Hitachi-IBM

Drive families: DTLA, AVER, AVVA, AVVN, AVV2, VLAT PLAT, ATDA, ATCS, ATMR, HTS548, HTS726

Contents

1. Purpose

As a part of the PC-3000 hardware and software suite for Windows, this utility can be used for service maintenance of hard disk drives manufactured by HGST (subsidiary of Hitachi Ltd.) using the technology received from the IBM HDD production branch acquired by Hitachi in 2002; the utility also supports IBM hard disk drives produced earlier.

2. Basic options for repair of Hitachi-IBM

1) Drive testing in factory (techno) mode

2) Restoration of the drive firmware

3) Checksum reading, writing and recalculation for NV-RAM (serial Flash ROM of the drive containing the head-and-disk assembly settings)

4) Removal of ATA password security lock

5) Reviewing and checking of the service data structure (available in an interactive mode as well)

6) Reviewing the P-List table of hidden defects

7) Resetting of S.M.A.R.T. and error logs.

3. Preparing for work

While preparing for work, please pay attention to the jumper settings of the drive and PC-3000 tester board. The utility functions in master mode.

Attention! The utility does not support the Native Hitachi drive families; it is designed exclusively for HDD based on IBM technology!

2.5" drives must be connected via the PC-2" adapter. All discussed HDD have no serial ports, therefore the TxD and RxD jumpers on the adapter can be set to a position matching a drive of any other manufacturer or to safe mode (please refer to section 9.2 for details), when it is necessary.

4. Architecture review of Hitachi-IBM HDD

4.1. Drive firmware

Firmware of Hitachi-IBM HDD consists of microcode in ROM, configuration data in NV-RAM and firmware overlays (stored in SA or Ovl-SA[1]) as well as the data recorded in the service area of a drive. Firmware is described by its version number and firmware version code (see Fig. 4.1). Firmware version number determines the microcode development while its version code actually represents a build (revision) number.

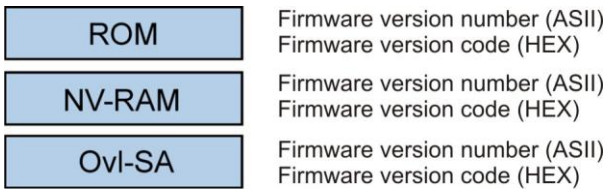

Fig. 4.1. The structure of drive service information in Hitachi-IBM.

[1] – Some HDD, e.g., the ATDA drive family, have no NV-RAM.

Firmware is stored in masked ROM, which therefore cannot be modified. All firmware modifications are added to NV-RAM + SA overlays. Thus IBM design teams adopted the following rule: only firmware version NUMBER gets changed while the firmware CODE remains invariable. The change affects not the whole number, but the last pair of characters only. E.g., if the firmware version number has been A46A prior to modification, then after an update the version will be changed to A4xx, where xx stand for two other characters.

Attention! Replacement with firmware from another drive family is not allowed.

Thus, the sets (ROM + NV-RAM + SA overlays) of firmware data will be compatible if they meet the following requirements:

- Firmware version CODE is identical for ROM, NV-RAM, and SA overlays
- μ - codes in NV-RAM and SA overlays match
- Firmware version NUMBER recorded in ROM may differ from the number for NV-RAM and SA overlays in the last pair of characters only.

Hitachi-IBM drives, similarly to HDD of other vendors, support the ATA command 92h, which is frequently referred to as loader start. The command may be employed exclusively for updating of the firmware version. It cannot be used for drive start in case of serious corruption in the service area. The current utility version does not feature an implemented support for loader start.

Two or three ROM chips are present on the PCB:

1) ***Masked ROM*** integrated with the processor. It contains the executable processor code and default setup values.
2) ***Flash ROM with serial access – NV-RAM.*** It contains setup parameters for access to the drive's firmware zone. Its size may be 256, 512 or 1024 bytes depending upon drive family.
3) The third ROM chip is not always present on a PCB. Those Flash ROM chips were used in sample testing shipments of drives with firmware recorded in serial Flash ROM instead of a masked ROM, the method allowed correction of errors in ROM code. The socket for that chip is located near NV-RAM. Its size is 1 Mbit, type – 25FV101T.

4.2. Compatibility of electronic printed circuit boards

Compatibility of PCBs can be conveniently identified using the label at IDE connector[1] or, in case of 2.5" drives, on the PCB (see Fig. 4.2). If the first symbols in the first two lines match, electronic parts are mostly compatible and are completely interchangeable. Precise identification of compatibility can be performed using the information from ROM or NV-RAM[2].

Fig. 4.2. Electronics PCB label at IDE connector.

NV-RAM contains the map of drive heads. Therefore PCBs from different models belonging to the same drive family turn out to be incompatible. In order to adapt a PCB you should record NV-RAM from a corresponding model into it. Besides, in that case the masked ROM version in the processor should match the version in NV-RAM and service area modules.

You can review the version of PCB firmware using the «Utility status» command. For 3.5" drives the version (μ - code in IBM terminology) will look like: ER2OA41A, where ER is the drive family code[3], 2 – means the number of physical heads, A41A – represents the actual firmware version number. In 2.5" drives the version consists of the firmware version only. The basic firmware version and its version code can be reviewed from ROM. The feature will be

[1] – The code from IDE connector label is also recorded in the PIDM «open» module.

[2] – Since NV-RAM may become corrupt or overwritten incorrectly it is safer to rely on information stored in ROM.

[3] – All supported drive families are listed with their codes in the parameter tables in Chapter 9.

implemented in the next version of the utility. Basic version here means the firmware set with the smallest number for a given ROM actually recorded in that ROM chip.

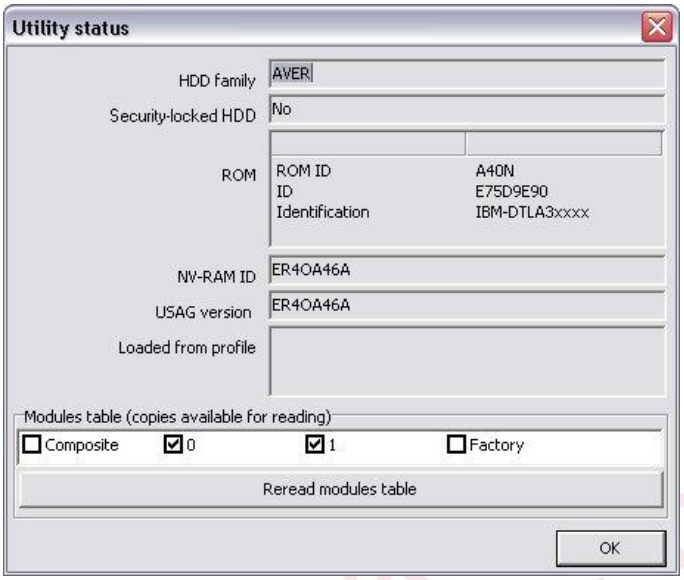

Fig. 4.3. Viewing utility status.

4.3. Service data modules

Similarly to many other drives, firmware in Hitachi-IBM HDD is recorded within service tracks allocated to a separate zone, and consists of modules. The only considerable difference is the presence of non-volatile memory (NV-RAM) with serial access on a PCB; memory size is 256, 512 or 1024 bytes. The memory contains an additional service module with setup information adjusted for a specific model. One more difference is manifested in the presence of «open» firmware modules that can be read and recorded without switching the drive to techno mode. A considerable part of the «open» modules list is made up by modules from USAG/RESF (the main table of drive modules, which partly may be represented by aliases, please see the list further). Besides, the list contains additional modules used by the utilities supplied by the manufacturer for diagnostics of malfunctions. A large part of those additional modules is not necessary for drive functioning. Some spaces are just allocated for modules, but contain nothing, therefore producing an error at an attempt to read such space. All the main functional parts are located in a closed service area described in the USAG/RESF module. Please keep in mind that the modules listed in USAG do not occupy the whole service track although the drive loads firmware reading the track as a whole. Therefore the terminology pertaining to the procedure includes the so-called «spaces» on the main track, i.e. the areas which are not covered by any of the modules from the main modules table. If any of those spaces cannot be read, the drive will fail to initialize. A possible indicator of such case might be the «Error reading the table of open modules» message. If such service data corruption is revealed, the respective space has to be overwritten. The feature will be implemented in the next version of the utility.

The data in the service area can be subdivided into four categories:

- RSVD module, present in none of the tables containing modules; it marks the service track beginning.
- Modules listed in the USAG/RESF table. All these modules are critical for drive operation.
- Records that are not included into USAG/RESF table but participate in factory self-testing.
- A part of open firmware data, which does not intersect with the group of modules from USAG/RESF (the table of open modules contains, apart from the rest, references to a large number of USAG/RESF modules required for functioning of the manufacturer's testing utilities).

After the «Start SA checking» command is issued, the utility reads both the closed and open parts of service area. The «Read» label indicates whether a module could be read. The «Header» label demonstrates whether a module identifier in the table of modules matches its identifier found inside the actual module body. We should note that the table of «open» modules contains, apart from the rest, aliases of modules (for example, the main copy of the RDMT module in the table of «open» modules in named RDM1, and a copy thereof is called RDM2). The utility also contains a list of correspondences between names and aliases, and features automatic substitution of information for comparison.

The command also outputs the table of zone allocation and some other parameters. The purposes of some firmware modules are listed in tables 1, 2, and 3.

Service area has several copies and some areas, which are not described in USAG/RESF being used, however, in the factory Self Test routine. The current version of the utility does not support manipulations with those copies.

Table 1. Functional purpose of some «closed» modules in 3.5" drives.

Module identifier	Purpose	Importance
RSVD	Mark of firmware data beginning	B
USAG	Main modules table	B
CNSL	Module containing logical configuration of the HDD	B
DCOT	–	B
IDNT	Drive ID	B
MLBA	Module containing logical configuration of the HDD	B
OVR1	Module containing code overlays (SA overlays)	B
PSHT	Factory table of defects (P-List) / translator	Ad
PTCH	Module containing a table of firmware links	B
PTRT	–	B
RAM0	Module containing code overlays (SA overlays)	B
RDMT	G-List	Ad
RLBA	Module containing a table of G-List reserve	B
RWCN	–	B
SECI	Module containing password information	B
SERL	Module containing S.M.A.R.T. error log	B
SMRT	Module containing S.M.A.R.T. values	B
SRIF	Module that controls Self Test launch	B
SRVM	Table of defective cylinders and servo adaptive data	Ad
SRVP	–	B
CHNM	–	B
ZONE	Zone allocation table	Ad

Table 2. Functional purpose of some «open» modules.

Module identifier	Purpose
RDM1	Alias of RDMT
RDM2	Copy of RDMT
PIDM	Module containing information from the labels on PCB and HDA
PDM1	Alias of PSHT
PDM2	Copy of PSHT
DDD0	Log of DDD utility
ELG1	Log of the drive defects table.
EVLG	Event Log

Codes of the «Importance» column in Tables 1 and 3:

- A – essential module for a specific HDD: As – adaptive settings, Ad – translator tables. Replacement of the module with an identical module from another drive will result in the loss of reading/writing settings and data loss (e.g., adaptive data modules).
- B – the module is necessary but it but can be replaced with one from another drive. Usually version and model match is required.
- C – the module is necessary but partial module corruption does not prevent drive from starting. The drive may correct module contents (recalculated automatically during the procedure of defects relocation) independently in certain circumstances.
- D – the module does not affect drive operability. The category usually includes informational modules.

Dd – original defect lists used to generate drive translator. «Dr» stands for techno Self Test modules.

Table 3. Functional purpose of some «closed» modules in 2.5" drives.

Module identifier	Purpose	Importance
RSVD	Mark of firmware data beginning	B
RESF	Main modules table	B
ABLD	–	B
ABLP	–	B
CHNL	–	B
CNS1	Module containing logical configuration of the HDD	B
DCOT	–	B
DUMP	Self Test log module	D
FLOG	–	B
ICES	Module containing password information	B
IDNT	Drive ID	B
MFGP	Module containing Self Test parameters	Dr
MISC	–	B
MLBA	Module containing logical configuration of the HDD	B
OVR0	Module containing code overlays (SA overlays)	B
OVR1	Module containing code overlays (SA overlays)	B
PESD	PES data log	D
PNID	Module containing information from the PCB label	D
PSHT	Factory table of defects (P-List) / translator	Ad
PTCH	Module containing a table of firmware links	B
PTRT	–	B
QMCN	–	B
RAM0	Module containing code overlays (SA overlays)	B
RDMT	G-List	Ad
RELI	–	B
RWCN	–	B
SERL	Module containing S.M.A.R.T. error log	B
SMRT	Module containing S.M.A.R.T. values	B
SN00	Serial number of the HDD	B
SPRE	–	B
SRIF	Module that controls Self Test launch	B
SRST	Self Test report	C
SRVM	Table of skipped defective cylinders and servo adaptive data	Ad

SRVP	–	B
SSST	–	B
SSTL	–	B
ZONE	Zone allocation table	Ad

During firmware analysis you should keep in mind that there is no checksum in the modules, therefore it is quite difficult to identify structural corruption of firmware modules.

IBM drives can read and record firmware data with a partially initialized PCB (initialization from NV-RAM is required; firmware loading from the service data area is not necessary for manipulations with modules), therefore if some modules in a drive cannot be read, such problem can easily be identified after looking through a report on the service area structure.

4.4. Translator

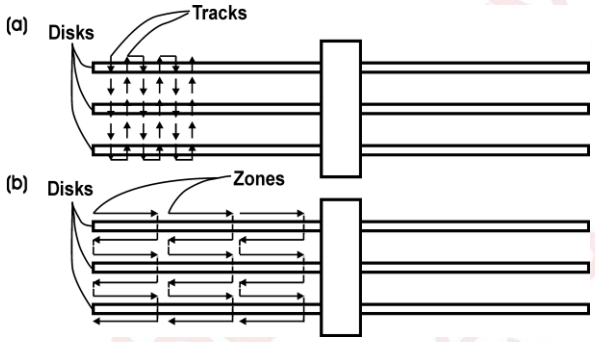

Fig. 4.4. Translation schemes.

Hitachi-IBM drives use two types of translation (see Fig. 4,4): cylinder (A) and zone (B) translation. «A» translation type is used in 3.5" drives while «B» type is employed in 2.5" HDD.

4.5. Critical modules for drive data

The following are modules essential for drive data in Hitachi-IBM drives: PSHT, RDMT, SRVM, ZONE, CNSL, and MLBA (see Table 2). Besides, you should remember about the requirement of conformity to the heads map stored in NV-RAM.

5. Launching utility

During start, the utility sends to the connected drive a command to identify itself (read HDD ID) and then uses the returned data to determine automatically the family of the drive. If the identification data (model name) do not correspond to any of the drive families supported in the utility, then it displays the following message: «Cannot identify the HDD family!» If the information matches, the drive family radio button will be automatically activated in the appropriate position of the ***start-up dialog*** of the utility (see Fig. 5.1).

If access to user data is blocked with an ATA password, the start-up dialog will contain an active «Password unlocking» button. Please refer to section for details.

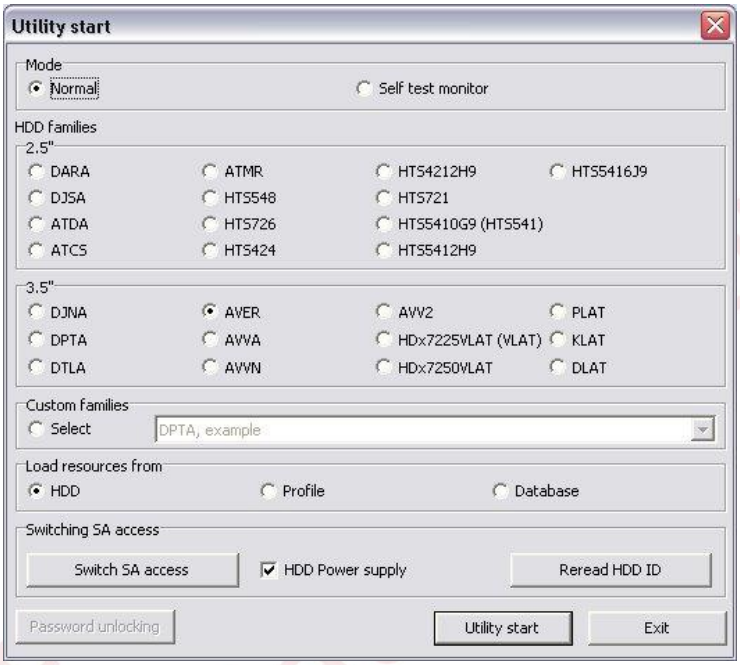

Fig. 5.1. Utility start-up dialog.

The start-up procedure for the utility offers two available methods: «Read resources from HDD» and «Read resources from DB». In the first case, the utility initializes using the connected drive. In the second case, it takes necessary data from its database instead of the service area of the connected HDD (except for NV-RAM). Start-up with the «Read resources from DB» option enabled actually eliminates access to the service area of a drive. It may be useful in situations when it is damaged, when such access causes the drive to hang or start knocking.

Manual selection of drive family is activated automatically if the utility fails to identify the family of the connected HDD. For Hitachi-IBM you can choose the configurable <Custom> family introduced for handling of new drive families that the utility does not support yet or if you encounter drive firmware, which is not completely compatible with the utility settings. Appropriate configuration is possible through a special IBMOverride.ini file copied automatically during setup. The ini file can be edited directly or within graphical interface of the utility. In the latter case you have to select the basic drive family in the custom list, enter the utility, open its settings dialog and then proceed to the special settings dialog.

Attention! Modification of IBM Override.ini is recommended for experienced users only.

Attention! If a key differs in its parameters or the mechanism of its generation from all existing base and custom drive families, you will have to create manually in the ini file a new section based on the closest family and then complete configuration from the utility settings editor.

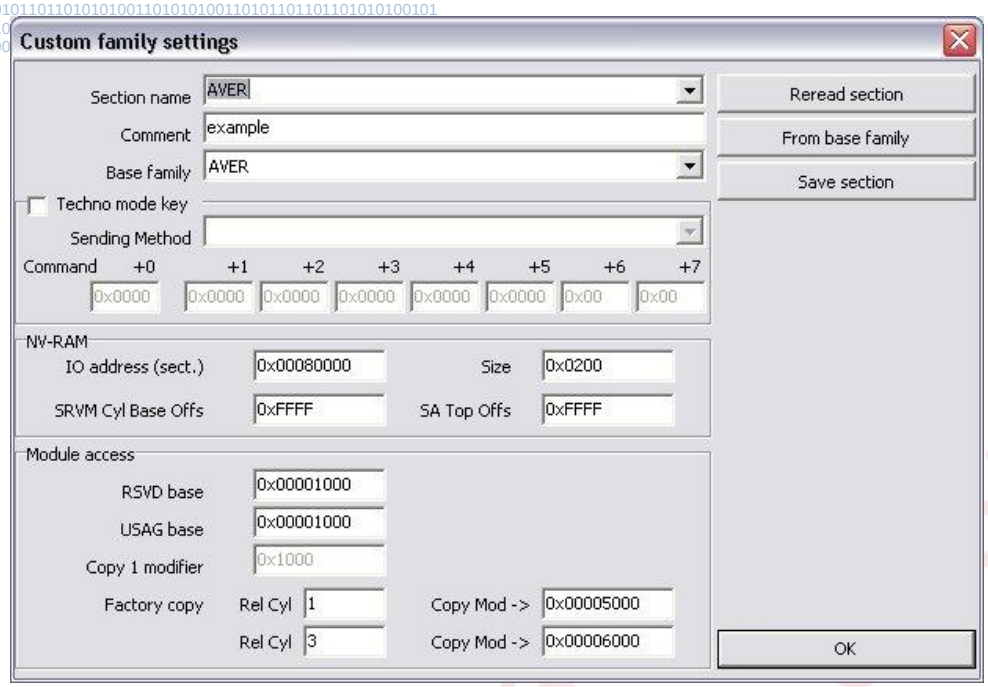

Fig. 5.2. Custom drive family configuration dialog.

- ***Section name*** defines the section title in IBMOverride.ini.
- ***Comment*** – a user-defined explanatory string.
- **Base family** – one of the main drive families supported in the utility. It will be used as a basis for parsing of some firmware data (NV-RAM, zone allocation table, defect lists....).
- ***Techno mode key*** is the ATA command enabling HDD to accept factory mode commands. 3 types of command generation are available:
  - **for LBA28** («short» command variant using just the registers employed in LBA28 commands)
  - **for LBA48** («long» command variant using directly word registers employed in LBA48 commands)
  - **for LBA48(bridge)** (bridge) («long» command variant with higher parts of word registers used in LBA48 commands transferred in a separate command). The variant for LBA48(bridge) is used to send factory mode commands to SATA drives equipped with Marvell PATA to SATA bridge chip.
- The ***NV-RAM*** field allows you to define the parameters of NV-RAM chip, such as: base address in the HDD address space and its size. Parsing of NV-RAM data is performed using the specified base drive family as reference.
- ***Module access*** – a group of controls regulating reading of service data modules from disk surface
- ***RSVD base*** – the main PBA part of the RSVD module indicating the main service track. It defines the module location in PCHS space (cylinder, head, sector) after conversion from PBA based on an appropriate formula.
- ***USAG base*** – the main PBA part of the USAG (RESF) module containing the principal modules table. It defines module placement in PCHS space (cylinder, head, sector) after conversion from PBA based on corresponding formula.
- ***Copy 1 modifier*** – the number added to PBA from the main modules table to produce PBA of a copy of that module. Actually it contains the increment to add to head or track number.
- The ***factory copy*** setting defines the parameters for address conversion into factory SA copy for two tracks of the main SA. The first parameter is relative cylinder number in the main SA (the utility calculates it using a special formula with the PBA module data), the second contains increment to add to PBA required to obtain the copy address. If the relative cylinder number parameter is -1, translation is not defined.

- The ***«Reread section»*** button reads a section from IBMOverride.ini (it allows discarding of accidental modifications before they are saved to the section).
- The ***«From base family»*** button copies some settings (such as NV-RAM location and size, modules translation into copies) from the base family settings within the utility code into the editor fields. Techno key parameters are not copied (the key is assumed to match the techno key of the base family).
- The ***«Save section»*** button stores modifications in IBMOverride.ini.

Please examine below a section of IBMOverride.ini created for a DPTA drive.

```
[Overrides]
DPTA = example
[DPTA]
BaseFam = DPTA
TechKeyExec = 28
TechKeyData = 300 03 37 03 57 03 A1 FF
NVR_IO_Base = 80000
NVR_ImgSz = 100
RSVD_Base = 1000
USAG_Base = 1000
ModuleCp1Mod = 1000
FactoryMod = 1 2000, FFFFFFFF FFFFFFFF
```

5.1. Removal of ATA password lock

The procedure of password unlocking in the utility is automated. During start-up, the utility reads the drive ID and determines whether the ATA password is enabled. If the password is present, then the «Password unlocking» button becomes active. No additional actions are required on the user's part to unlock a drive belonging to the DARA, DJSA, DTLA-5 or DTLA-7 families. In all other cases you will have to take some additional steps described below.

5.1.1. Removal of ATA password lock using the «ATMR, HTS548, HTS726» probe

Drive families: **ATDA**, **ATCS**.

Procedure:

1) Launch the utility while the locked HDD is connected.
2) Click «Password unlocking». The utility will power-off the drive.
3) Connect the probe (shown in the Fig. 5.3) to the pins corresponding to the drive's family (see section 9) and hold it there.
4) Click OK in the dialog «Set probe to the position shown in the manual, then click OK». The utility will power-up the drive. As soon as the drive reports on readiness, the utility will display a «Remove probe!» message.

Attention! There is risk of damaging the PCB, therefore please exercise caution while connecting the probe

5) Remove the probe, click OK.
6) Then the utility will unlock the drive. If the probe's contact with the PCB was unstable (then unlocking will be impossible), the utility will offer to repeat the attempt.

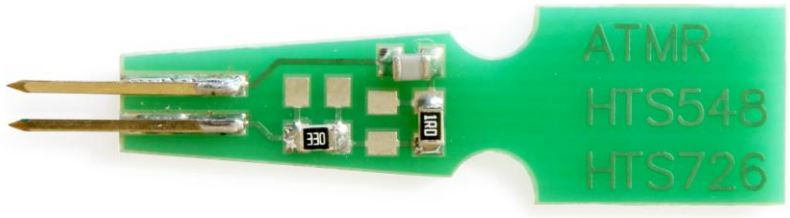

Fig. 5.3. Appearance of the «ATMR, HTS548, HTS726» prob.

5.1.2. Removal of ATA password lock using the SAFE MODE (3.5" HDD)

Procedure:

1) Launch the utility while the locked HDD is connected.
2) Click «Password unlocking». The utility will power-off the drive.
3) Set the jumpers on the HDD controller board to the AUTO SPIN DISABLE position in accordance with the on-board scheme at the interface drive connector.
4) After access restoration the utility will suggest that you return the jumpers back to the Master mode position.

5.1.3. Removal of ATA password lock using the SAFE MODE (2.5" PATA HDD)

Procedure:

1) Launch the utility while the locked HDD is connected.
2) Click «Password unlocking». The utility will power-off the drive.
3) Set the jumpers on PC-2" adapter to Safe Mode (see section 9.2).
4) After access restoration the utility will suggest that you return the jumpers back to the Master mode position.

5.1.4. Removal of ATA password lock using a short-circuit of NV-RAM contacts (2.5" SATA HDD, some PATA HDD families)

Procedure:

1) Launch the utility while the locked HDD is connected.
2) Click «Password unlocking». The utility will power-off the drive.
3) Then the utility will suggest to short-circuit NV-RAM contacts. You can accomplish that by soldering conductor wires to the corresponding NV-RAM pins (shown in the figure displayed in the prompt dialog) on the internal side of the board. You can check the location of the first pin in the section of chapter 9 devoted to the family of the drive in question. Besides, you can track the circuit from the specified pins to the external side of the board. As a rule, the data line of NV-RAM chip is passed to the external board side through a transition opening via two resistors. In that case the found transition opening should be grounded using any available conductor.

Attention! To ensure safety of NV-RAM content you can perform the following steps instead of the short-circuit procedure: unscrew the PCB from HDA when the utility displays its short-circuit prompt; and install it back and fix when the utility instructs you to remove the short circuit.

Attention! For PATA HDD you can set PC-2" jumpers to Safe Mode instead of NV-RAM short circuit (see section 9.2).

4) When the utility completes operations required to connect to the drive, it will instruct you to remove the short circuit.

6. Utility features

Specific features of the utility can be invoked from the «Tests» and «Tools» – «Utility extensions» menus. All other features are shared with the universal utility (please see the manual for the universal utility).

Table 4. Hot keys for utility-specific features.

Mode	Hot key
Modules table	[Ctrl]+[Alt]+[1]
View service information objects	[Ctrl]+[Alt]+[2]

6.1. The «Tests» menu

6.1.1. Utility status

The command displays the selected drive family together with information about NV-RAM version and USAG/RESF (see Fig. 4.3), as well as the list of loaded Offline start resources (if you have selected utility start using the resources from DB).

6.1.2. Service information

6.1.2.1. HDD resources backup

The command allows you to save the following parts of firmware from the connected HDD to its profile: NV-RAM, modules, offline start resources. The feature is useful for creation of a backup copy for the firmware from the drive being repaired prior to making any changes.

6.1.2.2. Work with NV-RAM

- ***Reading/Writing.***

Attention! The utility does not correct the checksum automatically while writing data in drives belonging to the families which do not feature ECC for writing operations. You can correct the checksum using a plug-in for the HEX editor (6.2.2).

- ***NV-RAM visual editing.*** The mode is used mostly for diagnostics of drive heads and temporary SA switch to other physical heads during HDD initialization (after which heads map in RAM is returned to the standard format for access to data).
- ***NV-RAM adjustment (SA search).*** The feature is used when the original NV-RAM content gets lost. The utility performs a special procedure to allow access to the SA, then you can start searching the area for the native NV-RAM image.

6.1.2.3. Reading ROM

The utility features ROM reading only because drive means do not allow its recording. The menu item is necessary because a HDD can lose the content of on-board Flash ROM. In that case the ROM chip content should be recorded in a programmer device using a library of previously recorded ROM data. The required version can be identified by NV-RAM content.

6.1.2.4. Work with SA

- ***Start SA checking.*** The test helps estimate the validity of the data written in the service area. The feature generates a check report.
- ***Modules reading/writing.*** You can use reading and writing procedures to save or overwrite all service area modules (described in the modules table) within a single copy. However, the firmware set includes some additional data missing in the list, for example, factory copy of the service area or copies of modules.

- ***HDD configuration editing.*** The mode allows you to edit the following ID information and settings:

1) firmware version returned with the drive ID
2) model
3) serial number
4) maximum LBA
5) enable/disable automatic reassignment of defects.
6) The utility also displays the following parameters:
7) Part Number
8) PCB ID

6.1.2.5. Work with DB

- ***HDD resources export*** allows you to extract from your database modules as files for subsequent import. The feature supports filter-based search for necessary resources.

- ***Resource master copy creation in DB*** allows you to create a master copy in the database. It is recommended for storage of sample firmware data from functioning drives, which will be available then for repair of other HDD.

6.1.3. HDD formatting

This command transfers grown defects from G-List to P-List with subsequent surface formatting. Formatting borders are specified in ABA notation without consideration of defective sectors. Thus, to format the entire surface, you will have to specify ABA range from 0 to drive capacity + total number of defects relocated in P-List. Such method allows detection of globally damaged surface areas because the factory formatting command terminates with an error when it encounters such locations.

6.1.4. Logical scanning

The procedure allows both analysis of surface condition with detection of defective areas and relocation of defects.

Attention! If Autoreassign feature is enabled in a HDD, global damage to user data is possible if the drive has reading or writing problems. That probability is determined by a specific algorithm used for reassignment of defects to G-List.

6.1.5. Defect list

- ***View Cylinder defect list table.*** This command allows viewing of the cylinder defects listed in the SRVM module.

- ***View P-List.*** This item allows viewing of drive P-List using the standard command for listing of existing defects.

- ***Move G-List to P-List.*** This command transfers grown defects from G-List to P-List using the corresponding factory command.

- ***Edit RDMT.*** This command allows viewing and editing of drive G-List. This version does not process the relocation index because the command should only be used before a command for G-List transfer to P-List for editing of the current list of autoreassigned defects and their manual addition.

- ***Edit PSHT.*** This command alows viewing of drive P-List parsed by the utility directly from the PSHT module. Full-featured editing is not supported in this version yet.

6.1.6. Reset S.M.A.R.T.

The command returns S.M.A.R.T. attributes to their default values. Similarly to many other drives, S.M.A.R.T. reset does not affect the number of reassigned defects created directly in G-List.

6.2. The «Tools» menu

The «Tools» menu traditionally contains a standard selection of dialog modes described in the universal utility and some specialized modes for work with Hitachi-IBM drives accessible in the «Utility extensions» mode.

6.2.1. Modules table

The mode (see Fig. 6.1) includes all features necessary for interactive restoration of the service area, i.e. the process of structure analysis is combined with the process of restoration. It can be invoked from the menu «Tools» – «Utility extensions» – «Modules table».

The following features are available in the context menu or the appropriate toolbar:

- ***Module viewing*** – opens a HEX editor window with the contents of the selected module. If the module contains unreadable sectors, no data will be loaded for reviewing.
- ***Start SA testing*** – initiates the process of reading modules and analyzing their structure, then it fills the fields that describe module status. You will have to select the modules for testing before start.
- ***Terminate process*** – terminates the structure testing process or module reading.
- ***Rewrite module from DB*** – allows you to overwrite a single specified module using the data from your database.
- ***Write modules group from DB*** – allows you to overwrite several specified modules using the data from your database.
- ***Write modules group from HDD profile*** – allows you to overwrite several specified modules using the data from your current drive's profile.
- ***Show log*** – the switch enables/disables the window containing a log of module structure test.

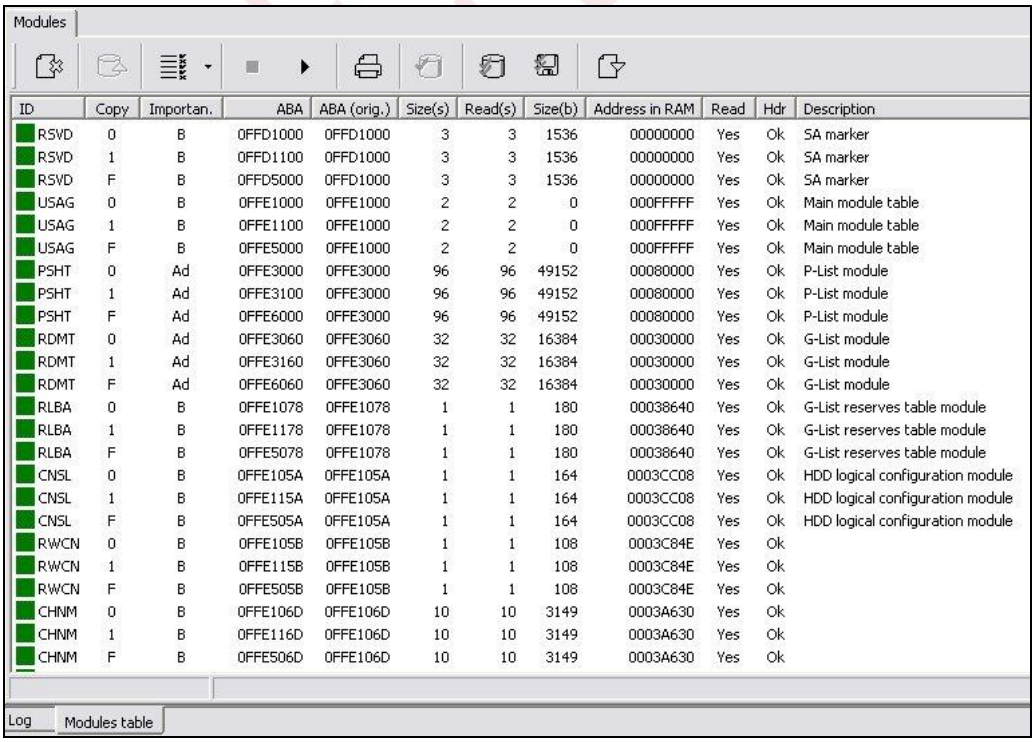

Fig. 6.1. Modules table.

6.2.2. Service information objects

This section contains features useful for viewing of service data modules, NV-RAM content and controller RAM (see Fig. 6.2). The system of extensions (plug-ins) allows you to recalculate ECC for NV-RAM taking into account the selected drive family because various families utilize different calculation algorithms.

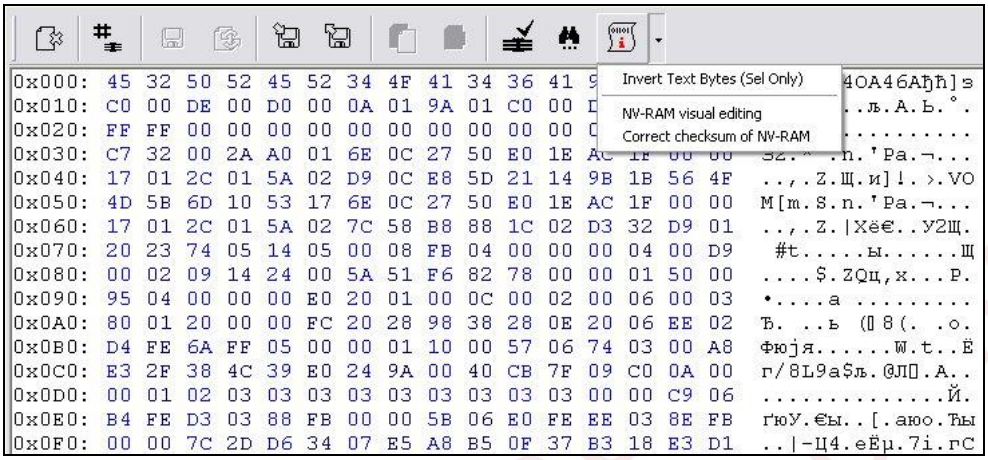

Fig. 6.2. Viewing service information objects.

6.2.3. Self Test

Self Test is a part of drive firmware intended for internal HDD testing and configuration. In IBM drives the Self Test procedure performs fine-tuning of adaptive drive parameters and multi-pass scanning of disk surface with registration of defects. The first pass is used to scan the service area, the second handles the user data area checking it for locations that should be added to cylinder defect list (if the drive family supports such list), the third pass adds revealed defects to P-List.

Attention! Self Test procedure destroys user data!

Attention! It is essential to leave the drive powered-on throughout the whole Self Test procedure. If you interrupt the self-testing routine by switching power off, then after next power-on the Self Test procedure will start with invalid parameters because some of them are stored in drive RAM. Therefore an incorrectly started Self Test should be interrupted using the «Stop Self Test» command with a subsequent test restart.

Attention! Self Test registers just some of the defects due to its specifics. Thus, after Self Test completion you will have to format the drive with a subsequent standard procedure for detection and reassignment of defects.

Self Test control and monitoring are performed within a special wizard accessible from the «Tools» menu. However, if Self Test is already running, you should launch the utility in Self Test monitoring mode directly from the start-up dialog. The requirement is determined by the fact that during Self Test a HDD does not process ATA commands and thus normal utility launch is impossible. The appearance of the Self Test control and monitoring dialog is shown below.

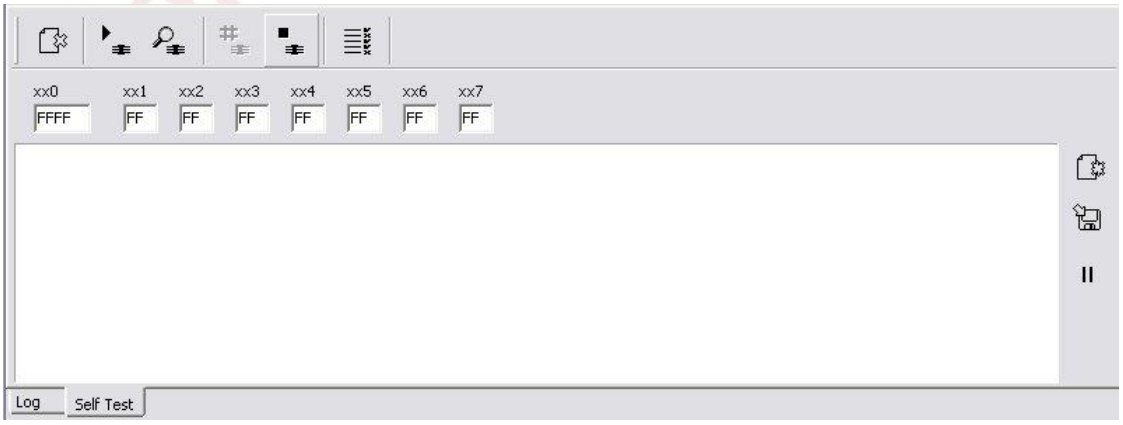

Fig. 6.3. Self Test control and monitoring dialog.

Purposes of toolbar buttons.

 – Close the Self Test control and monitoring wizard.

 – Start Self Test

 – Start Self Test monitoring

 – Terminate Self Test progress monitoring

 – Stop Self Test

 – View Self Test results

 – Display HDD status progressively

– Additionally, the section reflects the ATA registers of the drive being tested.

Self Test results viewing feature displays wizard log containing the Setlf Test status word and Self Test termination error code. The following status words are possible:

- «COMPFIN», «COMPLETE» – Self Test completed successfully.
- «ABORTED!» – «SELF TEST» completed with an error.
- «SELF TEST» – «SELF TEST» has not been completed, the utility forced it to stop.

Please see below some Self Test error codes:

Code	Description
00 00	Self Test completed successfully.
01 01	problems in service area – writing error, heads malfunction, surface scratches.
02 02	problem with head(s): incompletely operational, hit, bent, etc.
06 02	P-List overflow

If Self Test terminates with an error, you can attempt to restore HDD manually using the standard procedure for detection and reassignment of defects (of course, in cases other than P-List overflow).

7. Diagnostics of malfunctions

The task of Hitachi-IBM drive repair requires, first of all, precise diagnostics of malfunction, preferably without HDA disassembly; with simultaneous minimizing of further damage to the drive or data loss. Malfunctions, just like methods of diagnostics can be subdivided as follows:

- PCB malfunction.
- Motor/bearing failure.
- Parking element failure.
- Failure of one or more reading/writing heads.
- Damaged heads and surface scratch.
- Split glass plates (the malfunction can be easily identified by typical noise).

- BAD sectors.
- Instabilities of reading/writing.
- Complete or partial loss of service information.

When the scope of problems is identified, it is time to begin diagnostics. What of the above has happened?

7.1. Step 1: electronic components.

Let us begin with the electronics board. In order to make sure that the board is operational it is sufficient to connect it to another drive with the same firmware version and check, whether the drive works flawlessly with the board. Our guidelines for PCB selection on the basis of HDD version can be found in section 4.2. Several drive families have electronics compatibility peculiarities described in chapter 9. If a drive after power-up reports on readiness but does not spin up the spindle, it may mean that the program recorded in NV-RAM is incompatible with ROM contents. If at power-up a drive does not spin up the spindle and remains in the BSY state or its indicators blink in a chaotic manner, it may mean that the central processor or additional ROM containing microcode has been damaged (quite frequent situation with AVVN drives). Please keep in mind that an additional ROM chip is present on some PCBs only. As a rule, it can be found in drives from initial shipments while the manufacturer was still testing the HDD firmware. After testing, verified code is transferred into masked ROM inside processor chip. Another case of electronics malfunction may be demonstrated by incorrect operation of stress sensor. Such drive may pass verification without problems but it will start knocking in case of random reading. To fix it, you will have to unsolder the impact sensor, it is a large component resembling a ceramic capacitor and always installed at an angle of 45 degrees[1] to PCB edge (in some 2.5" drives it is installed inside the HDA).

7.1.1. NV-RAM selection when native PCB is lost

Hitachi-IBM drive use for access to service area such parameters as top cylinder (SA Top Cyl) and base cylinder for the list of cylinder defects in SRVM (SRVM Cyl base)[2]. SA Top Cyl – physical cylinder preceding the service area.

Attention! The list of cylinder defects is implemented in some drive families only (please see their detailed descriptions). In that case the only variable parameter is SA Top. Then utility prohibits SRVM Cyl base fitting. Some drive families record the appropriate numbers in ROM, others – in NV-RAM[3]. Consequently, in drives holding the settings in NV-RAM, the numbers will be unique for each drive. It means that loss of the original NV-RAM content prevents access to the service area. Utility feature described in this chapter allows adapting a borrowed NV-RAM for access to a HDD SA.

Attention! For drives that support variation of both parameters (SA Top, Cyl base) there is a whole set of parameter pairs, which enable access to the SA. Still, there is JUST ONE pair, which also provides access to user data (because SRVM Cyl base affects translation). Therefore, once you have access to SA, you should first of all search for the image of the native (active[4] or factory[5]) NV-RAM content.

Attention! Modern 2.5” HDD typically use individual SA Top cyl value for each head. Still, to speed up the fine-tuning procedure, the algorithm manipulates just one number. Therefore, once you have access to SA, you should first of all search for the image of the native (active[6] or factory[7]) NV-RAM content.

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1 – Such setup allows impact detection using three coordinates – both in the plane of the plates owing to the installation angle and vertically. Theoretically, the sensor's ability to detect impact directed along its axis is low.

2 – It is present in some drive families only. Please refer to descriptions of drive families for details.

3 – 2.5”: HTS5424, HTS541, HTS721; 3.5”: DTLA, AVER, AVVA, AVVN, AVV2, VLAT, PLAT, KLAT, DLAT

4 – The one used in the HDD when it was functional.

5 – It can have a different FW version but the actual data may match active NV-RAM.

6 – The one used in the HDD when it was functional.

7 – It can have a different FW version but the actual data may match active NV-RAM.

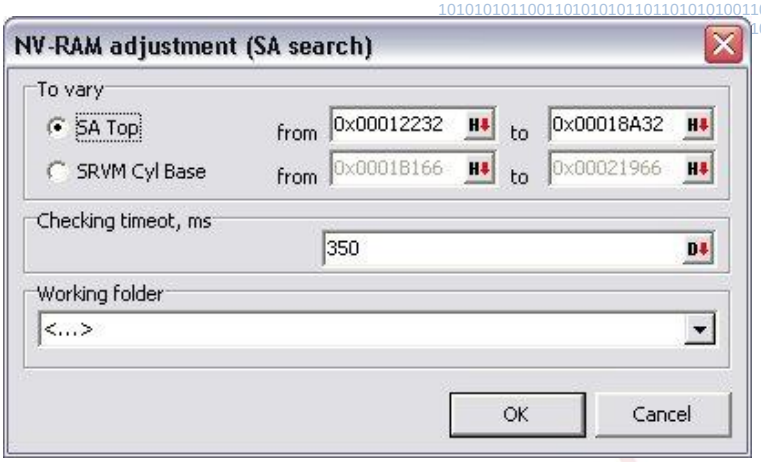


Fig. 7.1. Dialog containing the parameters for the algorithm picking NV-RAM settings.

The startup dialog of the algorithm is shown in the Figure 11. Here in the ***To vary*** group of controls the SA Top and SRVM Cyl base switches allow you to choose the parameter, which will be varied. For most drive families modification of any of the parameters produces identical results. Still, the utility suggests the optimal method in the initial dialog. ***From*** and ***to*** settings are used to define the variation borders. The «Checking timeout» parameter allows resriction of the time during which each variant will be tested. For a normal drive you can leave the default value (300 ms), while for HDD with reading problems the timeout can be increased to ensure correct identification of proper setting value. It means that a HDD must be able to return an error for an incorrect value and report readiness for a correct one within the timeout. ***Working folder*** defines the directory where work files for the algorithm will be stored:

- ***NV-RAM_Org.nvr*** – NV-RAM image existing at the moment of procedure start.
- ***NV-RAM_Adapted_For_Chk.nvr*** – NV-RAM image intended to search for the native NV-RAM in SA (with blocked routine for complete FW loading).
- ***NV-RAM_Adapted.nvr*** – NV-RAM image with substituted found parameter and without blocked routine for complete FW loading.

Attention! The algorithm used in the utility for 3.5" drives allows you to receive access to SA immediately after procedure completion, but for 2.5" drive you need to record the adapted NV-RAM, and then send a Reset signal or switch the power off/on.

In **DTLA, AVER, AVVA, AVVN** drive families at successfull firmware start a HDD performs writing test of the heads using the buffer which contains slightly corrupted NV-RAM image left after the initial startup. Specifically, the initial **E2PR** signature is replaced (it can be restored in any hex editor). Writing is performed to the initial sector of WRTx modules, where x stands for the head number. Thus, you can read the initial sector of the WRT module to obtain an NV-RAM image of the last successful startup.

Attention! To prevent its overwriting, you should either read the required data immediately after the fitting procedure or access SA using (having written to HDD) an NV-RAM image with blocked routine for complete FW loading ***– NV-RAM_Adapted_For_Chk.nvr***. For access to WRT modules you will need to load the utility in off-line start mode and then load the table of «open» modules or use known ABA addresses of WRT modules. Actual reading should be performed in the ***Service information objects*** wizard, ***the Modules / ABA Range*** tab, ***ABA Range*** mode, initial ABA must be represented with the address of a WRT module, length 1.

For **AVV2 and newer 3.5"** drives the list of modules includes NVRC – NV-RAM image.

In **2.5" HTS424, HTS541, HTS721** drives the factory NV-RAM image should be sought in the sector immediately following the last module of the main **FACTORY** SA track (after module SRIF) or within the track of the FLOG module (ABA range from module beginning should be read, length: 0x200-0x237). Search should be performed using the found SA Top value in combination with visual analysis of data structure.

Thus, the procedure is as follows:

- Connect to the HDA a corresponding functional PCB with recorded NV-RAM for startup.
- Switch drive power supply on.
- Launch the utility.
- Initiate the fitting feature in menu *Tests – Service information, Work with NV-RAM – NV-RAM adjustment (SA search).*
- Select the variation parameter (you are advised to keep the default selection).
- Select the variation range (you are advised to keep the default selection).
- Define test operation timeout (you are advised to keep the default selection or increase it if the drive is physically damaged).
- Launch the procedure.
- Wait for its completion. If access to SA has not been received, you can try repeating the procedure with another test NV-RAM, but the probability of success will be low.
- For 2.5" drives mentioned above, rewrite the NV-RAM *NV-RAM_Adapted_For_Chk.nvr* image and switch power supply off/on.
- Search SA for native NV-RAM image using the location guidelines above.
- Disable Autoreassign in the *HDD configuration editing* dialog.

If the procedure provides no access to SA, you can try extending the range of parameter variation. Please keep in mind that the drive will start knocking if the parameters are specified beyond the final cylinder. Therefore, please monitor the procedure carefully to avoid damage to the drive when you specify a custom testing range.

If the found image does not enable access to data, you should consider the probability of heads damage. If the heads are normal, access to data cannot be restored.

A malfunctioning PCB makes software restoration of a HDD with the utility impossible.

7.2. Step 2: mechanical/electrical parts

If the problem is not caused by electronics then motor diagnostics should be performed. If the motor does not spin up though the board is operational, the cause is either in a damaged motor winding or heads sticking to disk surface. Sometimes the motor damage causes the motor controller chip failure. One more cause preventing rotation is seizure of a fluid dynamic bearing. Seizure practically does not occur in drives using ball bearings in spindle, but another problem appears, namely motor operation with obviously high noise level. One more motor problem may be related to bad contact or broken cable in the connector between the electronics board and HDA. As a result motor problems can be identified by the following signs:

- Winding closure or break.
- Seizure of fluid dynamic bearing (FDB).
- Motor operation with a considerable noise level.
- Problem with connection between the motor and electronics board.

A malfunctioning motor makes software restoration of a HDD in the utility impossible.

7.3. Step 3: magnetic surface

If a drive with operational electronics having no obvious problems in motor functioning (VCM & spindle motor) does not knock with its heads or produces slight knocking at attempted calibration, we should proceed to the next Step 4. Now we should start diagnostics of surface scratches. It is difficult to perform the diagnostics completely without drive disassembly, but through the STW lifter opening one can see up to 90% of the surface from the upper HDD cover side. Once a scratch appears on one of disk surfaces, it spreads very quickly to all others. If a scratch is large, it will be sufficient to find it without HDA disassembly. In Hitachi-IBM drives the STW lifter opening is located in the HDA cover below the label. The mentioned opening allows you to see the upper head (one with the highest number). A scratch appears most frequently because of problems with the terminal strip of the parking element. Scratches on disk surface or detached heads make drive restoration impossible.

7.3.1. Diagnostics of head malfunction using NV-RAM modification

If a drive has a malfunctioning head, it will be unable to pass the calibration procedure (a HDD may start endless knocking) and consequently it will provide no access to data for the normal heads for information retrieval. We shall demonstrate the procedure for such cases using an example:

- Start the HDD in safe mode or, if the drive allows launching the utility (does not return constant BSY response), then use normal mode.
- Use visual NV-RAM editor (6.1.2.2) and try to modify the heads map as follows: e.g., the heads map may look like: 05 04 03 02 07 07 with the total number of used heads equal to 4. Let us assume that the 02 head does not work while head 04 is functional. Modify the heads map to substitute the normal head instead of the malfunctioning one. For that example it will be 05 04 03 04 07 07. If the problem is caused by the head 02 only, the drive will start and allow reading the data using logical access; however, the data from locations corresponding to head 2 will not be read. Therefore you should use Data Extractor to build a heads map and disable reading for the appropriate head number in the map. In this case, Data Extractor will display the following heads: 0, 1, 2, 3. Since the malfunctioning head 02 occupies the third position in the map (beginning with zero), then head 3 should be disabled in the map built by Data Extractor during data recovery from the HDD.

Attention! NV-RAM checksum must be recalculated after modification of the heads map! The utility does not do that automatically!

In typical cases you should begin with testing by filling the heads map with the same number and going over all the numbers from the valid cells of the original map. In this case, the numbers will be: 05 05 05 05 07 07, 04 04 04 04 07 07, 03 03 03 03 07 07, 02 02 02 02 07 07.

Please keep in mind also that when you substitute into the map a system head different from the original one, the drive attempting to read the service information will produce for a while noise similar to that heard when a BAD block reading is attempted (checksum does not match because of switched head and sectors will be unreadable), but the drive will not start endless knocking. The drive, of course, will not load the service data.

Besides, please remember that you cannot freely change head position if you need to enable correct operation based on logical parameters in such drives as AVVA and AVVN. Heads parity must be preserved because heads are switched in pairs. E.g., if the heads map is 05 04 03 02, operational map will be 03 03 05 04. Of course, you will need to rewrite the service area.

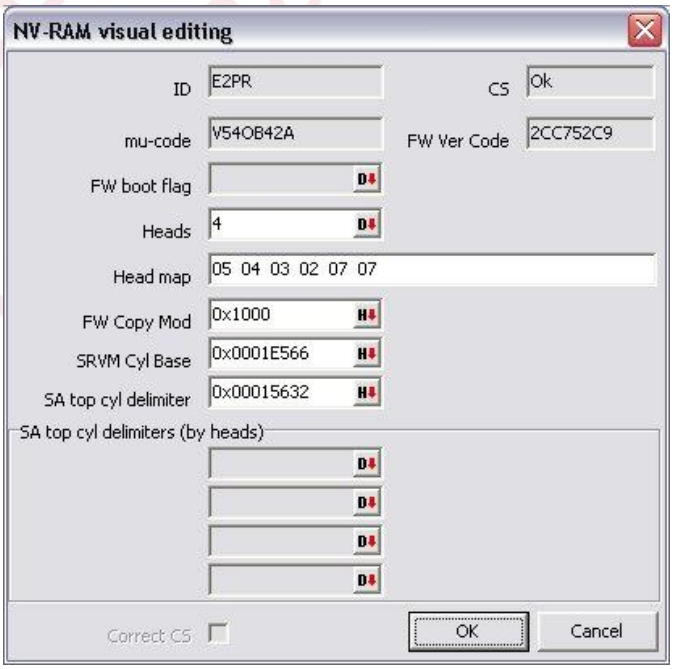


Fig. 7.2. NV-RAM editing dialog.

Attention! The method is applicable for drives equipped with NV-RAM only.

7.4. Step 4: firmware status during start / magnetic heads

Figure 7.3 demonstrates a scheme of diagnostics for a malfunctioning Hitachi-IBM HDD. Unlike drives of other vendors, Hitachi-IBM HDD can read/write the contents of their service area exclusively using the program written in drive electronics; they do not require external loaders. We should mention, however, that a loader still can be used with Hitachi-IBM drives in cases, when you need to overwrite the whole service area. That recording method sometimes works better than overwriting of modules, but it has not been implemented in this utility so far because the loader start algorithm was changed in new HDD.

An opportunity to read/write the contents of the service area allows easy diagnostics of malfunctioning modules with the «Start SA checking» command of the utility. Problems occur when RSVD and/or USAG/RESF module in the service area cannot be read. Such corruptions of firmware indicate poor performance of the system head making the repair of such drive impossible until you switch the system head and relocate its service area accordingly. It would be reasonable in that case to install a functioning magnetic heads assembly for data recovery.

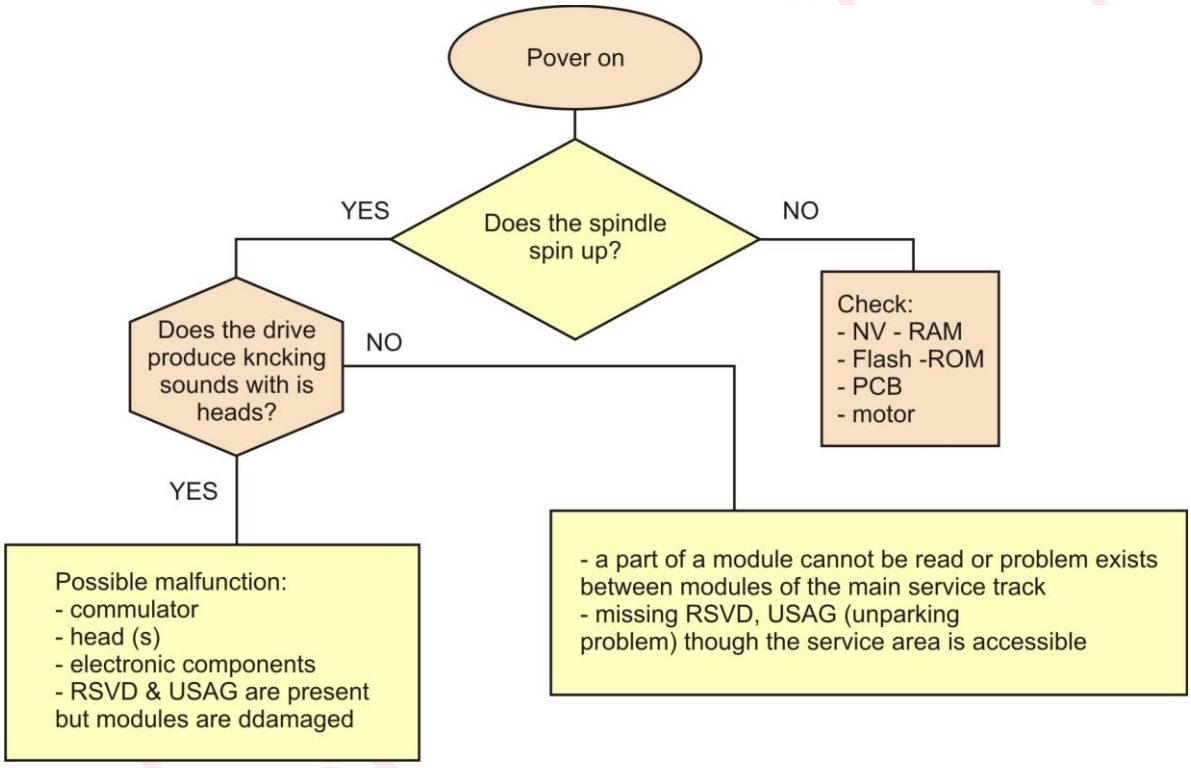


Fig. 7.3. Diagnostics procedure for Hitachi-IBM HDD.

8. Software restoration

The following features can be used for software restoration of a HDD:

- NV-RAM reading/writing
- Editing and fitting of a donor NV-RAM
- Analysis of SA structure using built-in test tools
- Reading/writing or damaged modules
- Editing of the defect lists (including reassignment of damaged sections within user data area)
- S.M.A.R.T. reset
- Self Test launch and monitoring is implemented for the drive families listed above.

In addition, you can use standard reading of factory modules copies and arbitrary access to SA via ABA to search manually for corrupted structures critical for the HDD or user data, such as NV-RAM and defect lists.

You can verify the structure of service data using two methods: «SA structure test» (6.1.2.3) and the «Modules table» interactive mode (6.2.1). If the utility encounters a module including sectors that cannot be read or a module with damaged structure, such object can be overwritten. If recording of a damaged module fails, it does not necessarily mean physical damage in SA. Quite often it is caused by drive startup with problems in blocking of the writing mechanism in SA. It can be circumvented by switching access to SA (startup dialog of the utility) or using the probes supplied with the product[1].

9. Peculiarities of drive families

9.1. Creating a database of master samples

The utilities of the PC-3000 complex for Windows use a database for storage of HDD firmware. The database allows convenient classification of firmware enabling the user to search the stored data by various signs, for instance, by NV-RAM identifier. All records pertaining to a single resource are combined into a common profile. Therefore you can reliably identify the drive (drive ID and technical details) that a certain object belongs to, which is hardly possible when a drive's service area is saved as files. Another benefit of the database is the opportunity to import/export one or several firmware copies facilitating their exchange. As you use import into your database, you can check the drive ID and technical details of the drive from which the firmware has been copied. In cases of exchange with firmware stored in files all the data had to be entered manually and some users would simply forget about that.

You can add the firmware of a HDD to your database with the «Tests» → «Service information» → «Work with DB» → «Resource master copy creation in DB» command.

9.2. General information about drive families

The discussed drive families do not park heads on the disks as it used to be earlier. Instead, they park their heads on a special plastic rack at the external plate's edge. Sometimes that parking method results in scratches all over disk surface in cases when a head either becomes bent during rack exit/entry or when the head gets under the guide of the parking rack. Heads also frequently stick onto the disk surface.

In 2.5" drives Safe Mode must be enabled using the jumper settings on the PC-2" adapter as shown in the Figure 7.2.

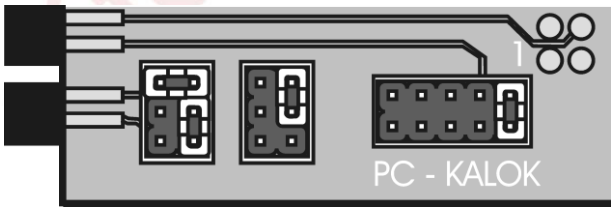


Fig. 9.1. Safe Mode jumper settings on the PC-2" adapter.

[1] – Locations for short-circuit of the read-write channel with the supplied probe are described for some families in this manual.

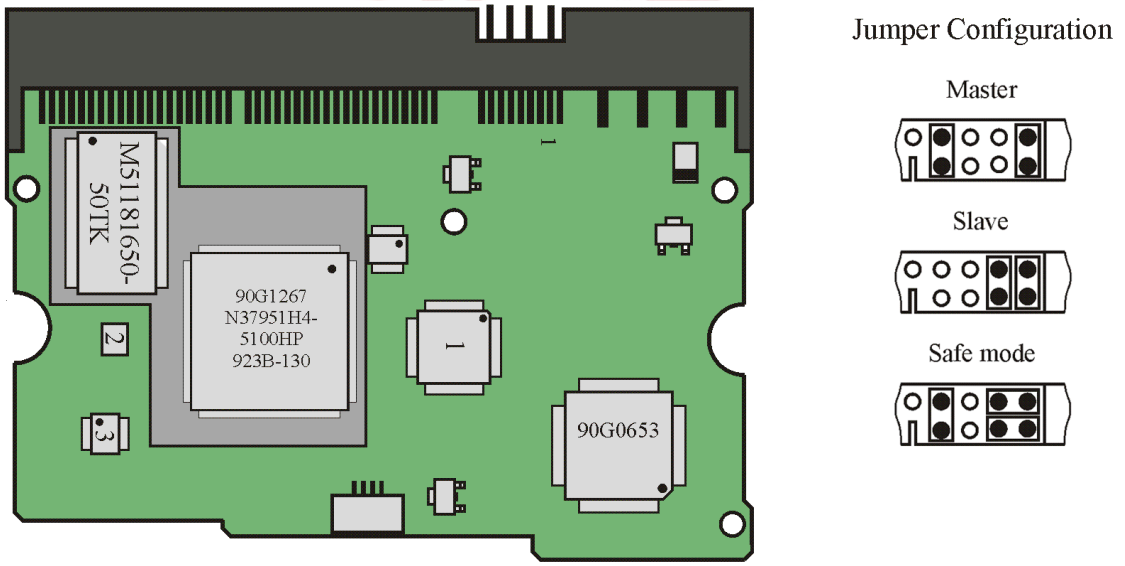
9.3. 22GXP, DJNA drive family

Table 5. DJNA family models

Drive family:	Model	Capacity, GB	Maximum LBA
DJNA	DJNA-372200	22.60	44,150,400
	DJNA-371800	18.04	35,239,680
	DJNA-371350	13.57	26,520,480
	DJNA-370910	9.11	17,803,440

Table 6. DJNA family specifications

Parameter	Purpose
Size	3.5"
Drive family code	JN
Spindle motor rotational speed	5400
NV-RAM	512 bytes, 6 bytes ECC



1. IBM36 JAPAN AMSRC04 03 TQA7BB.6C 1C23081TQA
2. 25.0 Mhz
3. NV-RAM S93C56

Fig. 9.2. External view of the controller board in DJNA drive family.

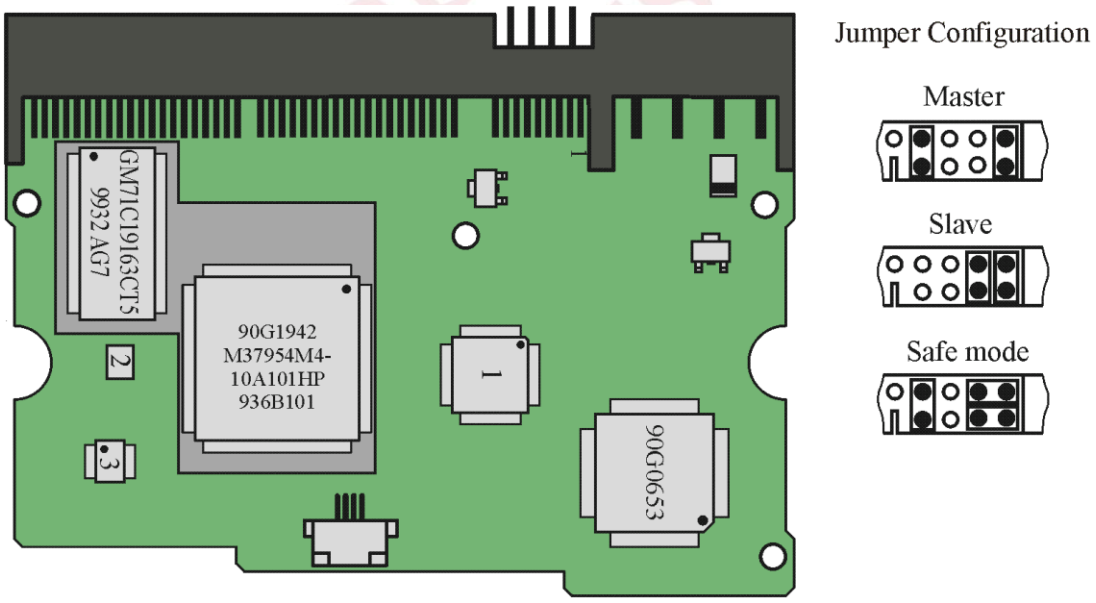
9.4. 34GXP, DPTA drive family

Table 7. DPTA family models

Drive family:	Model	Capacity, GB	Maximum LBA
34GXP, DPTA	DPTA-373420 DPTA-372730 DPTA-372050 DPTA-371360	34.21 27.37 20.52 13.67	66,835,440 53,464,320 40,088,160 26,712,000

Table 8. DPTA family specifications

Parameter	Purpose
Size	3.5"
Drive family code	PT
Spindle motor rotational speed	5400
NV-RAM	512 bytes, 6 bytes ECC



1. IBM36 JAPAN AMSRC04 03 TQA7AA.6C 1C32194TQRTQA
2. 25.0 Mhz
3. NV-RAM-S93C5

Fig. 9.3. External view of the controller board in 34GXP-DPTA drive family.

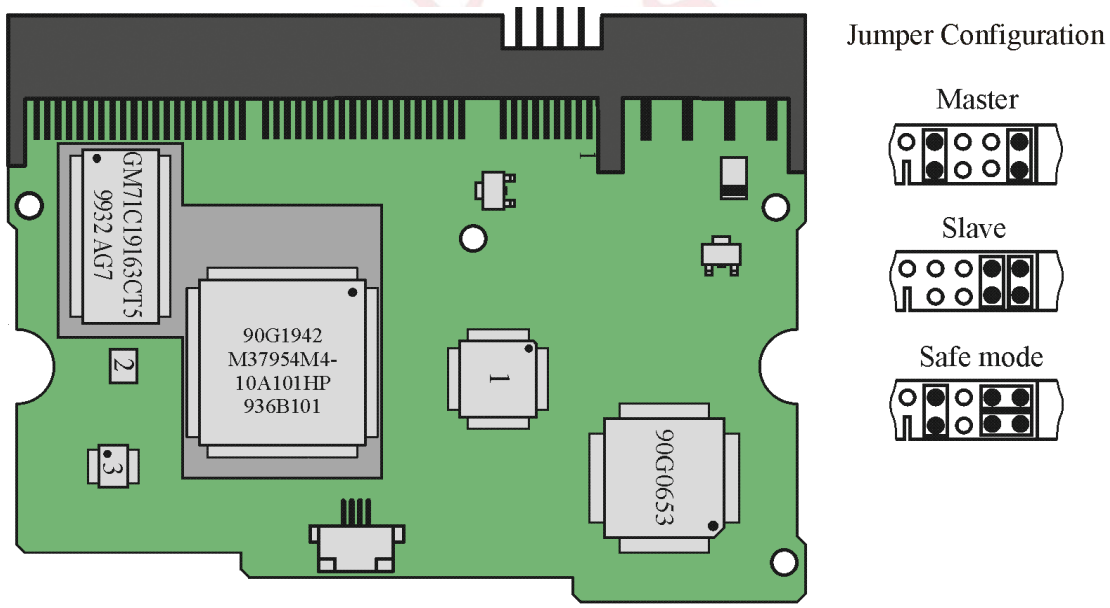
9.5. GP – DPTA drive family

Tabe 9. DPTA family models

Drive family:	Model	Capacity, GB	Maximum LBA
37GP, DPTA	DPTA-353750 DPTA-353000 DPTA-352250 DPTA-351500	37.50 30.00 22.52 15.02	73,261,440 58,600,080 43,985,088 29,336,832

Table 10. DPTA family specifications

Parameter	Purpose
Size	3.5"
Drive family code	PT
Spindle motor rotational speed	5400
NV-RAM	512 bytes, 6 bytes ECC



1. IBM36 JAPAN AMSRC04 03 TQA7AA.6C 1C32194TQRTQA
2. 25.0 Mhz
3. NV-RAM-S93C5

Fig. 9.4. External view of the controller board in GP - DPTA drive family.

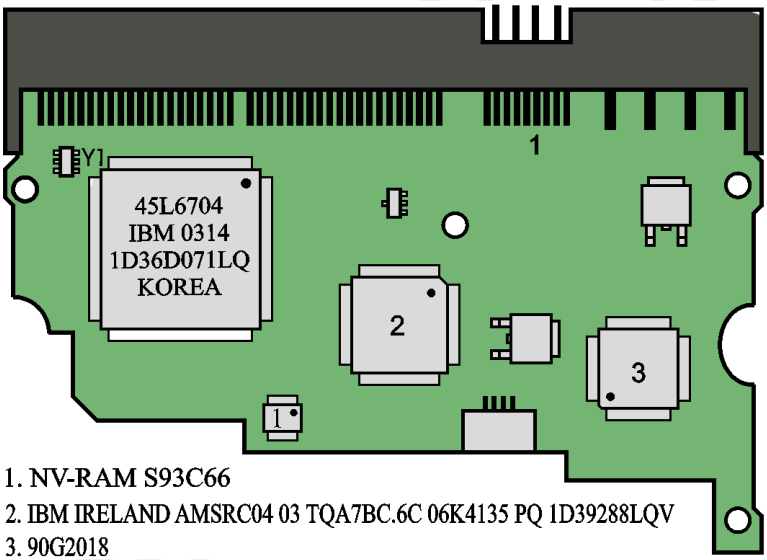
9.6. 40GV, DTLA5 drive family

Table 11. DTLA5 family models

Drive family:	Model	Capacity, GB	Maximum LBA
DTLA-5	DTLA-305040	41.17	80,418,240
	DTLA-305030	30.73	60,036,480
	DTLA-305020	20.57	40,188,960
	DTLA-305010	10.27	20,074,320

Table 12. DTLA5 family specifications

Parameter	Purpose
Size	3.5"
Drive family code	TW
Spindle motor rotational speed	5400RPM
NV-RAM	512 bytes, 6 bytes ECC



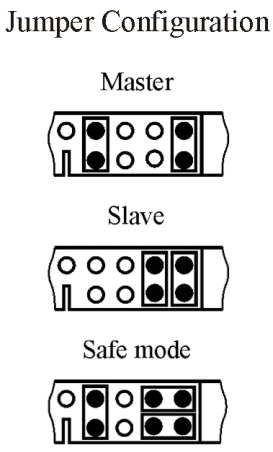


Fig.9.5. External view of the controller board in DTLA5 drive family.

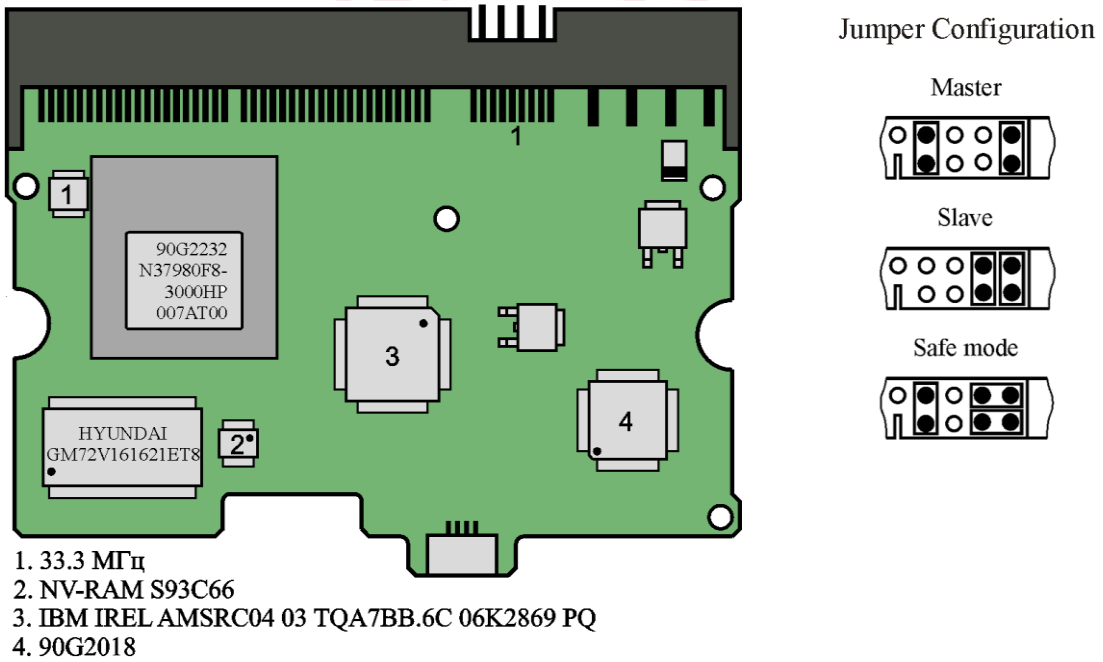
9.7. 75GXP, DTLA7 drive family

Table 13. DTLA7 family models

Drive family:	Model	Capacity, GB	Maximum LBA
DTLA-7	DTLA-307075	76.86	150,136,560
	DTLA-307060	61.49	120,103,200
	DTLA-307045	46.11	90,069,840
	DTLA-307030	30.73	60,036,480
	DTLA-307020	20.57	40,188,960
	DTLA-307015	15.36	30,003,120

Table 14. DTLA7 family specifications

Parameter	Purpose
Size	3.5"
Drive family code	TX
Spindle motor rotational speed	7200RPM
NV-RAM	512 bytes, 6 bytes ECC



1. 33.3 МГц
2. NV-RAM S93C66
3. IBM IREL AMSRC04 03 TQA7BB.6C 06K2869 PQ
4. 90G2018

Fig.9.6. External view of the controller board in DTLA7 drive family.

9.8. 60GXP, AVER drive family

Table 15. AVER family models

Drive family:	Model	Capacity, GB	Maximum LBA
AVER	IC35L060AVER07	61.49	120,103,200
	IC35L040AVER07	41.17	80,418,240
	IC35L030AVER07	30.73	60,036,480
	IC35L020AVER07	20.57	40,188,960
	IC35L010AVER07	10.27	20,074,320

Table 16. AVER family specifications

Parameter	Purpose
Size	3.5"
Drive family code	ER
Spindle motor rotational speed	7200RPM
NV-RAM	512 bytes, 6 bytes ECC

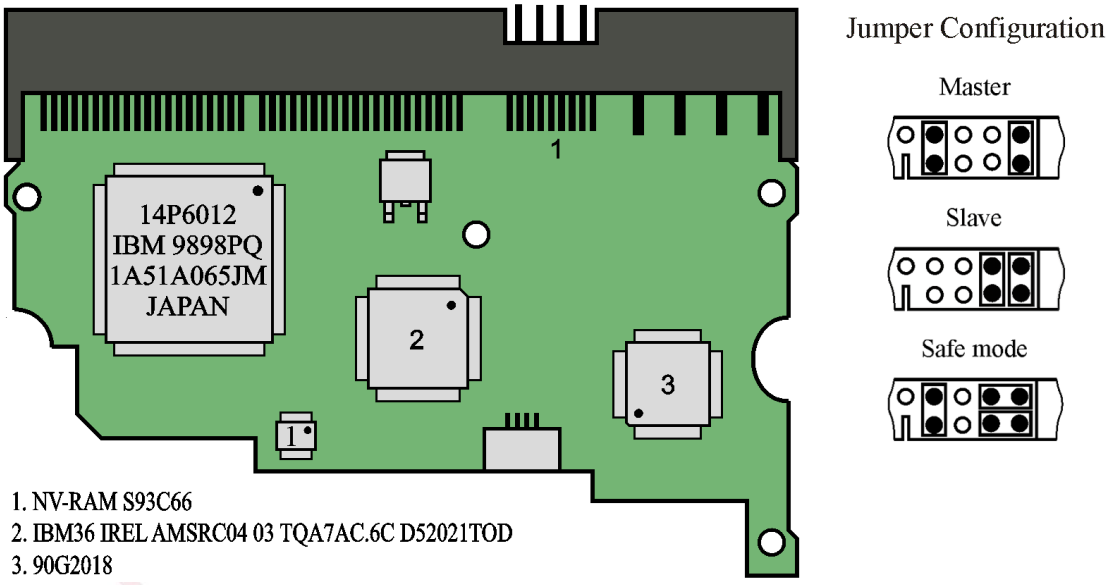


Fig. 9.7. External view of the controller board in AVER drive family.

9.9. 120GXP, AVVA drive family

Table 17. AVVA family models

Drive family:	Model	Capacity, GB	Maximum LBA
AVVA	IC35L120AVVA07	123.52	241,254,720
	IC35L100AVVA07	102.93	201,045,600
	IC35L080AVVA07	82.34	160,836,480
	IC35L060AVVA07	61.49	120,103,200
	IC35L040AVVA07	41.17	80,418,240
	IC35L020AVVA07	20.57	40,188,960

Table 18. AVVA family specifications

Parameter	Purpose
Size	3.5"
Drive family code	VA
Spindle motor rotational speed	7200RPM
NV-RAM	512 bytes, 6 bytes ECC

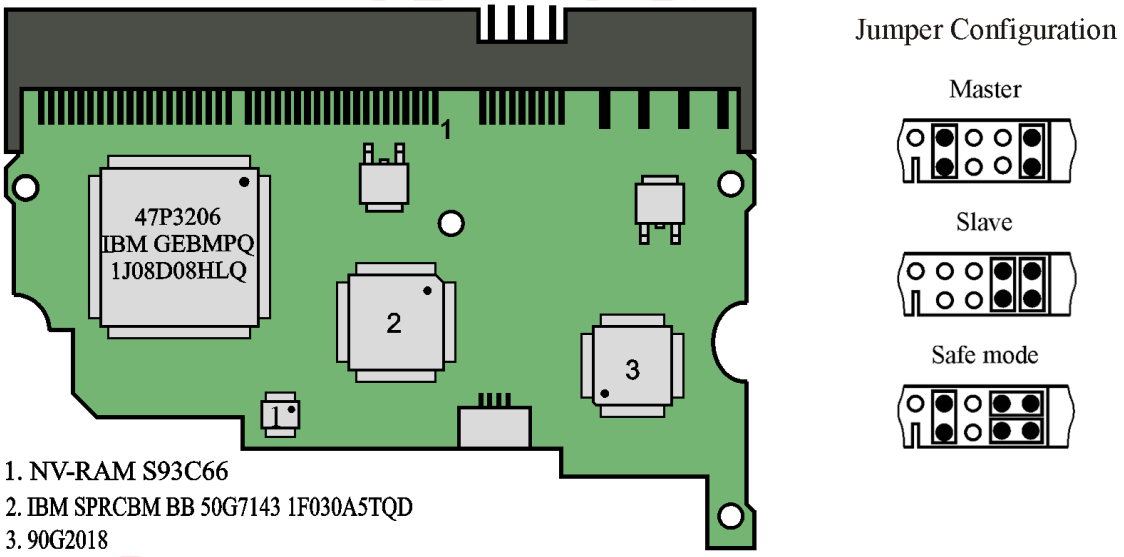


Fig. 9.8. External view of the controller board in AVVA drive family.

9.10. 120GXP, AVVN drive family

Table 19. AVVN family models

Drive family:	Model	Capacity, GB	Maximum LBA
AVVN	IC35L040AVVN07 IC35L020AVVN07	40 20	80,418,240 40,188,960

Table 20. AVVN family specifications

Parameter	Purpose
Size	3.5"
Drive family code	VN
Spindle motor rotational speed	7200RPM
NV-RAM	512 bytes, 6 bytes ECC

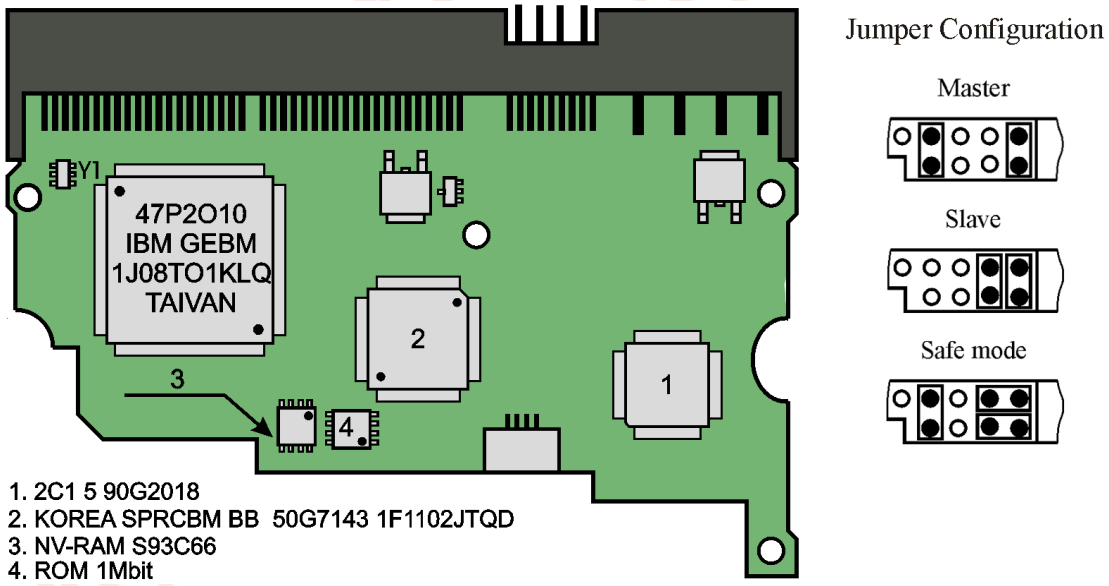


Fig. 9.9. External view of the controller board in AVVN drive family.

This drive family has a typical controller board malfunction caused either by damaged processor or corruption of data integrity in Serial Flash ROM chip shown in Fig. 9.9 under number 4.

9.11. GXP180, AVV2 drive family

Table 21. AVV2 family models

Drive family:	Model	Capacity, GB	Maximum LBA
AVV2, GXP180	IC35L180AVV207-1	180	361,882,080
	IC35L120AVV207-0	120	241,254,720
	IC35L090AVV207-0	90	160,836,480
	IC35L060AVV207-0	60	120,103,200
	IC35L030AVV207-0	30	60,036,480

Table 22. AVV2 family specifications

Parameter	Purpose
Size	3.5"
Drive family code	V2
Spindle motor rotational speed	7200 RPM
NV-RAM	512 bytes, 6 bytes ECC

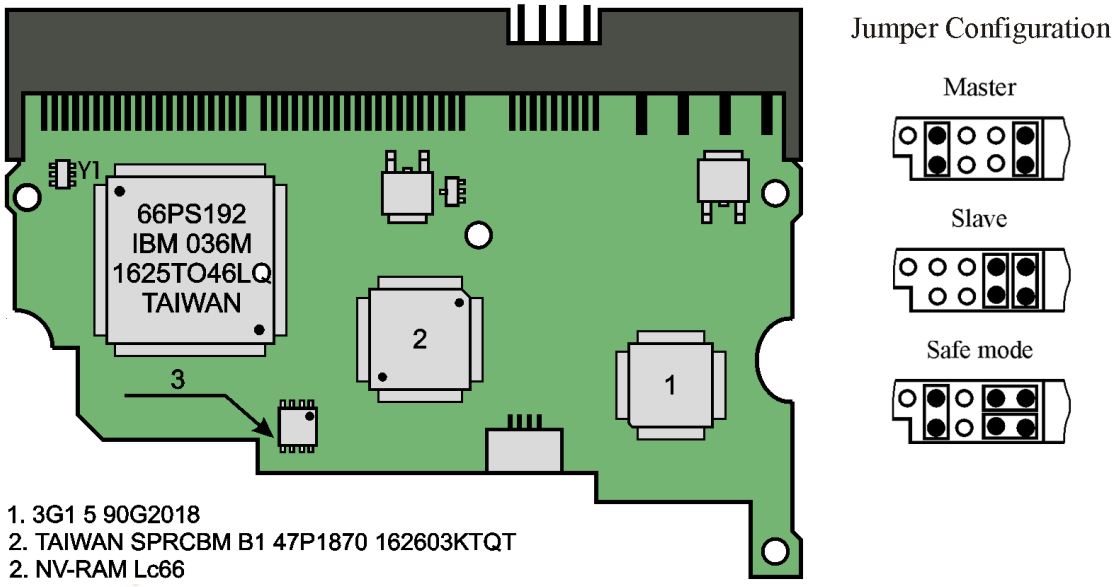


Fig.9.10. External view of the controller board in AVV2 drive family.

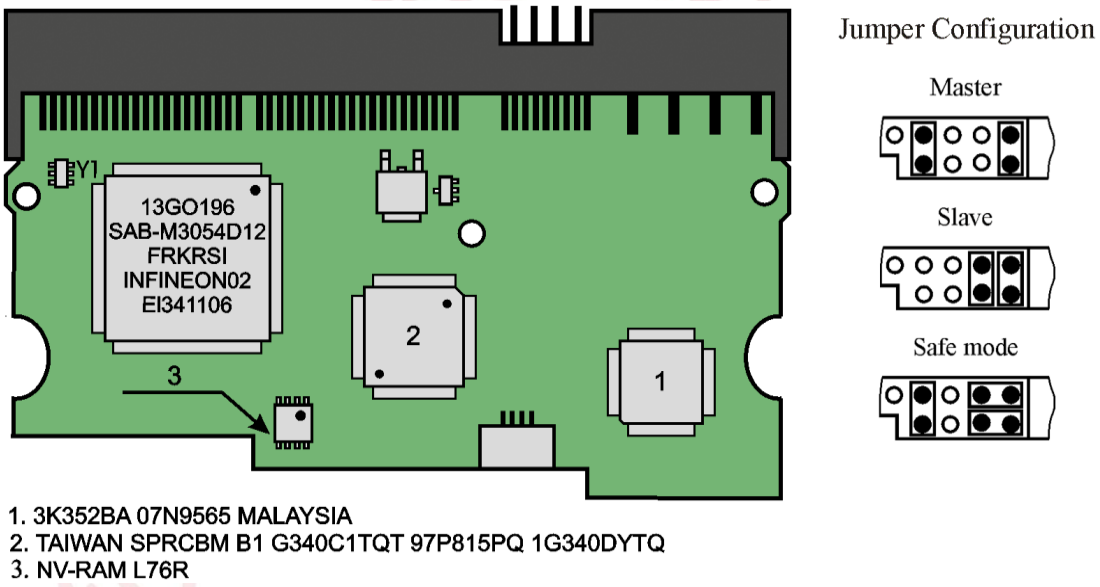
9.12. 7K250, VLAT drive family

Table 23. VLAT family models

Drive family:	Model	Capacity, GB	Maximum LBA
7K250, VLAT	HDS722525VLAT80	250	488,397,168
	HDS722516VLAT20	160	321,672,960
	HDS722512VLAT20	120	241,254,720
	HDS722580VLAT20	80	160,836,480
	HDS722540VLAT20	40	80,418,240

Table 24. VLAT family specifications

Parameter	Purpose
Size	3.5"
Drive family code	V3
Spindle motor rotational speed	7200 RPM
NV-RAM	1024 bytes, 12 bytes ECC



1. 3K352BA 07N9565 MALAYSIA
2. TAIWAN SPRCBM B1 G340C1TQT 97P815PQ 1G340DYTQ
3. NV-RAM L76R

Fig. 9.11. External view of the controller board in VLAT drive family.

9.13. 7K80, PLAT drive family

Table 25. PLAT family models

Drive family:	Model	Capacity, GB	Maximum LBA
7K80, PLAT	HDS728080PLAT20 HDS728040PLAT20	80 40	160,836,480 80,418,240

Table 26. PLAT family specifications

Parameter	Purpose
Size	3.5"
Drive family code	PF
Spindle motor rotational speed	7200 RPM
NV-RAM	1024 bytes, 6 bytes ECC

Attention! Calculation of ECC bytes for the PLAT drive family is not implemented in the utility yet! The drive performs ECC for NV-RAM while recording it on its own.

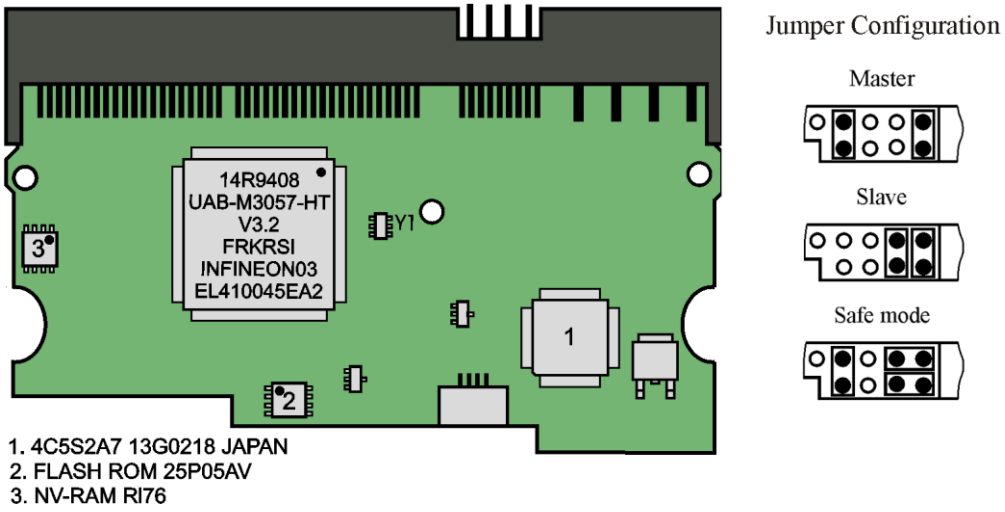


Fig. 9.12. External view of the controller board in PLAT drive family.

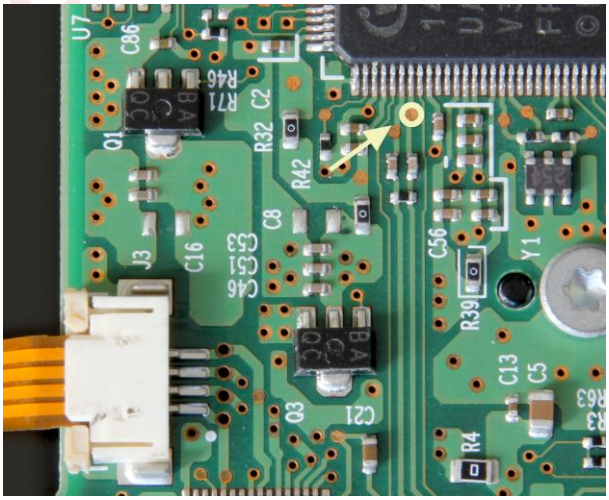


Fig. 9.13. Location where the probe should be connected to unlock a HDD.

9.14. 7K400, KLAT drive family

Table 27. KLAT family models

Drive family:	Model	Capacity, GB	Maximum LBA
7K400, KLAT	HDS724040KLAT80 HDS724040KLSA80	400 400	781,422,768 781,422,768

Table 28. KLAT family specifications

Parameter	Purpose
Size	3.5"
Drive family code	KF
Spindle motor rotational speed	7200 RPM
NV-RAM	1024 bytes, 6 bytes ECC

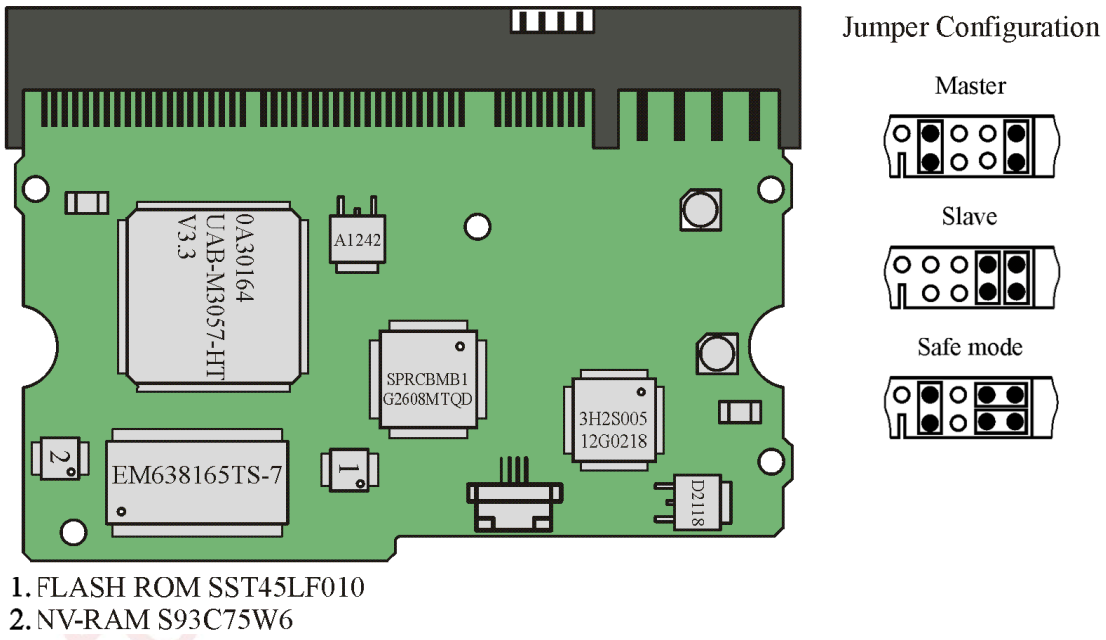


Fig. 9.14. External view of the controller board in 7K400- KLAT drive family.

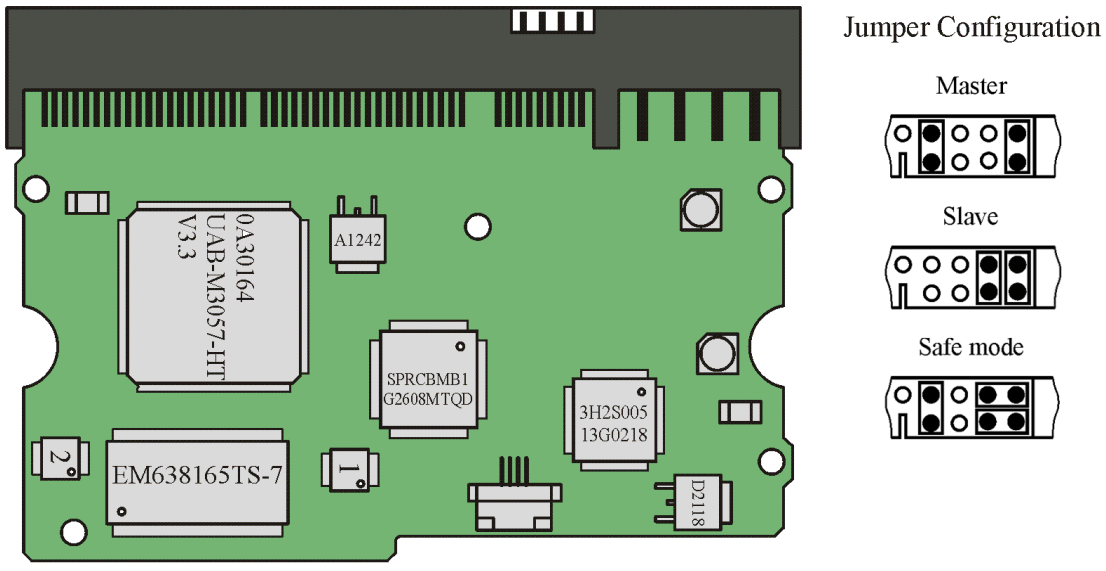
9.15. 7K500, KLAT drive family

Tabe 29. KLAT family models

Drive family:	Model	Capacity, GB	Maximum LBA
7K500, KLAT	HDS724050KLAT80 HDS724050KLSA80	500 500	976,773,168 976,773,168

Tabe 30. KLAT family specifications

Parameter	Purpose
Size	3.5"
Drive family code	KF
Spindle motor rotational speed	7200 RPM
NV-RAM	1024 bytes, 6 bytes ECC



1. FLASH ROM SST45LF010
2. NV-RAM S93C75W6

Fig .9.15. External view of the controller board in 7K500, KLAT drive family.

9.16. T7K250, DLAT drive family

Tabe 31. DLAT family models

Drive family:	Model	Capacity, GB	Maximum LBA
T7K250, DLAT	HDT722525DLAT80	250	488,397,168
	HDT722520DLAT80	200	390,721,968
	HDT722516DLAT80	160	321,672,960
	HDT722525DLA380	250	488,397,168
	HDT722520DLA380	200	390,721,968
	HDT722516DLA380	160	321,672,960

Tabe 32. DLAT family specifications

Parameter	Purpose
Size	3.5"
Drive family code	DF
Spindle motor rotational speed	7200 RPM
NV-RAM	1024 bytes, 6 bytes ECC

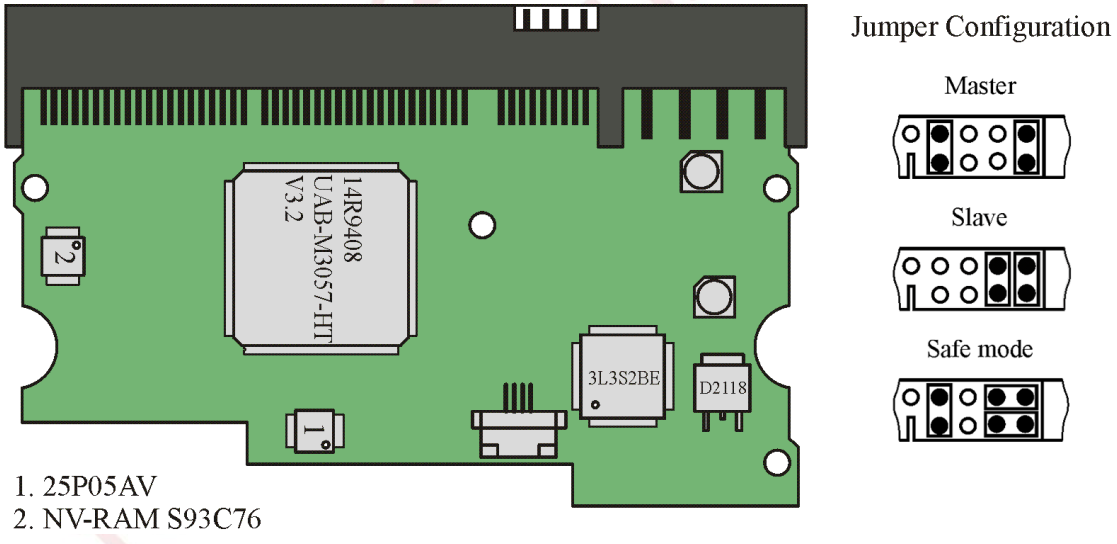


Fig. 9.16. External view of the controller board in T7K250, DLAT drive family.

9.17. 25GS, DARA drive family

Tabe 33. DARA family models

Drive family:	Model	Capacity, GB	Maximum LBA
DARA	DARA-225000	25.3	49,577,472

Tabe 34. DARA family specifications

Parameter	Purpose
Size	2.5"
Drive family code	
Spindle motor rotational speed	5400
NV-RAM	No

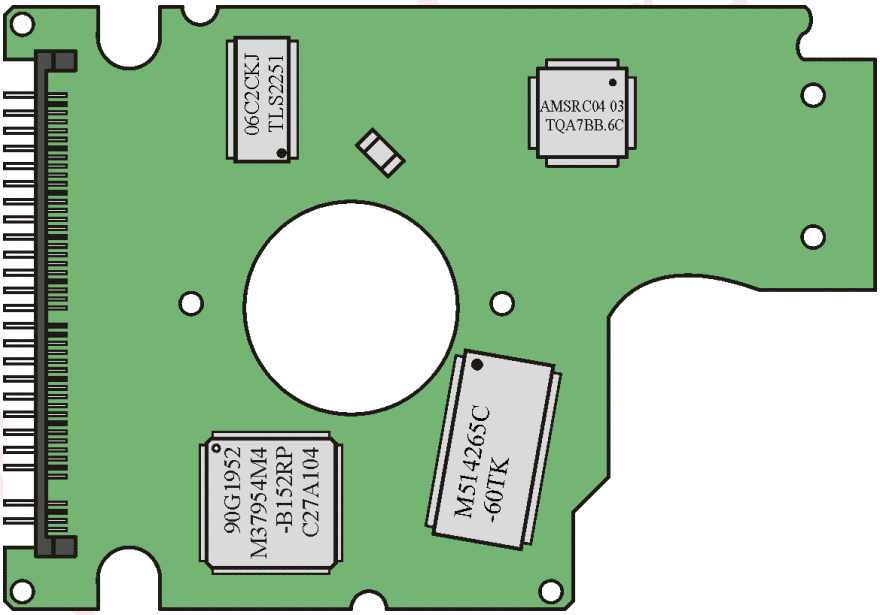


Fig.9.17. External view of the controller board in 25GS, DARA drive family.

9.18. 18GT, DARA drive family

Tabe 35. DARA family models

Drive family:	Model	Capacity, GB	Maximum LBA
DARA	DARA-218000 DARA-215000	18.1 15.1	35,433,216 29,498,112

Tabe 36. DARA family specifications

Parameter	Purpose
Size	2.5"
Drive family code	
Spindle motor rotational speed	4200
NV-RAM	No

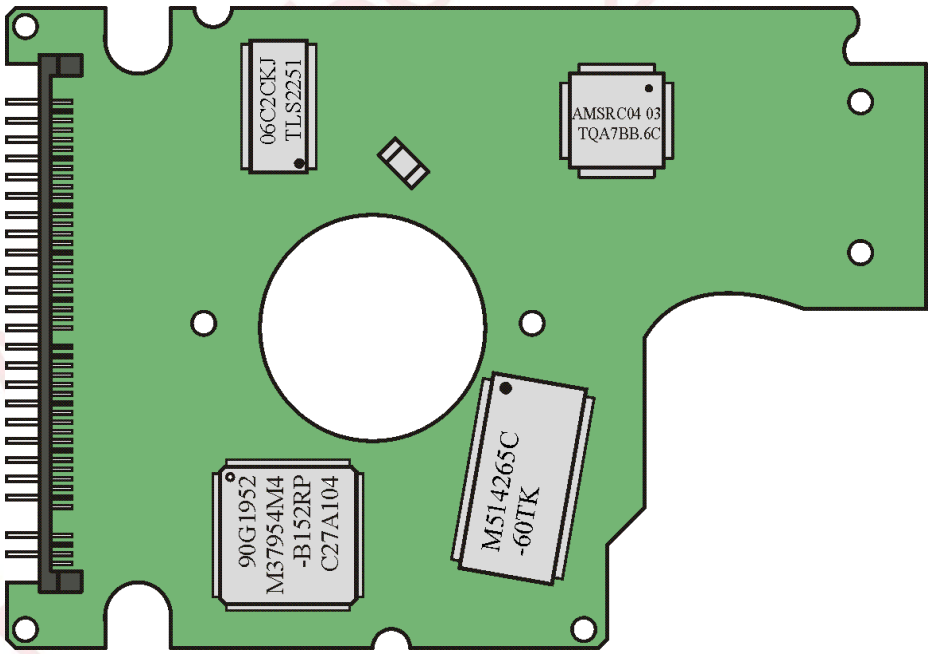


Fig. 9.18. External view of the controller board in 18GT, DARA drive family.

9.19. 12GN, DARA drive family

Tabe 37. DARA family models

Drive family:	Model	Capacity, GB	Maximum LBA
DARA	DARA-212000 DARA-209000 DARA-206000	12 9 6	23,579,136 17,660,160 11,733,120

Tabe 38. DARA family specifications

Parameter	Purpose
Size	2.5"
Drive family code	2.5"
Spindle motor rotational speed	
Size	4200

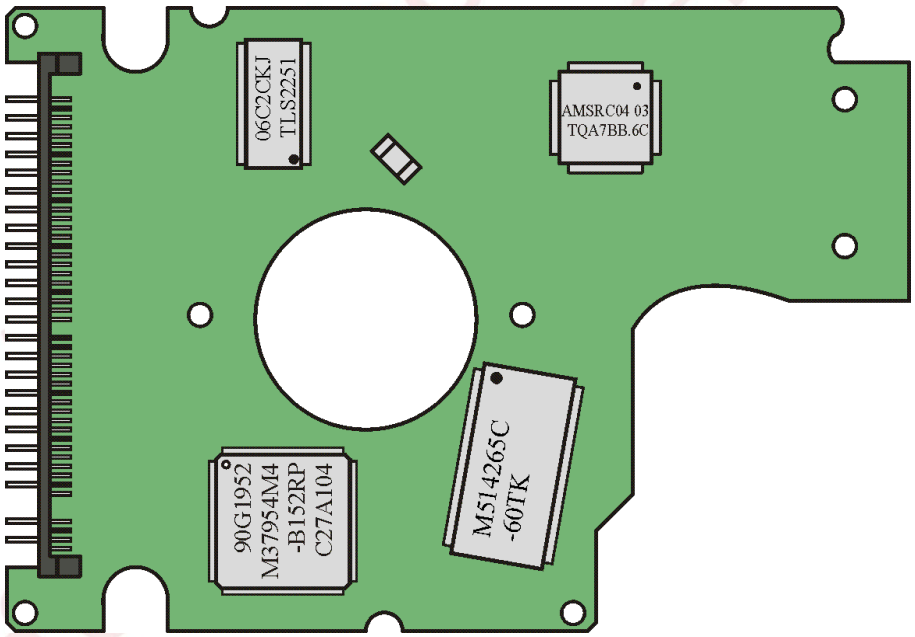


Fig. 9.19. External view of the controller board in 12GN, DARA drive family.

9.20. 20GN, DJSA drive family

Tabe 39. DJSA family models

Drive family:	Model	Capacity, GB	Maximum LBA
20GN, DJSA	DJSA-220 DJSA-210 DJSA-205	20 10 5	39,070,080 19,640,880 9,767,520

Tabe 40. DJSA family specifications

Parameter	Purpose
Size	2.5"
Drive family code	J2
Spindle motor rotational speed	4200
NV-RAM	No

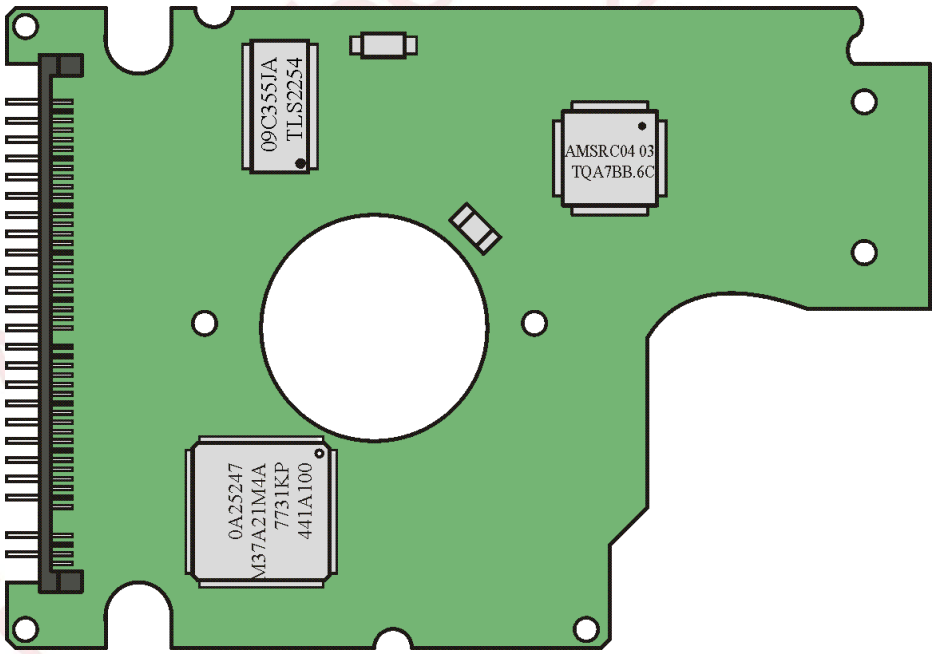


Fig. 9.20. External view of the controller board in 20GN, DJSA drive family.

9.21. 30GT, DJSA drive family

Tabe 41. DJSA family models

Drive family:	Model	Capacity, GB	Maximum LBA
30GT, DJSA	DJSA-230	30	58,605,120

Tabe 42. DJSA family specifications

Parameter	Purpose
Size	2.5"
Drive family code	J2
Spindle motor rotational speed	4200
NV-RAM	No

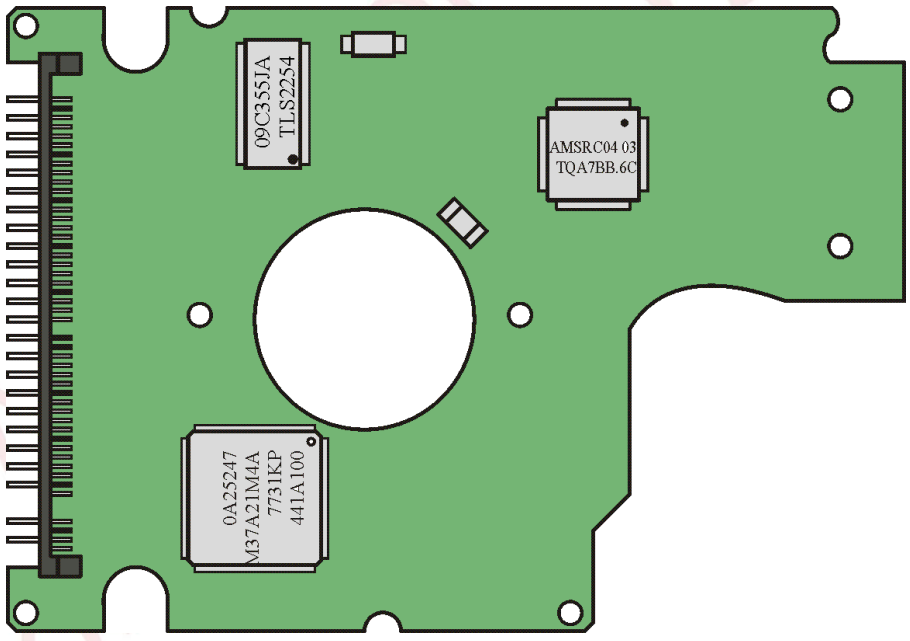


Fig. 9.21. External view of the controller board in 30GT, DJSA drive family.

9.22. 32GH, DJSA drive family

Tabe 43. DJSA family models

Drive family:	Model	Capacity, GB	Maximum LBA
32GH, DJSA	DJSA-232	32	62,506,080

Tabe 44. DJSA family specifications

Parameter	Purpose
Size	2.5"
Drive family code	J2
Spindle motor rotational speed	5400
NV-RAM	No

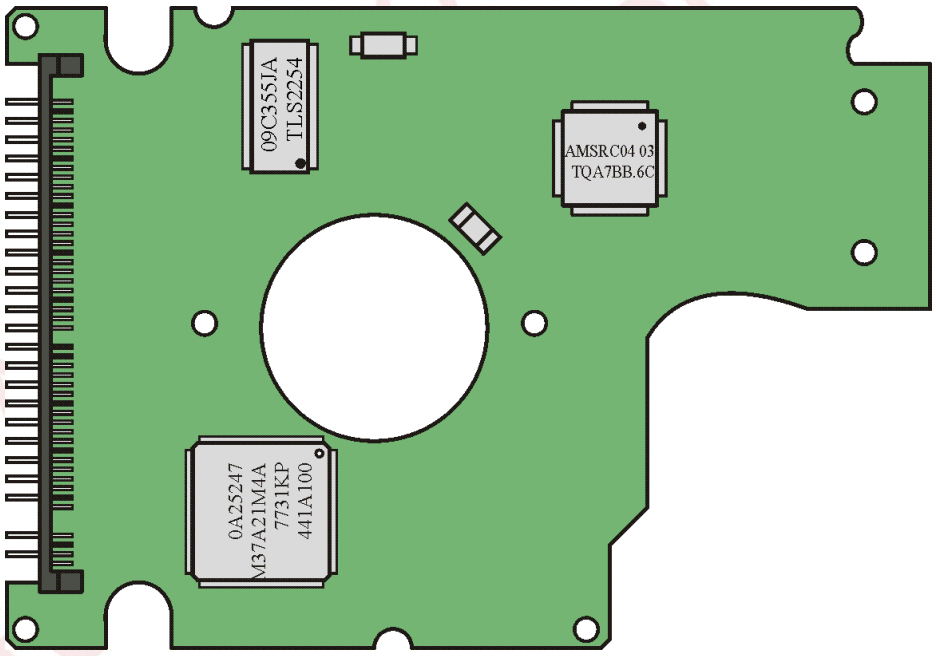


Fig. 9.22. External view of the controller board in 32GH, DJSA drive family.

9.23. 30GN, ATDA drive family

Table 45. ATDA family models

Drive family:	Model	Capacity, GB	Maximum LBA
15GN, 30GN, 48GH, ATDA	IC25T048ATDA05	48	93,759,120
	IC25N030ATDA04	30	58,605,120
	IC25N020ATDA04	20	39,070,080
	IC25N015ATDA04	15	29,498,112
	IC25N012ATDA04	12	23,579,136
	IC25N010ATDA04	10	19,640,880
	IC25N007ATDA04	7,5	14,651,280
	IC25N006ATDA04	6	11,733,120
	IC25N005ATDA04	5	9,767,520

Table 46. ATDA family specifications

Parameter	Purpose
Size	2.5"
Spindle motor rotational speed	4200 RPM, 5400RPM для IC25T048ATDA05
NV-RAM	No

To unlock the HDD, connect the probe to the same location as with ATCS drives (see Fig. 9.25).

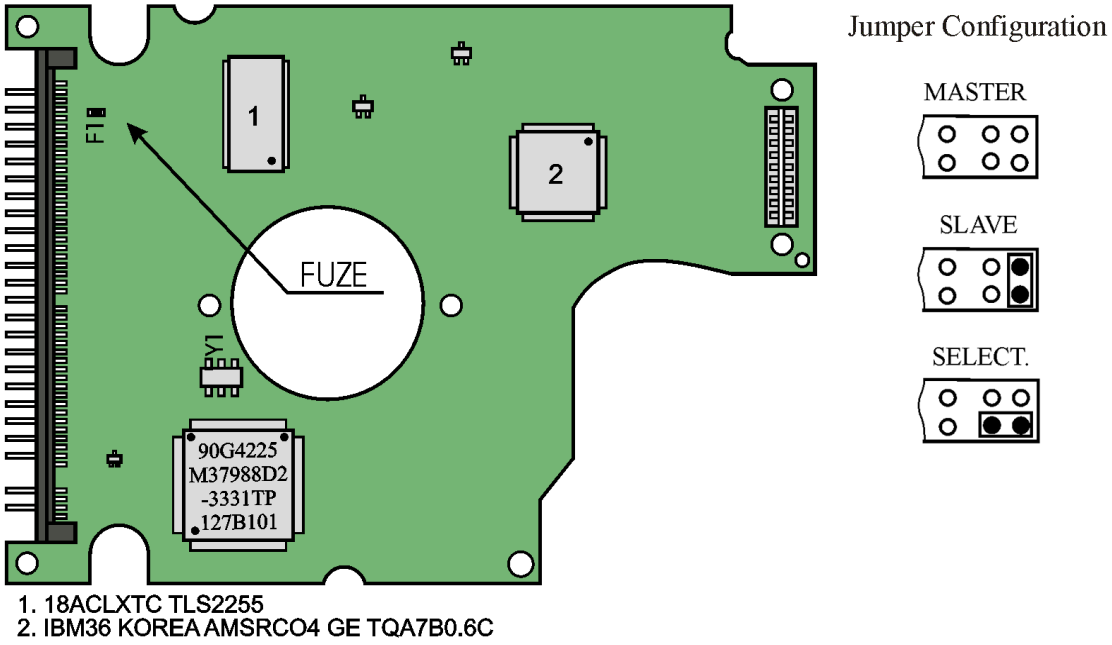


Fig. 9.23. External view of the controller board in 30GN, ATDA drive family.

9.24. 40GN, ATCS drive family

Table 47. ATCS family models

Drive family:	Model	Capacity, GB	Maximum LBA
40GN, ATCS	IC25T060ATCX05	60	117,210,240
	IC25N040ATCS04	40	78,140,160
	IC25N030ATCS04	30	58,605,120
	IC25N020ATCS04	20	39,070,080
	IC25T060ATCX05	10	19,640,880

Table 48. ATCS family parameters

Parameter	Purpose
Size	2.5"
Spindle motor rotational speed	4200 RPM, 5400RPM для IC25T060ATCX05
NV-RAM	NONE

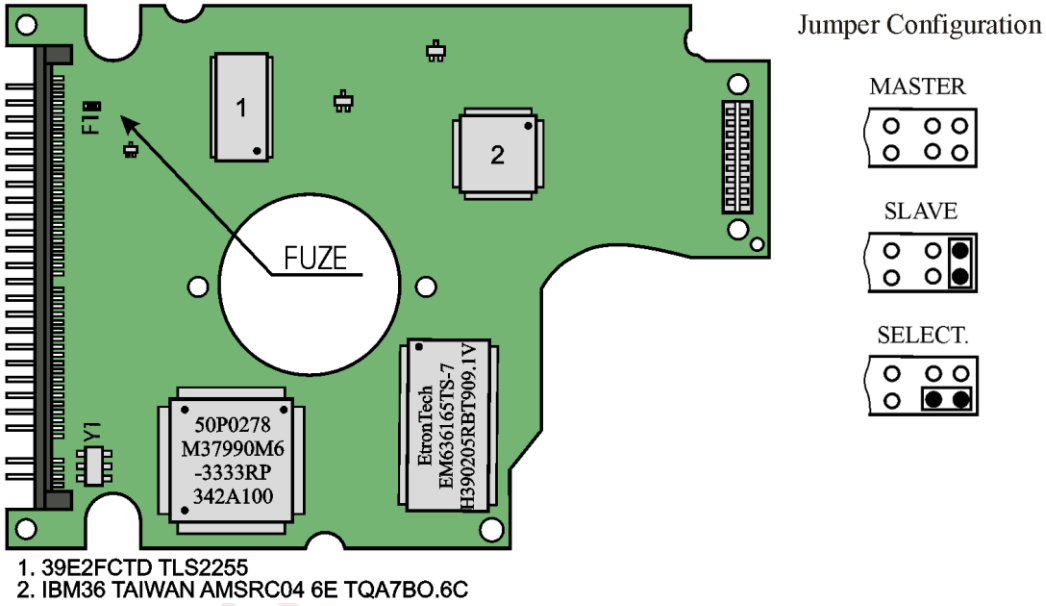


Fig. 9.24. External view of the controller board in 40GN, ATCS drive family.

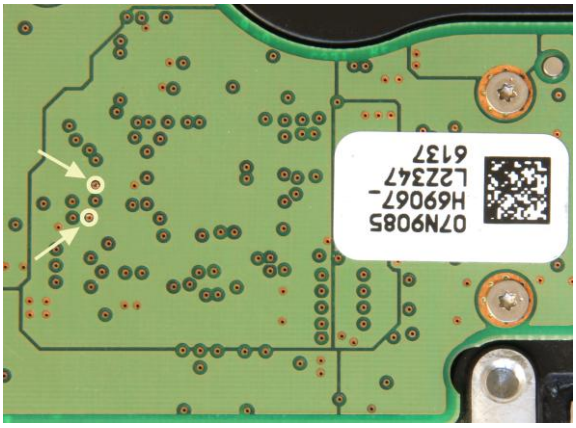


Fig. 9.25. Location where the probe should be connected to unlock a HDD.

9.25. 80GN, ATMR drive family

Table 49. ATMR family models

Drive family:	Model	Capacity, GB	Maximum LBA
80GN, ATMR	IC25N080ATMR04	80	156,301,488
	IC25N060ATMR04	60	117,210,240
	IC25N040ATMR04	40	78,140,160
	IC25N030ATMR04	30	58,605,120
	IC25N020ATMR04	20	39,070,080

Table 50. ATMR family specifications

Parameter	Purpose
Size	2.5"
Spindle motor rotational speed	4200 RPM
NV-RAM	256 bytes, 3 bytes ECC

To unlock the HDD, connect the probe to the same location as with HTS548 drives (see Fig. 9.13).

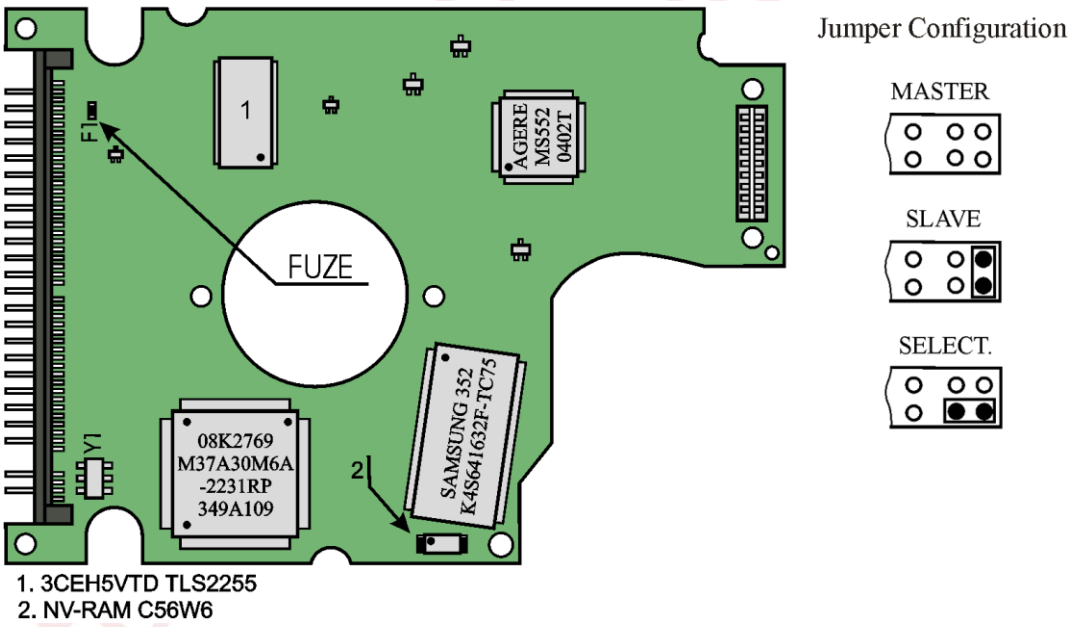


Fig.9.26. External view of the controller board in ATMR drive family.

9.26. 5K80, HTS548 drive family

Table 51. HTS548 family models

Drive family:	Model	Capacity, GB	Maximum LBA
5K80, HTS458	HTS548080M9AT00HT	80	156,301,488
	S548060M9AT00	60	117,210,240
	HTS548040M9AT00	40	78,140,160
	HTS548030M9AT00	30	58,605,120
	HTS548020M9AT00	20	39,070,080

Table 52. HTS548 family specifications

Parameter	Purpose
Size	2.5"
Spindle motor rotational speed	5400 RPM
NV-RAM	256 bytes, 3 bytes ECC

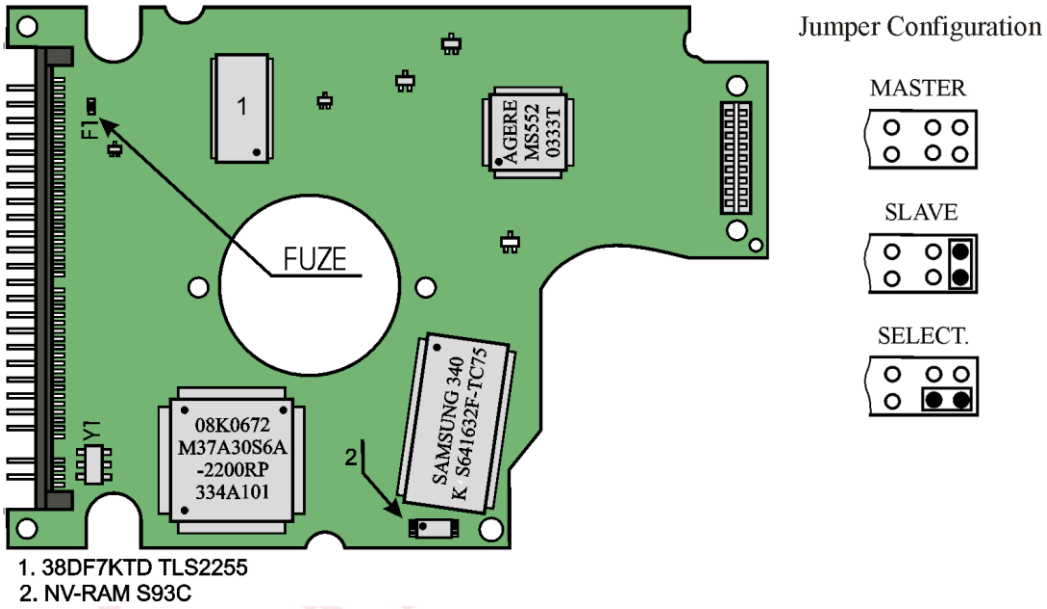


Fig.9.27. External view of the controller board in HTS458 drive family.

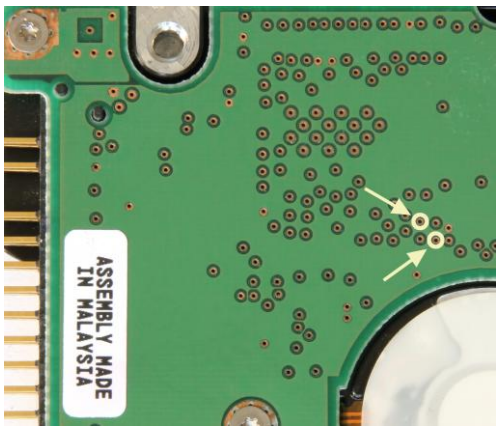


Fig.9.28. Location where the probe should be connected to unlock a HDD.

9.27. 7K60, HTS726 drive family

Table53. HTS726 family models

Drive family:	Model	Capacity, GB	Maximum LBA
7K60, HTS726	HTS726060M9AT00	60	117,210,240

Table 54. HTS726 family specifications

Parameter	Purpose
Size	2.5"
Spindle motor rotational speed	5400 RPM
NV-RAM	256 bytes, 3 bytes ECC

To unlock the HDD, connect the probe to the same location as with HTS548 drives (see Fig. 9.28).

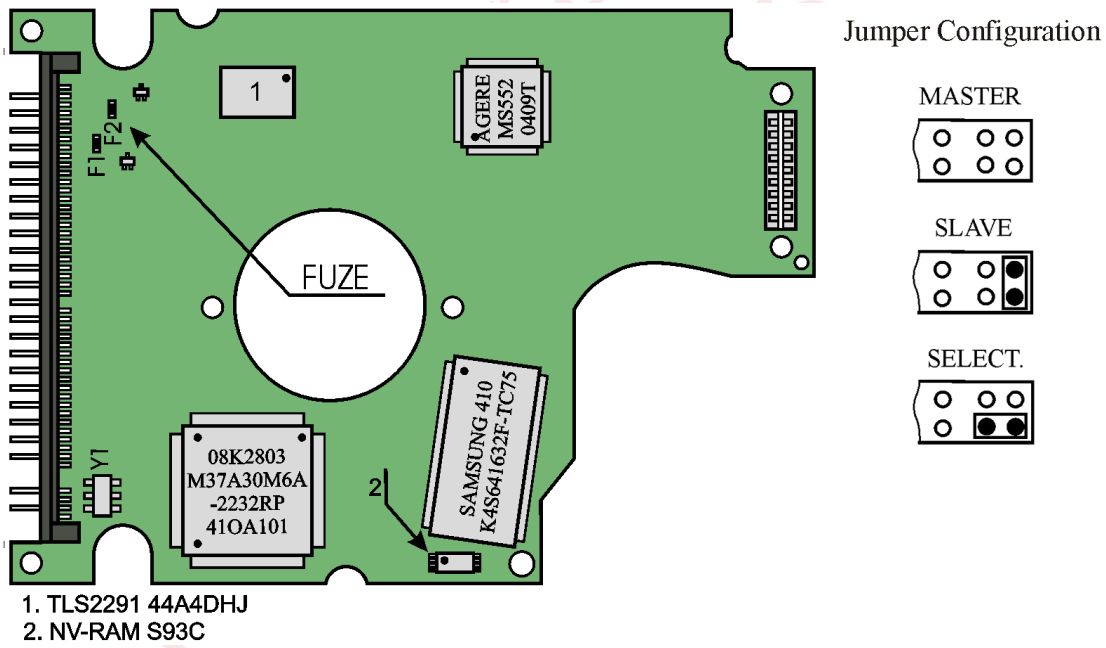


Fig.9.29. External view of the controller board in HTS726 drive family.

9.28. 4K40, HTS424 (HTS424M9) drive family

Table 55. HTS424 family models

Drive family:	Model	Capacity, GB	Maximum LBA
4K40, HTS424	HTS424040M9AT00 HTS424030M9AT00 HTS424020M9AT00	40 30 20	40,007,761,920 30,011,642,880 20,007,761,920

Table 56. HTS424 family specifications

Parameter	Purpose
Size	3.5"
Drive family code	M7
Spindle motor rotational speed	4200
NV-RAM	512 bytes

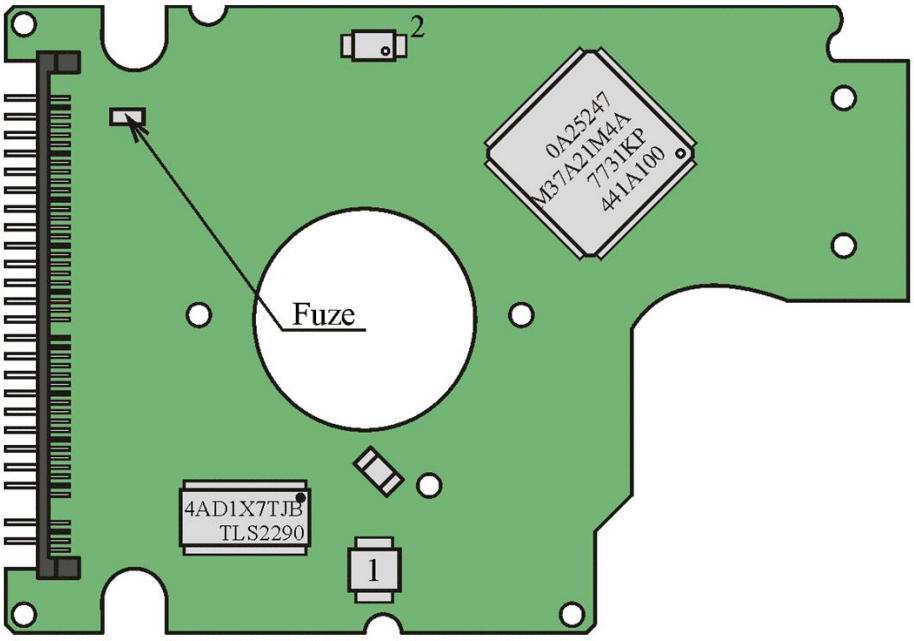


Fig.9.30. External view of the controller board in 4K40, HTS424 (HTS424M9) drive family.

9.29. 5K100, HTS541 (HTS541G9) drive family

Table 57. HTS541 family models

Drive family:	Model	Capacity, GB	Maximum LBA
5K100, HTS541	HTS541010G9AT00	100	195,371,568
	HTS541080G9AT00	80	156,301,488
	HTS541060G9AT00	60	117,210,240
	HTS541040G9AT00	40	78,140,160
	HTS541030G9AT00	30	58,605,120
	HTS541020G9AT00	20	39,070,080
	HTS541010G9SA00	100	195,371,568
	HTS541080G9SA00	80	156,301,488
	HTS541060G9SA00	60	117,210,240
	HTS541040G9SA00	40	78,140,160
	HTS541030G9SA00	30	58,605,120
	HTS541020G9SA00	20	39,070,080

Table 58. family specifications

Parameter	Purpose
Size	3.5"
Drive family code	M8
Spindle motor rotational speed	5400
NV-RAM	512 bytes

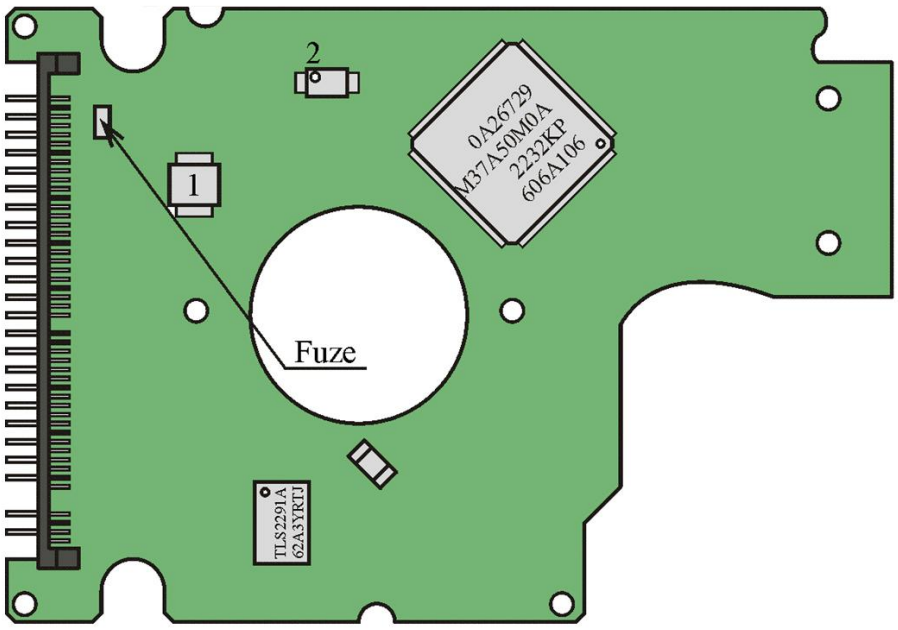


Fig.9.31. External view of the controller board in 5K100, HTS541 (HTS541G9) drive family.

9.30. 7K100, HTS721(HTS721G9) drive family

Table 59. HTS721 family models

Drive family:	Model	Capacity, GB	Maximum LBA
7K100, HTS721	HTS721010G9AT00 HTS721080G9AT00 HTS721060G9AT00	100 80 60	195,371,568 156,301,488 117,210,240

Table 60. HTS721 family specifications

Parameter	Purpose
Size	3.5"
Drive family code	M9
Spindle motor rotational speed	7200
NV-RAM	512 bytes

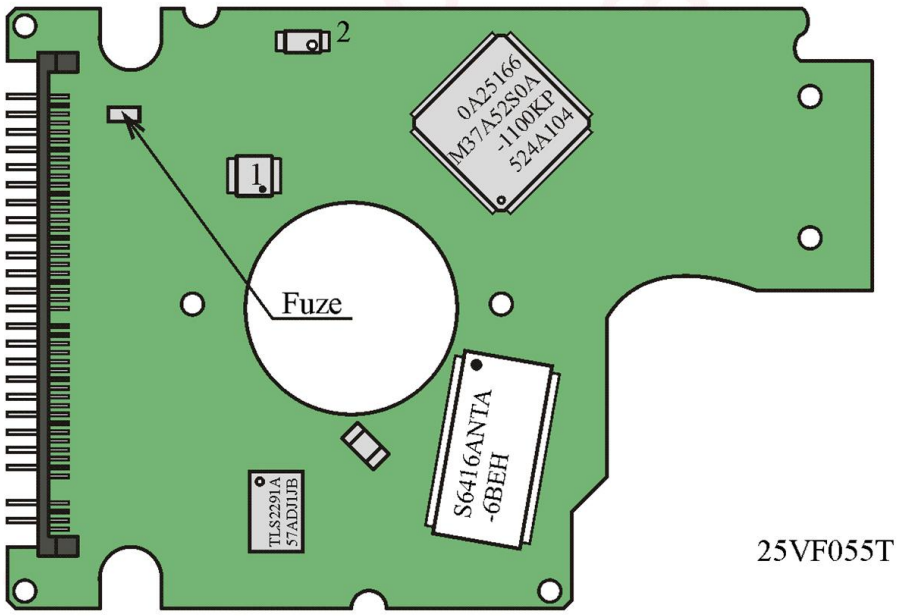


Fig.9.32. External view of the controller board in 7K100, HTS721(HTS721G9) drive family.