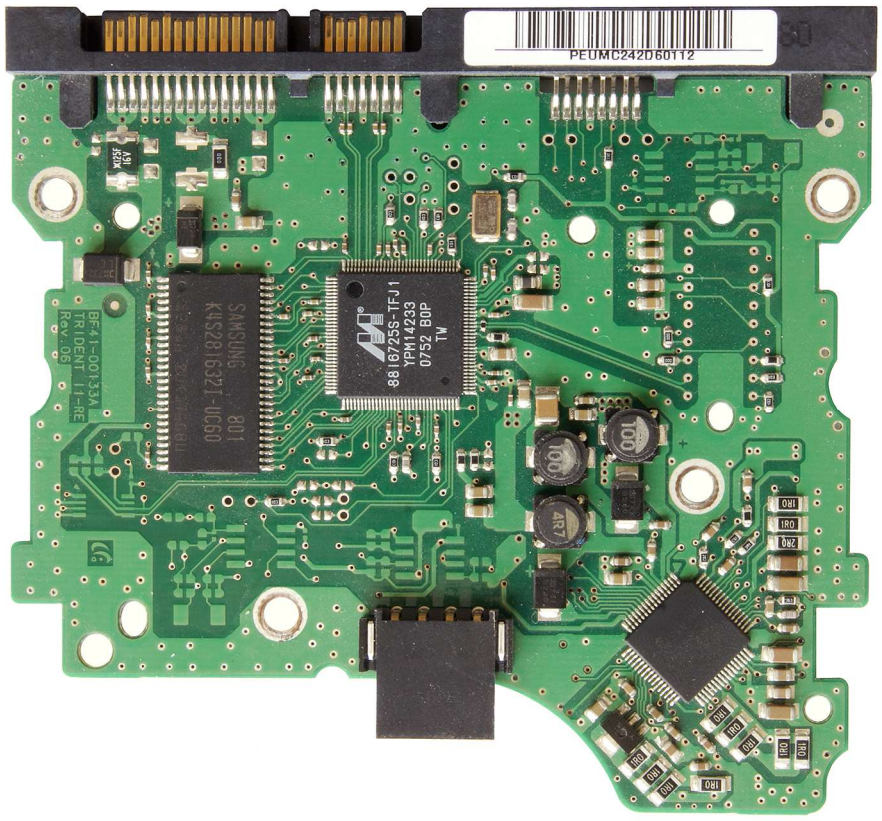

Fig.10.23. Control board in T166(S) drive family (REV.06).

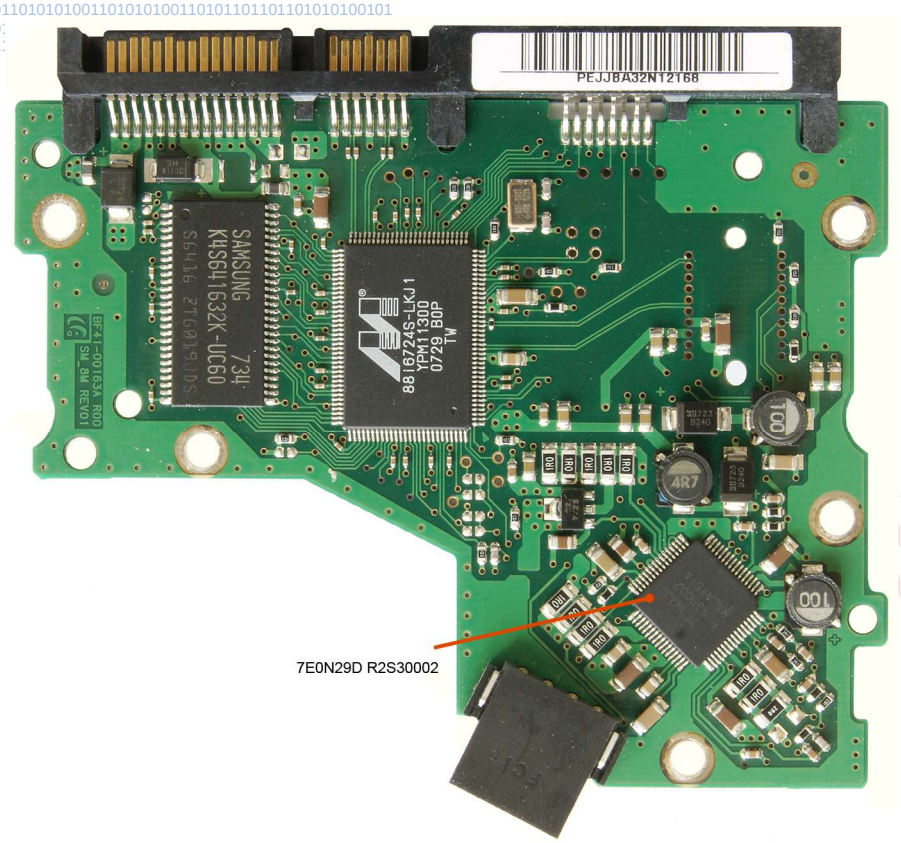

Fig.10.24. Control board in STORM2 drive family (REV.01).

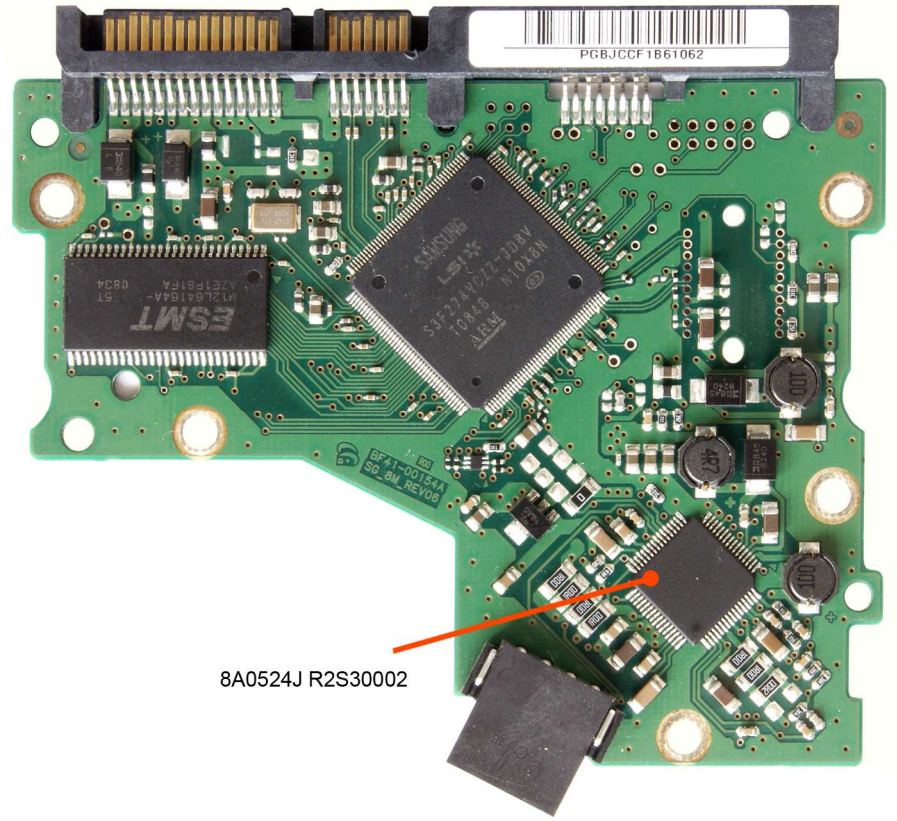

Fig.10.25. Control board in STORM2_G drive family (REV.06).

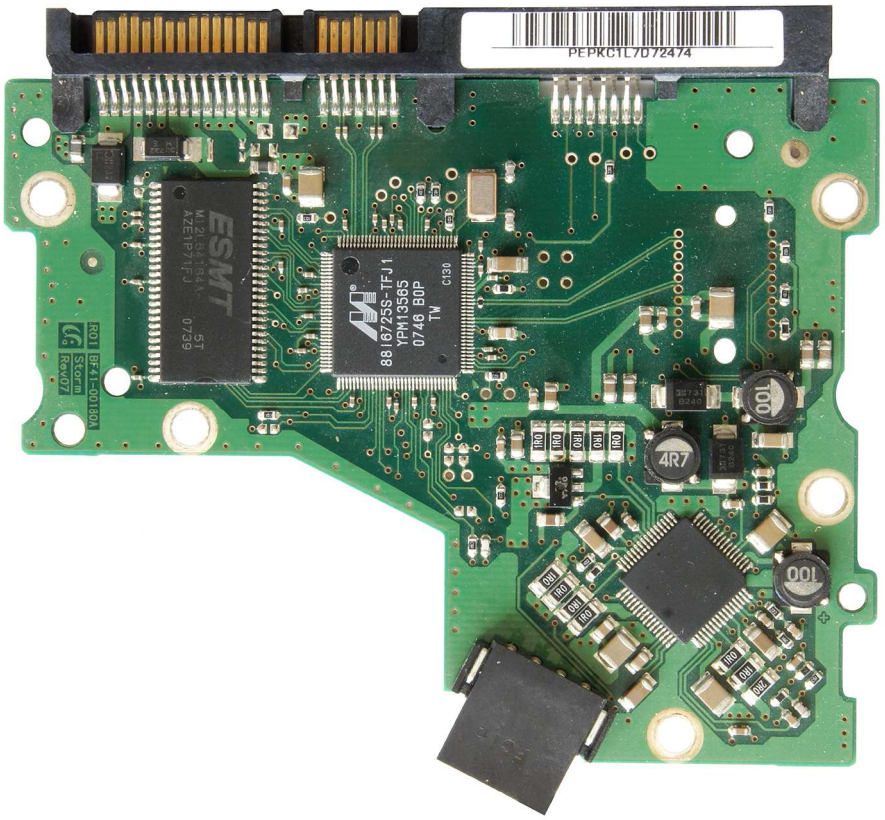

Fig.10.26. Control board in TRIDENT3 drive family (REV.07).

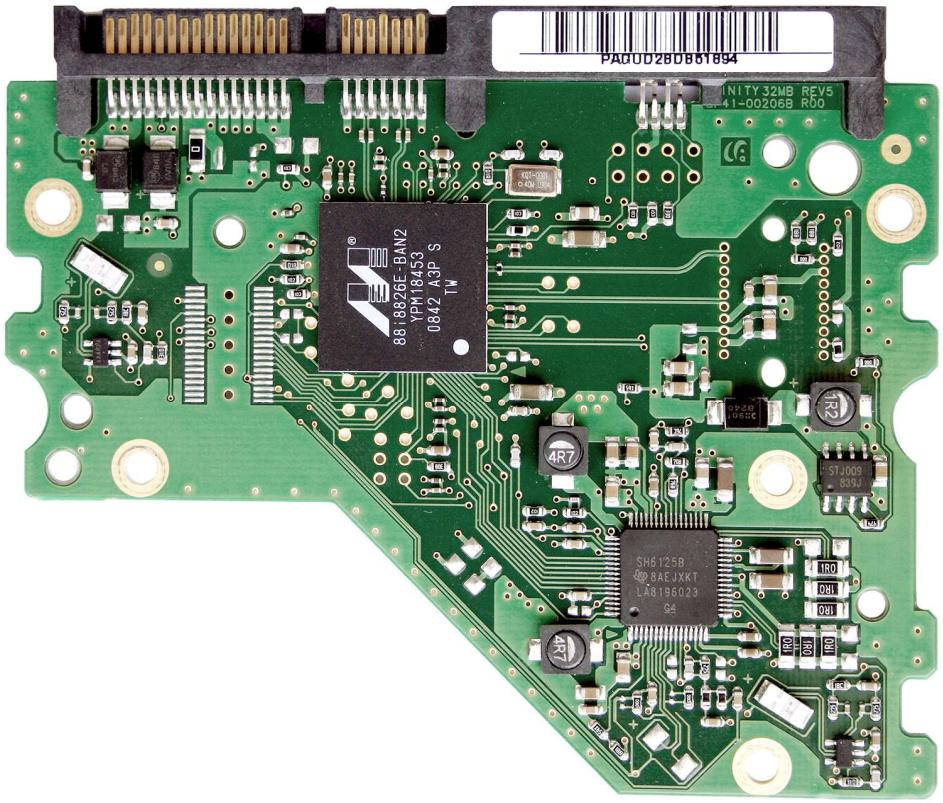

Fig. 1010.27. Control board in F1_3D and F2_EG drive family (REV.05).

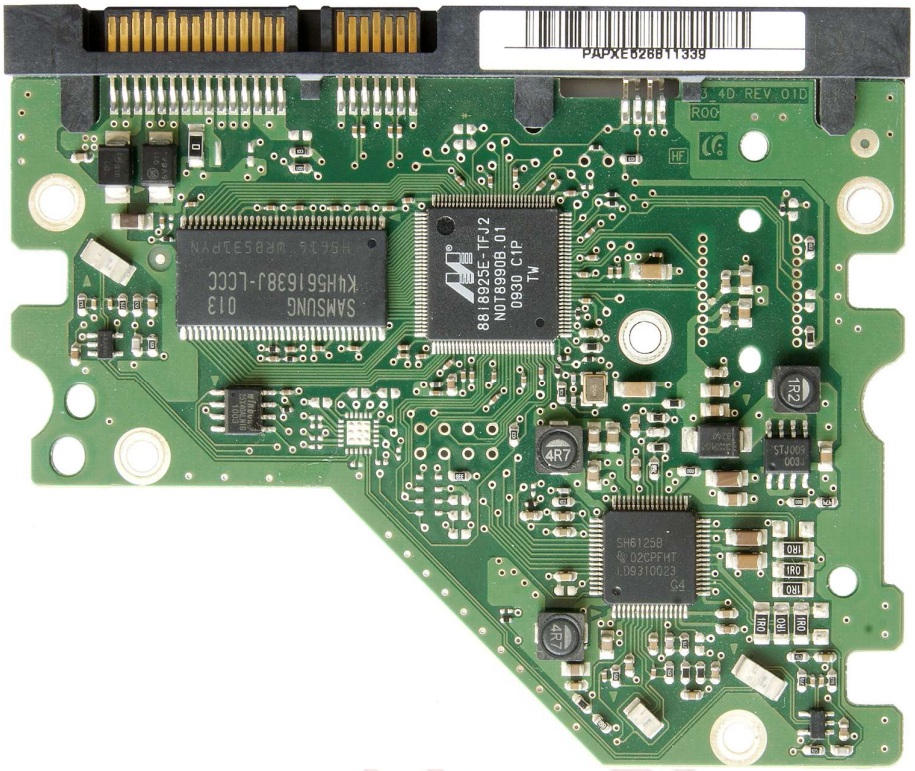

Fig.10.28. Control board in F3_4D drive family (REV.01D).

11. Appendix 2. Error Codes table of the drives with classical firmware architecture

Stop condition	Description
0x00	End of Program
0x02	Invalid Stop Condition
0x11	Bias force too high error
0x12	Seek error
0x13	Head Unlatch error
0x14	Bias calibration error
0x15	Spindle speed error
0x16	Spin-up error
0x17	Track zero not found error
0x18	NP-offset test result error
0x19	AB-slope test result error
0x1A	Total gain calibration error
0x1B	Loop gain calibration error
0x21	Head skew calibration result error
0x22	VCM bias force check result error

0x23	Seek time error
0x24	1 track seek time too long
0x25	1/3 stroke seek time too long
0x26	Full stroke seek time too long
0x27	Head switching time too long
0x28	Spin up time error
0x29	Latch force too low
0x2A	Too many pes error
0x2B	STW fail
0x2C	Servo defect in maintenance cyl
0x2D	Excessive servo defect per zone
0x2E	Excessive servo defect per drive
0x2F	Too many gray error
0x31	Too many real servo dfct per drive
0x32	Error logging over flow
0x33	Excessive defect per drive limit
0x34	Excessive defect per zone
0x35	Excessive defect per head
0x36	Excessive defect per track
0x37	No defect map exist
0x38	Defect free format error
0x39	Servo defects too close
0x3A	Too many scratch
0x3B	Too many dlist in buffer
0x3C	Too many ecc error
0x3D	Too many write fault
0x41	Error rate too high
0x42	Too many error during Gap Filling
0x43	Head compensation cal test is bad
0x44	Excessive soft error
0x45	Format error
0x46	Burn-In script error
0x47	RCO timeout error
0x48	Final test error
0x49	Continuous test
0x51	PCB not ready error
0x52	Load system table fail
0x53	Maintenance write error

0x55	Burn-In code version downlevel
0x57	Power-on initialization error
0x59	Bad killing head information
0x5A	IPC related error
0x5B	Maintenance read error
0x5C	Function test timeout error
0x61	CPU RAM error
0x62	Sequencer RAM error
0x63	Buffer Ram error
0x64	Flash rom error
0x65	Burn-in script error
0x66	Head unique test error
0x67	Serial number checksum error
0x68	Excessive TA error
0x69	Excessive seek error
0x6A	Servo ram error
0x71	FSAM error
0x72	FGRAY error
0x73	PES error
0x74	Index error
0x75	Head Margin Test error
0x82	BLPL Test Fail
0x83	Head unique test error
0x85	Excessive TA error
0x86	Excessive write fault error
0x87	Calibration error
0x88	Latch force too hign
0x89	Latch force too hign
0x91	Rco criteria system write error
0x92	Rco criteria system read error
0x93	Rco criteria not found
0x94	Rco header system write error
0x95	Rco result system write error
0x96	TF_Rco result system write error
0x97	Write boost optimize fail
0x98	Weak head test fail
0x99	Find test track fail

12. Appendix 3. . Error Codes table of the drives with Trinity firmware architecture

0x0000	End of Program
LATCH or Ramp Errors	
0x1102	All Head Fail
0x1107	Latch force too low
0x1108	Latch force too high
SPSTW (offline) Errors	
0x1314	Difference of bias calibration value is big; HSA bearing Fail
0x1510	Bias Seek Fail (only Head 0)
Servo_Calibration Errors	
0x1601	Bias calibration error
0x1602	Track zero not found error / Kt Fail (only Head 0 or 1)
0x1603	NP - offset test result was bad
0x1604	AB - slope test result was bad
0x1606	Loop calibration was bad
0x1607	Head skew calbration result was bad
0x1608	Head gap calibration is failed
0x1610	RRO 1x calib result was bad
0x1615	Difference of bias calibration value is big
0x1617	OD to ID Misalignment
0x1702	Seek error
0x1703	Spin up error
0x1704	Too many parking during process
0x1705	Spin up too long
Servo Defect Errors	
0x1901	Drive per servo vitual defect over
0x1902	Drive per servo defect over
0x1903	Drive per servo real defect over
0x1904	Drive per track defect over
0x1905	Zone per track defect over
MC Access Errors	
0x1A03	MC write error
0x1A04	MC read error

H/M Screen	
0x1B01	Error rate too high
0x1C01	TPI test fail
0x1C02	MR tune to different from skew
0x1C03	Zonemap verification error (for downsize)
0x1C04	Force downsizing
0x1C05	Force downsizing
0x1C06	Only for inline downsizing
0x1F01	Head/Media interference fail
0x1F02	Interfere test fail
0x1F03	Failed Amplitude Spike Test
0x1F04	WII Test Fail
0x1F05	Thermal Decay
0x1F06	Head Degradation screen
0x1F07	BIG diff AGC between tracks
0x1F08	HDI problem
0x1F09	Bad CSM defects OD
0x1F0A	Bad CSM
FOD Errors	
0x2101	Write Error when HSC test
0x2102	Read Error when HSC test
0x2103	FOD resistance test before FOD touch down test
0x2104	FOD TD fail: channel table verify failure
0x2105	HSC FH Error when screen
0x2106	HSC TCC Error when screen
0x2107	WPTP Error
0x2108	FOD TD fail: too high fluxion
0x2109	Out of TD test range
0x210A	FOD Resistance Bad
0x210B	MC read error during FOD test
0x210C	MC write error during FOD test
0x210D	FH one step difference is too big
0x210E	No good zone
0x210F	FOD TCC make fail

Timeout Errors	
0x2201	SLOW Run Error
0x2202	Cont Test
0x2203	Timeout Error
0x2204	Too many retry errors
0x2205	IPC related error
0x2206	Function test timeout error
Process Misc Errors	
0x2301	Channel calibration fail
0x2303	O Pattern write fail after RCO
0x2304	Read Screen Error
0x2305	Failed compiling
0x2306	Unrecognized Opcode (opcode cmd function not available)
0x2307	Script Error
0x2308	Firmware Assert
0x2309	2nd Downsize Error
0x230A	5400 rpm DownSpeed Criteria: Zone Cutting Bug
0x2353	5400 rpm DownSpeed Criteria: Zone Cutting Bug
Version Mismatch	
0x2501	Overlay version incorrect
0x2502	Wrong code download
0x2503	Serial Number checksum error
0x2504	Overlay Error
0x2505	New ID
0x2506	Overlay Checksum Error
0x2507	Can't find MRR look up table
Defect Overflow	
0x2801	Error log in full
0x2807	Linear scratch
0x2809	Too many DLIST in buf
0x2810	Too many write errors
0x2811	Too many sequential track errors
0x2812	Too many bad tracks
0x2813	Defect in cylinder zero

0x2814	Capacity check error
0x2815	VLIST SF overflow
0x2816	TNU per head overflow
0x2818	Login full MC
0x2819	Too many SLIST
IC(preamp, channel, engine, FFS)	
0x2A01	Preamp is out of order
0x2A02	Preamp voltage regulator error
0x2A03	Chip rev error
0x2A04	NLS Register error
0x2A05	Linked List Register error
0x2A06	Free Fall Sensor is out of order
Ram/Buffer	
0x2B01	CPU RAM error
0x2B02	SEQ RAM error
0x2B03	BUF RAM error
0x2B04	Flash error
0x2B06	Servo SPIRAM/YRAM/XRAM error
0x2B07	ECC RAM_ERR
0x2B08	Hybrid ONENAND flash error
0x2B09	BufferAlloc reuturned NULL
OEM screen	
0x2C04	Drive per track defect over
0x2C05	Too many parking during process
0x2C07	TPI test fail
0x2C0C	Screen moszt OD