

Hitachi HDDs Repair Scheme Based on MRT Pro

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Table of Contents

1. Overview

1.1 Basic information of Hitachi disc label

2. Basic structure of Hitachi HDDs

2.1 Structure of Toshiba HDD PCB

2.2 Hitachi HDD boot principle

3. Firmware description of Hitachi HDD

3.1 ROM and NV-RAM

3.2 SA firmware description

3.3 Key modules

4. MRT Hitachi factory program

4.1 Boot options

4.2 Common functions

4.3 Usage of the program

4.4 Key modules

4.5 Software restoration

1. Overview

1.1 Basic information of Hitachi disc label Hitachi-IBM Series HDD



Hitachi-ARM Series HDD

HITACHI www.hitachigst.com

Production Date



0F13180MRS5Q00C19

SEP-2011



P/N: 0F13180



S/N: 5H02B4ZG

CAPACITY: 1.0TB MLC: MRS5Q0 FW: 5Q0—Firmware Version

LBA: 1.953.525.168 SECTORS CHS: 16383/16/63

MADE IN CHINA BY Hitachi Global E182115 CN

Storage Products(Shenzhen)Co., Ltd. CN

RATED: 5V 420mA.12V 420mA

SATA 6.0 Gb/s

HDS721010DLE630

RPM: 7200RPM

Rotation
Speed

Type DS7SAE100

C P/N: H3D10003272S

Interface Type & Maximum Transmission Speed

2. Basic structure of Hitachi HDDs

2.1 Structure of Toshiba HDD PCB

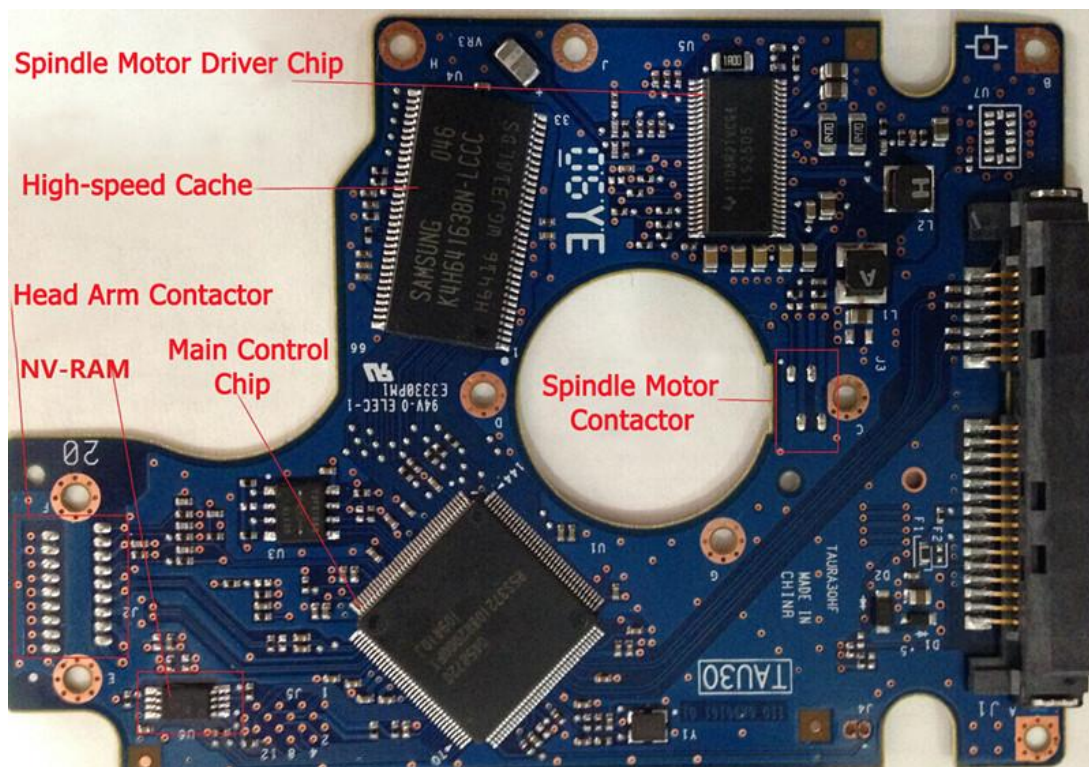
Like HDDs of other brands, firmware of Hitachi HDDs locates in the separate SA of magnetic surface and consists of many modules. The only obvious difference is that PCB of Hitachi HDD adopts serial non-volatile memory chips (NV-RAM, non-volatile memory); Storage capacity is 256/512/1024 bytes. This memory chip stores calibration information modules of corresponding HDD models. There are main control chip, motor driver chip, Flash ROM and high-speed cache on PCB. The disc can be divided into firmware zone and user area (data area).

There are three kinds of ROM chips on PCB:

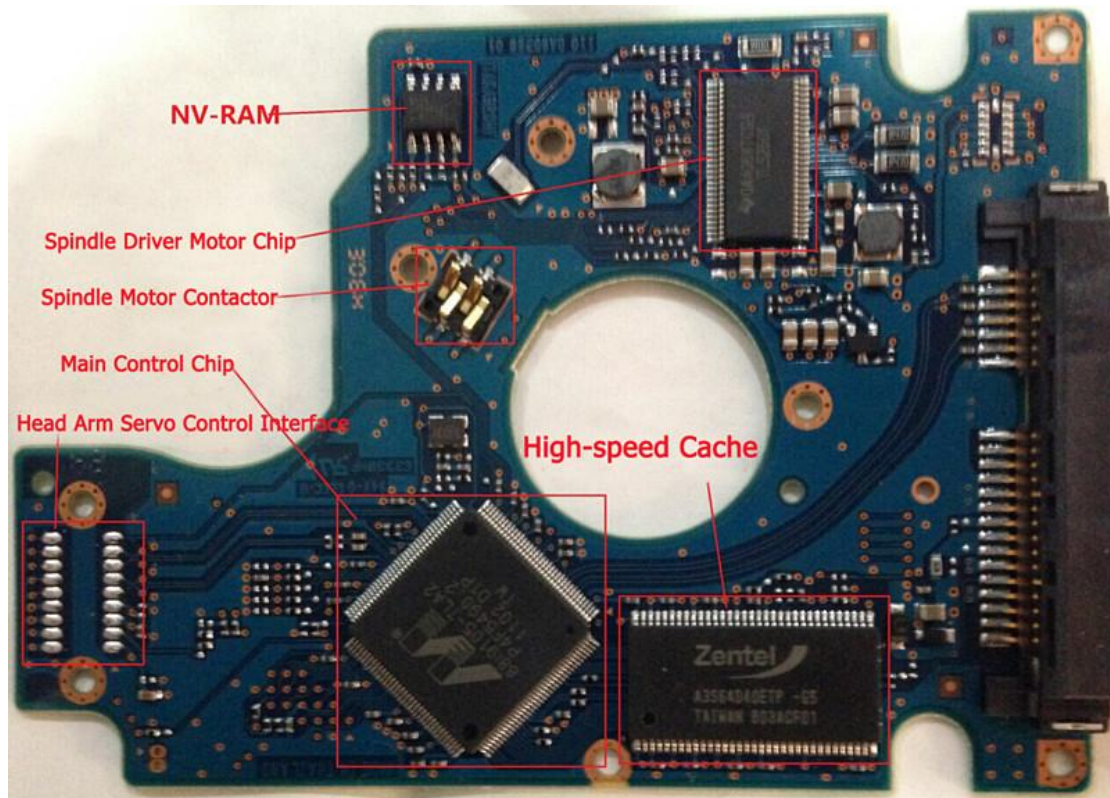
- ① Mask ROM integrated in processor contains executable code and default settings.
- ② NV-RAM (non-volatile RAM) includes setting parameters of access to HDD firmware zone. Model S93C56, capacity is 512 bytes.
- ③ The third ROM chip is not included on all PCBs. This Flash ROM stores firmware data used for sample test instead of mask ROM (allow modification of error code). The socket of this chip locates near NV-RAM. Model 25FV101T, the capacity is 1M bytes.

Structure of Hitachi HDD PCB is shown below (PCB of 2.5" laptop HDD):

PCB Structure of Hitachi-IBM



PCB Structure of Hitachi-ARM

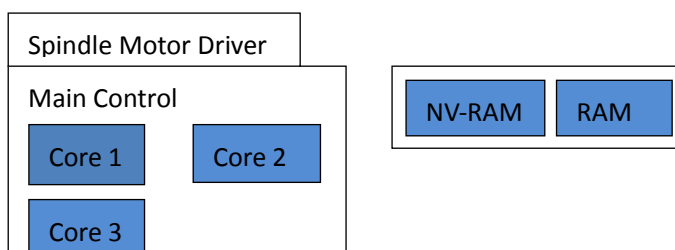


HDDs of earlier models have two heads (Sometimes, you may encounter factory-restored HDDs with only one head), or 5 heads at most. HDDs of these series adopt glass discs, which is smoother than aluminum discs in the surface. As can be seen from the figure above, there is no significant changes in PCB structure from IBM series to ARM series of Hitachi HDDs. There are two functions of main control chip.

- ① Control movement of the head arm and process the physical read and write of HDDs.
- ② Control SATA interface, process high-speed cache and translate logical block addressing into cylinder / head / sector.

Hitachi HDD firmware includes three parts: startup information of ROM, configuration information of NR-RAM and loadable information of HDD firmware zone (Diskin firmware, disk firmware)

2.2 Hitachi HDD boot principle PCB structure of Hitachi HDD



- .Core ROM(Bootload) physical read and write of disc.
- .Core 2: Process SATA interface.
- .Core 3: Process cache and translate logical block addressing to cylinder / head / sector.

As can be seen from the figure that boot of Hitachi HDD can be divided into the following steps:

- ① After being powered on, master control start to execute Bootload code in ROM. Load ROM data to RAM. If error should occur in this process, servo and ATA will stop working.
- ② Master control start executing code in RAM, loading NV-RAM, and performing self check for all parts of HDD according to configuration information of NV-RAM, including number of heads, head performance, motor speed etc. If error occurs in this process, there may be the following phenomena:
 - a) Cannot get basic information of HDD.
 - b) Head cannot normally seek or servo system stops working.
 - c) Cannot load modules from SA.
 - d) Cannot access user data area.
- ③ Load necessary modules from SA, such as: ATA micro-program module, P-List, G-List, CHNL, ZONE etc. These modules are loaded into RAM for HDD to use when working. As long as there is no power failure, the information saved in RAM will always exist. If there is error in this process, the following phenomena may occur: Cannot get basic information of HDD.

2.2 Compatibility of PCB

Compatibility of PCB can be identified by the label at IDE joint (see Figure 3.1, there is same content in PIDM module, too). If the first characters of the first two lines are the same, then the PCBs are compatible and interchangeable. More accurate identification method is to identify by information of ROM or NV-RAM (As the data of NV-RAM may be damaged or rewritten, the information in ROM is more reliable).



Figure 3.1. Label of IDE joint

NV-RAM contains data of head bitmap. Therefore, HDD PCBs of same series but different models are not compatible. To make PCB compatible, we can rewrite NV-RAM from HDD of same model (provided that the version numbers of Flash ROM match).

You can view firmware version of PCB by running "Edit NV-RAM" under menu "Work with NV-RAM". The form of μ -Code: ER20A41A, of which ER stands for HDD family code (see Table 2, "family code"), 2 stands for number of heads,

A41A stands for firmware version number. In addition, you can view version number and version code of ROM firmware by "Basic Information" command.

3. Firmware description of Hitachi HDD

3.1 ROM and NV-RAM

We can learn from the above analysis:

Firmware boot program of Hitachi HDDs locates in ROM chip on PCB. Servo part of motor also locates in ROM, while HDD configuration information is saved in NV-RAM, including boot identification, head bitmaps, SA entry address, user area entry address, SA adaptive information etc.

Since ROM information cannot be modified but only be read, let us focus on analyzing data structure of NV-RAM. Now let us have a look at NV-RAM structure of a 2.5" notebook HDD.

Offset	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	NV-RAM Type
00000000	43	36	30	48	B5	4F	D7	17	04	01	00	00	00	00	00	00	Startup Identification
00000010	00	00	00	00	00	00	00	00	00	00	04	00	C0	01	00	00	C60H
00000020	00	00	00	00	00	01	02	03	6B	60	6E	80	5F	90	53	00	Head Bitmap
00000030	6B	60	6E	80	65	A0	5D	00	09	4F	4A	59	04	1D	7D	79	Adaptive Parameter
00000040	80	65	7A	72	C7	8E	CB	99	7B	82	80	88	81	85	42	1B	
00000050	00	00	00	00	01	05	00	04	09	4F	4A	59	04	1D	7D	79	
00000060	80	65	7A	72	C7	8E	CB	99	7B	82	80	88	81	85	42	1B	
00000070	00	00	00	00	01	05	00	04	94	01	00	00	D9	00	00	00	
00000080	75	FF	FF	FF	67	0A	00	00	05	ED	FF	FF	63	01	00	00	
00000090	4E	01	00	00	06	FF	FF	FF	EF	09	00	00	D7	EC	FF	FF	Data Area Entry Address
000000A0	60	60	00	40	00	40	A0	00	20	01	09	02	01	00	D8	0B	
000000B0	01	00	2B	7F	2B	7F	2B	7F	2B	7F	00	00	9F	2D	78	10	
000000C0	38	6F	3B	80	04	CD	2A	2A	35	35	FF	FF	00	00	00	00	
000000D0	00	00	0A	00	00	00	00	00	00	00	00	00	00	00	00	00	SA Entry Address
000000E0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
000000F0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000100	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000110	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000120	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000130	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000140	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000150	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000160	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000170	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000180	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000190	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
000001A0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	SN
000001B0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
000001C0	00	00	58	4B	47	39	34	44	5A	4D	FD	AE	D6	52	06	33	XRG94DZM
000001D0	7D	0A	20	00	00	88	00	00	00	00	53	02	16	00	EE	7F	
000001E0	00	27	2B	02	00	00	00	00	00	02	00	8A	52	00	00	00	
000001F0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	Check

NV-RAM of Hitachi-IBM HDD

- ① NV-RAM model is NV-RAM version number,
- ② Boot identification is firmware loading identification, which indicates that whether the HDD loads single-head firmware of multi-heads firmware. When the identification is 0, the HDD will only boot with single-head firmware. Otherwise the HDD will boot with multi-heads firmware.
- ③ Heads bitmap. Heads bitmap shows the logical sequence of head. At the same time, HDD also loads firmware according to logical master head.
- ④ Adaptive parameter. Adaptive parameter is unique to each HDD. This parameter indicates the adaptive information of HDD servo and heads.
- ⑤ Entry address of data area. It indicates the starting address of user data area.
- ⑥ SA entry address. It indicates the starting address of loading firmware. HDD loads firmware from disc through this address.
- ⑦ SN.
- ⑧ Check. As NV-RAM of Hitachi HDD performs automatic check, generally there will not be errors in the information, but we cannot rule out the checking

error of certain HDD here, which usually causes "open modules" unable to be read. At this time, we can clear all check bits and write to disk.

3.2 SA Firmware Description

SA firmware of Hitachi HDD is divided to main modules and open modules. Main modules are loaded according to the module list recorded in RESF / USAG (2.5 / 3.5) module and stored in firmware zone. Open modules is loaded by reading a certain area after entering factory mode.

Data of firmware zone can be divided into four categories:

- RSVD module, not recorded in modules list, used to mark the starting address of firmware zone.
- Modules listed in RESF / USAG, essential to the running of HDD.
- Modules not listed in RESF / USAG, used for HDD self-check.
- "Open modules" that are not listed in USAG.

It should be paid attention that the "open modules" use the aliases of modules. (e.g. RDMT module is named RDM1 in the "open modules" table.

Functions of firmware module are listed in Table 4 and Table 5.

Table 4 Main Modules

Module Name	Function
PSHT	Permanent Defects List (P-List)
RDMT	Grown Defects List (G-List)
ZONE	Firmware Zone Allocation List
RAM0	Resident Firmware
OVR1	Resident Firmware
SMRT	S.M.A.R.T. Module
PSWD or SECI	Password and Security Setting Module
IDNT	HDD ID
USAG	Modules Allocation List of Firmware Zone
RSVD	Start Tag of Firmware Zone
SRVM	Cylinder Defects List

Table 5 Open modules

RDM1	Alias of RDMT
RDM2	Copy of RDMT
PIDM	Module that Contains Tag Information of PCB and HDA
PDM1	Alias of PSHT
PDM2	Copy of PSHT
DDD0	DDD Program Log
ELG1	Log of Defects List
EVLG	Event Log
@@01 or MFGP	MFG parameter module – contains SELFSCAN

	parameters
--	------------

Note: MFGP module begin to appear in "Open modules table" since AVER series. In the "open modules table" of earlier HDDs, it is "~@@01.rmp".

3.3 Key Modules

The following modules are key modules of Hitachi HDDs: microcode module (RAM0, OVR0, OVR1), PSHT, RDMT, SRVM, ZONE, CHNL / CNSL (2.5 / 3.5). HDD will not be able to work normally if the above modules are not loaded properly. Users can put emphasis on checking if the information of above modules when analyzing faults. Additionally, the head bitmap data of NV-RAM should be correct, too.

An engineer of IBM put forward a way to identify firmware version: change the firmware version and keep firmware code unchanged. For example, after upgrade, firmware version number will be changed from A46A to A4xx, with the former two characters unchanged and only the latter two changed.

Note: Firmware of different HDD families cannot replace each other.

When the following conditions are met, the firmware is compatible:

- Version code of ROM and NV-RAM are the same.
- μ -Code of NV-RAM and Disk Firmware match.
- Only the latter two characters of ROM version number and NV-RAM version number are different.

4. MRT Hitachi factory program

MRT data recovery software is a high-performance HDD repair and data recovery suite for data recovery market released by MRT Lab. There incorporates the following modules: disc scan tool, ROM programming tool, data copy and file extraction tool, HDD repair of Seagate, Western Digital, Hitachi, Toshiba etc.

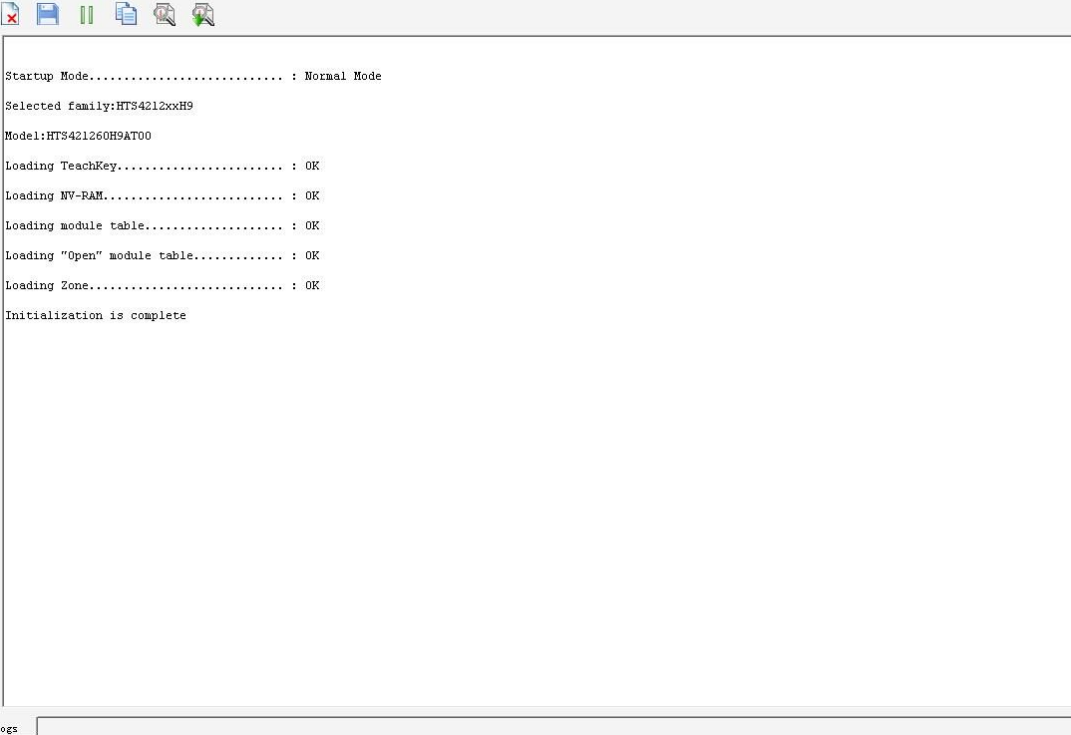
4.1 Boot Options

There are three modes of boot for selection in Hitachi HDDs repair module: "regular mode", "safe mode" and "diagnostic mode." When boot in "regular mode", the program will read ROM, NV-RAM and disc firmware in sequence; When boot in "safe mode", the program will no longer read firmware of disc but ignore internal fault and visit PCB only. If the damage of HDD firmware data cause it stops responding or starts clicking, you should select "safe mode". When boot in "diagnostic mode", the program will check the version of NV-RAM and clear the check of NV-RAM, then check and repair the following modules: "RSVD", "RESF version", "RAM0", "OVR0", "OVR1", "PSHT", "RDMT" etc. Finally it will check zone information of ZONE module.

The program will read the HDD ID information first when boot. The extracted HDD ID information will be displayed in "HDD information" bar at the top of window. There will display "model", "SN", "firmware version" and "capacity" by default. Then the program will conduct necessary initialization according to selected HDD family.

The following is detailed description of several boot modes.

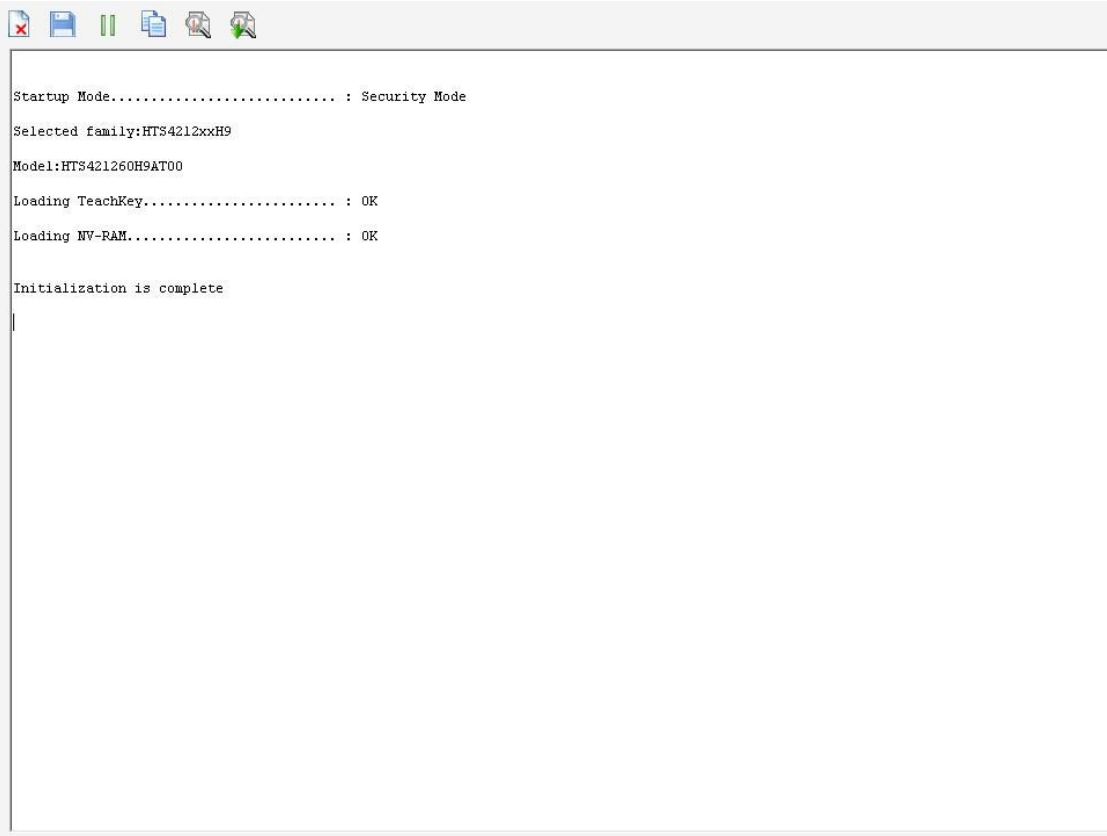
① "Regular mode". The interface of starting in regular mode is shown below:



```
Startup Mode..... : Normal Mode
Selected family:HTS4212xxH9
Model:HTS421260H9AT00
Loading TeachKey..... : OK
Loading NV-RAM..... : OK
Loading module table..... : OK
Loading "Open" module table..... : OK
Loading Zone..... : OK
Initialization is complete
```

Logs

② "Safe mode". Starting in safe mode:

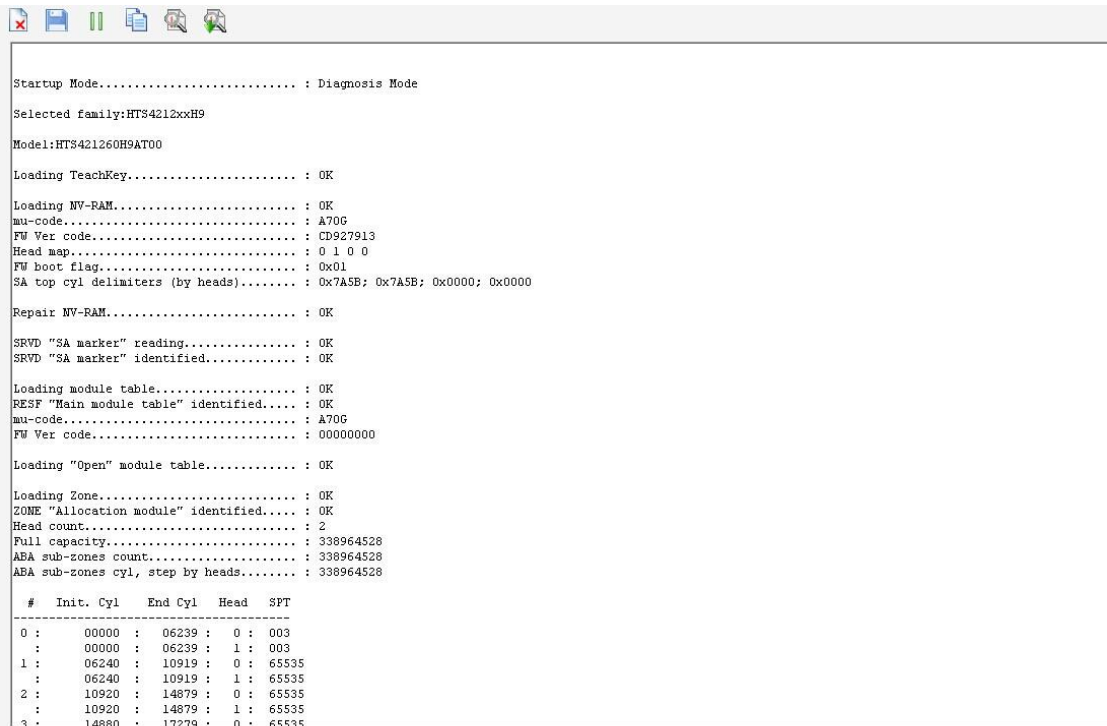


```
Startup Mode..... : Security Mode
Selected family:HTS4212xxH9
Model:HTS421260H9AT00
Loading TeachKey..... : OK
Loading NV-RAM..... : OK

Initialization is complete
```

Logs

③ "Diagnostic mode". Starting in diagnostic mode:



```
Startup Mode..... : Diagnosis Mode
Selected family:HTS4212xxH9
Model:HTS421260H9AT00
Loading TeachKey..... : OK
Loading NV-RAM..... : OK
mu-code..... : A706
FW Ver code..... : CD927913
Head map..... : 0 1 0 0
FW boot flag..... : 0x01
SA top cyl delimiters (by heads)..... : 0x7A5B; 0x7A5B; 0x0000; 0x0000
Repair NV-RAM..... : OK
SRVD "SA marker" reading..... : OK
SRVD "SA marker" identified..... : OK
Loading module table..... : OK
RESF "Main module table" identified..... : OK
mu-code..... : A706
FW Ver code..... : 00000000
Loading "Open" module table..... : OK
Loading Zone..... : OK
ZONE "Allocation module" identified..... : OK
Head count..... : 2
Full capacity..... : 338964528
ABA sub-zones count..... : 338964528
ABA sub-zones cyl, step by heads..... : 338964528

#   Init. Cyl   End Cyl   Head   SPT
-----
0 :   00000 :   06239 :   0 :   003
  :   00000 :   06239 :   1 :   003
1 :   06240 :  10919 :   0 :  65535
  :   06240 :  10919 :   1 :  65535
2 :  10920 :  14879 :   0 :  65535
  :  10920 :  14879 :   1 :  65535
3 :  14880 :  17279 :   0 :  65535
```

Logs

4.2 Common Functions

① Load technique keys. If error occurs, there will display the following message:

"Load TeachKey Error "

② Read NV-RAM to get some internal parameters of HDD. If error occurs, there will display the following message:

"Read NV-RAM Error "

③ Read the modules table ("USAG"), the program will read Copy0 of USAG first. If Copy0 cannot be read, it will attempt to read Copy1. There will display the following message if error occurs:

Read module table Error, Try to Copy1

If error occurs when reading Copy1, there will display the following message:

Read module table Error

④ Read "open modules table". If error occurs, there will display the following message:

Read "Open modules table" Error

⑤ Read zone allocation table ("ZONE"). If error occurs, there will display the following message:

Read ZONE Error.

If reading this module is successful, there will try to get number of heads according to this module; Otherwise number of heads will not be displayed but initialized to 0.

If the above error messages appear, please refer to the following failure analysis and solutions.

4.3 Usage of the program

① NV-RAM

Firmware version number (e.g. A45A). The first two characters of firmware version number should be the same as that of μ -code, otherwise the HDD cannot initialize with data of NV-RAM and the servo system cannot work properly. This firmware version code should also be the same as the corresponding code of NV-RAM. If not, the HDD cannot initialize with data of NV-RAM and the servo system cannot work properly.

② Basic information of HDD.

The following information will be displayed when you view the basic information:

- Identifier.

-- μ -Code: the first four characters (ER40) indicate HDD model (see Table 2 "family code").

Table 2 Family Code

Code	Drive family
J5	DJNA 5400
J7	DJNA 7200
TW	DLTA 5400
TX	DLTA 7200
ER	IC35AVER
VA	IC35AVVA

The last four characters (A45A) indicate the firmware version number. It is related with firmware version number of ROM: the first two characters (A4) must be the same, while the last two characters can be different. Additionally, μ - Code in NV-RAM should also be the same with that in the modules table (RESF / USAG). Otherwise the HDD will initialize with the data of NV-RAM and the servo system will start but will not read the data on disc firmware zone.

--Code of microprogram version.

--Heads map (e.g. 00, 01, 02, 03). It indicates the number of heads and their connection status.

"SA structure test" (check firmware structure) is to check the integrity of firmware and whether there is damage of their content. Information of module is displayed in the program's Log page and Report page in the form of logs.

"Module object backup", this feature can fix a single module or a group of modules. It also allows reading modules in a variety of modes:

Read in combination mode

a) When only Copy 0 is damaged, some module contains incorrect data, or some data of the module needs to be read from a certain copy, this mode will be very useful.

b) Read selected Copies (Copy 0, 1, F), and ignore the read errors.

In read selected Copies mode, only user-selected Copies will be read. In multi-heads HDDs, Copy 1 corresponds with Head 1. In single-head HDDs, Copy 1 is located on another track. Accurate position of module copy is determined by SA entry address of NV-RAM. So if the data of multi-heads HDD is written to NV-RAM of single-head HDD, the HDD will start clicking – the HDD begins to seek corresponding module copy of nonexistent head.

Disc rotation will cause damage of Copy 1 module expands to neighboring tracks. Then you can use hex editor to put together and recover data read from Copy 0 and Copy1. Before doing this work, you should select "Ignore read errors" mode.

Caution: Not all modules have a copy in Copy 1. There is no Copy 1 or Copy F in modules that are listed in "Open modules table", but not listed in "Modules Table (USAG)".

"Copy F" will read modules written in factory. Caution: Only modules listed in "modules table (RESF / USAG)" have Copy F. In addition, "Copy F", "Copy 0" and "Copy 1" of micro-code modules (microprogram) RAM0, OVR0, OVR1 are different; "Copy F" of SRVM (Cylinder Defect List) module is different from the

actually used module in the check part. Obviously, after "Copy F" of SRVM (cylinder defect table) module is written into HDD, the HDD was corrected, thus causing the difference. As a result, in the above modules, "Copy F" cannot replace "Copy 0" or "Copy 1", otherwise it will cause clicking or abnormal seek.

③ "Modify Configuration"

If some original module is unreadable, you can copy corresponding module from HDD of the same model. Here we must note that the module copied from other HDD needs to re-executed modification according to the configuration of modified head. The modules need to be modified are ZONE, SRVM (cylinder defect table) and CNS1 / CNSL. There is possibility that all modules are unreadable (when head 0 is damaged).

"Change head bitmap" is to change head bitmap by modifying NV-RAM data. When there are defective sectors in firmware zone, you can use this method to repair the HDD.

"Modify boot identification" is to clear NV-RAM boot flag. When firmware zone is damaged and causing HDD boot suspended or head starts clicking, you can use this command to visit firmware module on HDD. This method is like a "switch".

④ Recalculate Translator

As P-List of Hitachi -IBM series HDDs cannot be operated directly, you can only write defects in G-List to P-List with the command "Transform G-List to P-List". As this command operates on translator, it will ignore candidate defects (unstable sectors).

⑤ HDD ID

Modify HDD ID. HDD ID is read out by system BIOS at boot in desktop. While in MRT application, HDD ID is acquired directly from HDD when the program is initializing. Users just need to check if the information in firmware zone is in accordance with that of HDD label.

⑥ Formatting

Formatting is to recalculate translator. Cover the surface of HDD quickly with random code of sector buffer. If there encounters a severely damaged area, the process will stop. When performing this function, you need to fill in the starting LBA address and ending LBA address, formatting step length and the maximum number of sectors to skip, so as to skip some sectors and continue when error is encountered. In addition, you can also choose whether to record defects. If you selected a defects recording sector, there will display a defective sector list after formatting. Users can add the recorded defects to G-List, and finally execute the command of transforming G-List to P-List to shield defects to P-List.

⑦ Logical Scan

Logical scan is to scan the disc surface with logical parameters and save the defects as file. HDD will automatically record the detected bad sectors to defect list (LBA defects). After the scan is completed, there will display defect entries. Users can manually edit the defects file, write defects to G-List (RDMT) by

hiding defects, and finally transform G-List to P-List to write defects of RDMT to PSHT. After this operation, RDMT will be cleared.

⑧ Defect List

Caution: The program can display 65,535 records at most. If G-List contains more than 65,535 records, the excess will not be displayed. However, the total number of defects displayed at the beginning is correct.

⑨ Overall Offset of SA

When there is bad track in SA, you can try "SA overall offset" if there is a copy of HDD key modules. Caution: "SA overall offset" cannot use micro-code module of Copy F, of which the reason has been explained before. In addition, this method is also effective for some clicking HDDs. Specific method is as follows:

- a) Separate the head control contactor on PCB from the disc. Pay attention to keeping other parts unchanged. Wait for the HDD to be ready. The disc will rotate normally; Return the head control contactor and disc to the original condition. Then the head does not seek any more.
- b) Start the program in "safe mode" and select loading LDR. In this mode, the head will not seek unless disc is accessed. You can initialize "Modules Table" by loading LDR.
- c) Use the "SA overall offset" function to move SA to designated area.

If the HDD starts clicking after reading firmware data, you can fix the fault in the following method:

Unplug the servo system control cable between PCB and HDA, and wait for the HDD to be ready. In this case, the HDD can be initialized from NV-RAM normally. But due to the wrong version USAG, loading HDD data will stop while firmware zone can be accessed. Then you can perform firmware zone (Disk Firmware) diagnosis. Use the "modules batch backup / SA structure test" command to read the modules one by one. The module read when HDD starts clicking is the damaged module.

In addition, here provides a brief introduction of "safe mode" of IBM HDD. We can enter safe mode through a special jumper (see section 4). In safe mode, we can read / write NV-RAM, but cannot work with the disc surface. So we can replace "short circuit method" with safe mode to modify NV-RAM. HDDs of different families will have different functions over firmware repair in safe mode.

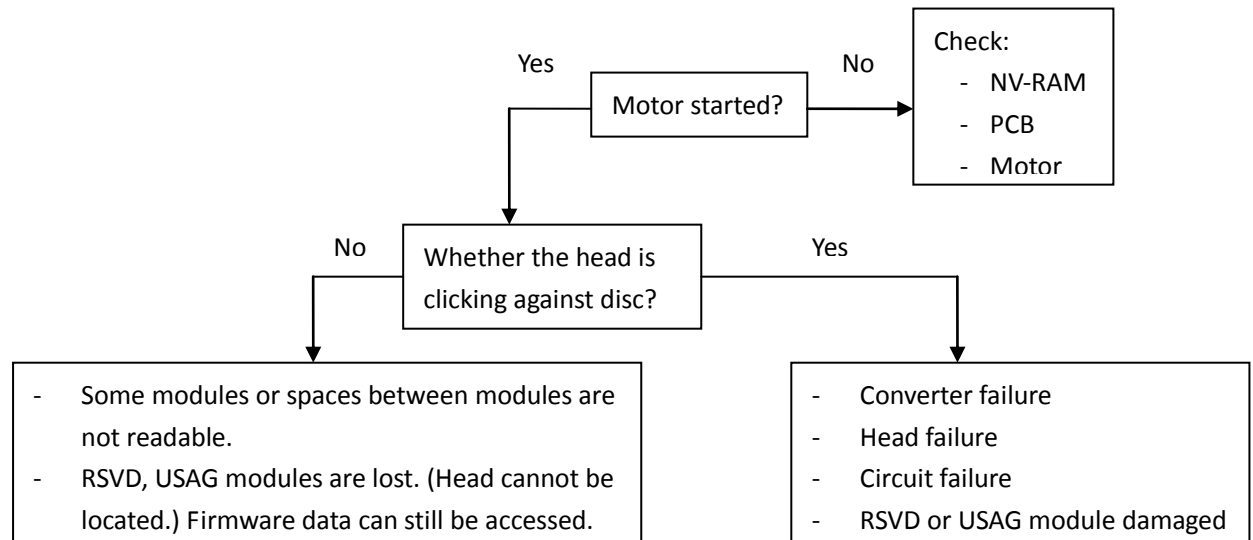
22GXP, 34GXP, 37GP	When addressing in firmware zone, overlays will be read and started. The HDD will be fully initialized. As a result, the HDD will start clicking if firmware zone is damaged.
40GV and Updated Model	Do not access firmware zone.

So safe mode cannot be used to test or restore firmware zone.

When working with firmware zone, you should abide by the instruction of the following two sections:

- Work with NV-RAM operation
- Work with firmware zone

Please refer to the following diagram as the guide for identifying faults:



Pay attention to the following issues when checking NV-RAM:

- The identifier must be "E2PR"
- Firmware version number and version code must match ROM firmware version number and version code respectively.

Head bitmap must match. There should not be incorrect head bitmap.

In addition, NV-RAM contains a checksum. If there is checksum error, the HDD will suspend loading data. Then you can re-copy the corresponding NV-RAM data.

When using the "SA structure test" command to check modules, the program will report the module as unreadable if some module cannot be read. In this case, you can write in corresponding normal module. Note that there is no checksum of modules in IBM HDDs, therefore it is a bit difficult to judge whether the module is damaged.

It is necessary to mentioned that the operation when "RSVD" module is damaged. When "RSVD" module is damaged, it often manifests as head failure, which cannot be repaired in common methods. Let us describe the situation and repair method:

Fault: HDD cannot find firmware and starts clicking. It cannot be written in, which is to say, all heads are disabled. Additionally:

- a) Part of the modules are damaged
- b) All the modules are damaged
- c) All the heads cannot read data

Cause: RSVD module damage. RSVD mark is still in the original position, but the data is invalid.

Repair method:

- Set the drive to safe mode (or for DJNA, DPTA models, unplug the servo system cable), modify the head bitmap - use another head (you can try using Head 1) to replace the original Head 0 and regenerate boot program. Then set the jumper back to regular mode. Turn on the power supply and wait for the HDD to report ready. You can also check NV-RAM.
 - Run the boot program to reassign the heads.
 - HDD should report ready, while there will still be the message "modules table unreadable".
 - Clear data of firmware zone
 - Turn off the power supply and then turn it on. Remove the data of firmware zone again. Note:
 - Rewrite NV-RAM, RSVD, USAG modules
 - Rewrite other modules
 - Run the boot program to write in modules (not the boot program of changing head bitmap, but the one of writing modules). This operation can ensure the modules written correctly.
 - Rewrite PSHT, RDMT
 - Turn off the power supply and then turn it on. Note:
 - Clear firmware area
 - Rewrite RSVD, USAG
 - Rewrite other modules
 - Run the boot program to write modules
 - Rewrite PSHT, RDMT
- Caution: The operations marked with arrow must be performed at one time. You cannot restart power supply or the program halfway.

4.4 Key Modules

The following modules are key modules of IBM HDDs: PSHT, RDMT, SRVM, ZONE, CNSL. In addition, head bitmap data of NV-RAM should also be correct. When the module is damaged, the phenomenon is the same as is shown in Table 4.1.

The heads of these series of HDDs may not be parked on the disc, but on the shelf made from special synthetic material on the outer edge of disc. This approach will make heads curve when entering and exiting, thus scratching the disc. Additionally, the heads will stick to the disc frequently.

If the defects of disc disappear during the writing, you can repair with the "factory formatting" command. It will no longer rewrite the entire disk space, so the speed is the fastest. For 40GB HDDs of AVER series, it will take about 25 minutes.

Many cases of sector damage are caused by poor contact of cable connecting PCB and HDA sector. The connection was done by plug near the power plug located under PCB, while the assembly of PCB is not firm with both mechanical displacement and thermal deformation can lead to the tin of plug falling off. Therefore, it should be re-welded before repaired.

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4.5 Software Restoration

① Identification and processing of defects in user area

Mrt Hitachi-IBM program can write defects to G-List and manually edit G-List (RDMT).

If it is caused by poor contact, please refer to *"IBM HDD PCB failure"*.

- a) Format. If it is completed normally (no error), then there is no severe damage.
- b) Run logical scan, and write defects to G-List. You cannot use physical parameters to make defects written to defect list automatically.
- c) If there are defects, recalculate translator. In this process, the defects of G-List will be written to P-List, and then G-List will be emptied. Note that candidate defects will not be written from G-List to P-List because HDD recognizes candidate defects as unstable region. If you want to write candidate defects to P-List, please enter RDMT editor (menu "Tools -> LBA defect list editor") and follow the prompts to write defects to P-List. Rebuilding compiler will be completed automatically.
- d) Run logical scan again. If defects are found, repeat Step 3.

"Factory formatting" command can operate on local servo area, then write defects to "cylinder defect list". After modifying "cylinder defect list", you should clear P-List and G-List because defects records of P-List and G-List have been invalid.

In addition, defects that are not added to G-List automatically can be added to G-List manually. After editing G-List, the program will recalculate translator automatically.

You can also add defects found by the "Formatting" command to defect list.

② Software restoration features

When firmware data is corrupted, HSS usually manifests as constantly clicking and continuous waiting etc. That is, software restoration cannot be realized. In this case, you need to prevent the HDD from loading firmware data from firmware zone while retain its access to firmware zone. This can be done by modifying head bitmap of NV-RAM and firmware version number etc.

Note: In safe mode, you can only read / write NV-RAM and cannot work with the disc surface.

③ Auxiliary Files

File name is selected by the user, and the extension is specified by the program according to the type:

- * .tsk - task files, used for saving settings of automatic test mode;
- * .bin - RAM / ROM firmware file, created when reading RAM / ROM;
- * .nvr - NV-RAM firmware file, created when reading NV-RAM;
- * .rpm - firmware module of HDD.

④ PCB Failure

The following describes the electronic components that may cause failure.

a) There is no doubt that the most annoying part is the connector between the PCB and HDA. The fixation of IBM HDD PCB is not firm, so mechanical and thermal deformation can both cause the tin of connector falling off. This can cause numerous "Phantom" bad sectors, and even cause damage to disc firmware. Therefore, the connector should be re-welded before repaired. You can use logical parameters to perform formatting so as to clear the "Phantom" bad sectors.

b) Microprocessor and ceramic filter near 35th pin of IDE interface can be tested with oscilloscope.

c) IDE interface failures caused by poor welding and low-impedance transmission nearby.

d) Voltage stabilizing circuit, coil and other power supply components. There is no separate voltage stabilizing chip on PCB. Voltage stabilizing function is realized by voltage stabilizing unit of servo system and voice coil control chip. The failure of voltage stabilizing circuit will cause the voltage to rise from 3.3V to 5V. This will not only burn components on PCB, but also damage the adapter inside the HDA. If you want to recover data from this HDD, you must replace the head assembly in HDA.

e) Flash ROM or NV-RAM on HDD. The damage of this chip or internal data will cause the HDD unable to run.

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