Data Recovery

Firmware and Service Area
Chapter 5
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Maxtor FW Repair

- To repair FW problems on Maxtor HDD it is important to understand the importance of FW and how it works
- FW is unique to the SA of each HDD and controls the calibration and track information
- The SA of a HDD contains critical information that the HDD needs to function properly
- Specialized micro code is stored in RAM
- Micro code is loaded into RAM from three sources 1) the marked ROM inside the processor chip or internal boot ROM, 2) the Flash ROM or external boot ROM, and 3) the HDD SA if it is installed on the HDD
- The information is programmed to the board during HDD construction to meet individual HDD specifications
- When FW fails this information must be reconstructed

Maxtor FW Repair

- N40P, Calypso, and Sabre drive family the manufacture uses an alternate SA
- Alternate SA is used during manufacturing for creating the main SA and hiding the defects
- The Alternate SA contains the same modules but their contents differ
- Not all N40P drives have an Alternate SA
- The Alternate SA is identified in the module table if the presence of module = 95 the HDD has no alternative SA
- A HDD with an alternate SA can be used to create a FW donor file to use for repair on another HDD without an alternate SA
- The alternative program version is NCRxxxx0 in N40P HDD and YCRxxxx0 in Calypso family HDD which represent the program inside the SA-C which is also known as Program C
- The program from the main SA-A is Program A

Maxtor FW Repair

- HDD with Alt-SA HDD boot ROM after motor starts reads the modules containing program code and the translator from the main SA checking the structure
- If structure = invalid and module cannot be read the loading switches to the Alternate SA-B
- If HDD initialized from an Alt-SA during operations a recovery of the HDD translator and program modules need to be repaired to switch the HDD back to SA-A
- The SA is accessible by UBA (unit block addressing) where the logical sectors assigned are automatically converted by the microcode into respective physical location on the disk surface taking into account the defects inside the SA

Maxtor FW Repair

- **The UBA block inside the SA consists of**:
1. Smart data
2. System logs
3. Serial number
4. Model number
5. P-List
6. G-List
7. Program overlays
8. Specific tables like PRO
9. Zone tables
10. Servo parameters
11. Test routines
12. Factory default table
13. Recalibration code routines
14. Translator data
15. Heads and tracks skewing information
16. Security data password for the drive

Maxtor FW Repair

- The HDD consists of 2 or more copies of the SA stored on the platter/platters of the HDD
- The SA information can be stored on the outer edge, innermost area near spindle, or randomly written in the platter
- If information in SA-A is corrupted it can be copied from SA-B
- HDD system logs can be written here
- The SA is not uniformed or standard and can be completely different for every HDD
- Selecting FW donor files there are 3 important factors needed: 1) the model number of the HDD, 2) the same code ID for the HDD (NAR61590) and 3) the first three digits of the serial number. Note that it is possible if the first three digit of your serial number are H14 and you can not find a FW donor file H14 try to use H13 or H15 they work fine in most cases. In some cases I have found that these FW donor files work better than matching the exact SN of the HDD
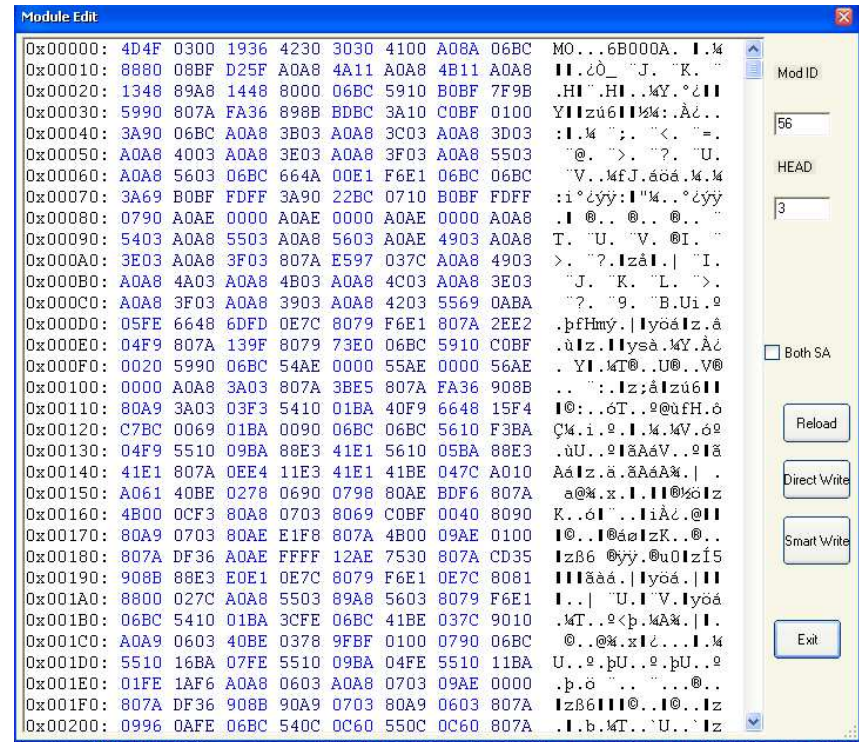
Maxtor FW Repair

- Key modules:
- Module 31 is the HDD parameter – the module contains model number, serial number, LBA, physical head map and number of heads
- **4449 534B** – Disk module header
- **0200 0300 0400 0500**
- **FFFF FFFF FFFF FFFF** – The eight two byte words limit the maximum number of heads.
- **3C00** - The first 4 bytes of address 0x00000020 and the 10th and 11th bytes of address
- x000001F0 are 0x3C00 (0x3C=00111100b
- **Binary** 0 0 1 1 1 1 0 0
- **Head** (0 1 2 3 4 5 6 7)

| Offset	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
00000000	44	49	53	4B	02	00	03	00	04	00	05	00	FF	FF	FF	FF	DISK........ÿÿÿÿ
00000010	FF	FF	FF	FF	20	5F	A0	12	04	00	04	00	20	5F	A0	12	ÿÿÿÿ _ ...... _ .
00000020	3C	00	3C	00	34	59	38	44	50	4D	45	44	20	20	20	20	<.<.4Y8DPMED
00000030	20	20	20	20	20	20	20	20	61	4D	74	78	72	6F	36	20	aMtxro6
00000040	31	59	30	36	30	4D	20	20	20	20	20	20	20	20	20	20	1Y060M
00000050	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	
00000060	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....
00000070	00	00	00	00	00	00	00	00	00	00	00	00	00	00	64	00	..............d.
00000080	64	00	32	00	4B	20	00	00	00	00	00	00	00	00	00	00	d.2.K ....
00000090	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....
000000A0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....
000000B0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....
000000C0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....
000000D0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....
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	01	00	00	74	15	13	61	4D	74	78	72	6F	36	20	31	59	...t..aMtxro6 1Y
00000110	38	36	34	4D	20	20	20	20	20	20	20	20	20	20	20	20	864M
00000120	20	20	20	20	20	20	20	20	20	20	20	20	20	20	00	74	.t
00000130	15	13	61	4D	74	78	72	6F	36	20	31	59	30	36	34	4D	..aMtxro6 1Y064M
00000140	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	
00000150	20	20	20	20	20	20	20	20	20	20	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	80	F7	4F	0E	61	4D	74	78	72	6F	......!÷O.aMtxro
00000190	36	20	31	59	30	32	34	4D	20	20	20	20	20	20	20	20	6 1Y024M
000001A0	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	
000001B0	20	20	20	20	20	20	20	20	20	00	00	00	00	00	00	00	....
000001C0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....
000001D0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....
000001E0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....
000001F0	00	00	00	00	00	00	00	00	00	00	3C	00	00	00	39	6F	..........<...9o

Maxtor FW Repair

- Key Mod 56

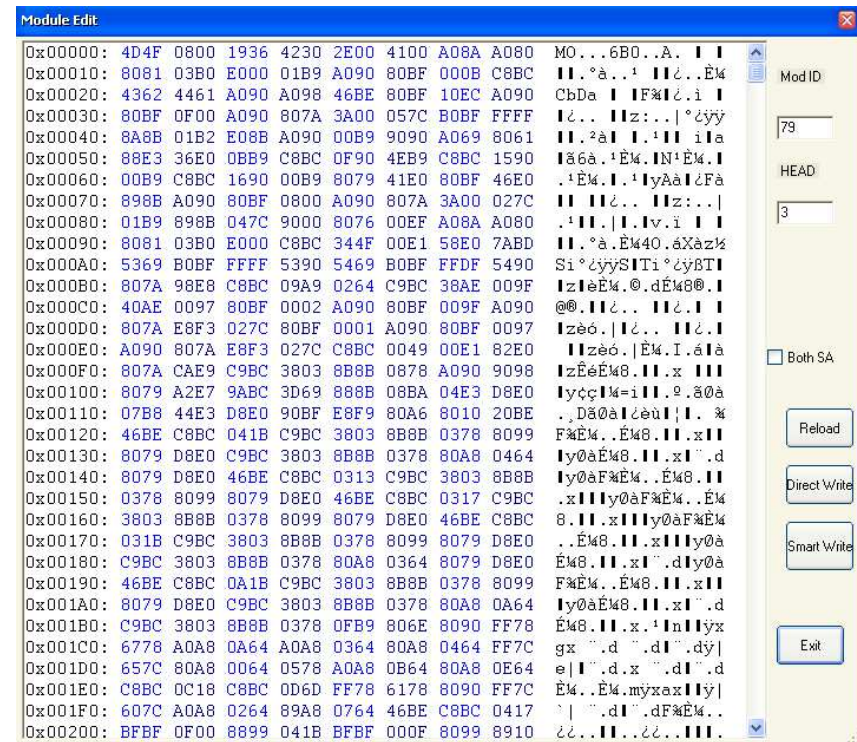- **4D4F 0300 1936 4230 3030 4100 0A8A 06BC** – HDD model series 6B000A

Maxtor FW Repair

- Key Mod 57
- ATA Module belonging to one group of ATA Mods that has to be uploaded together
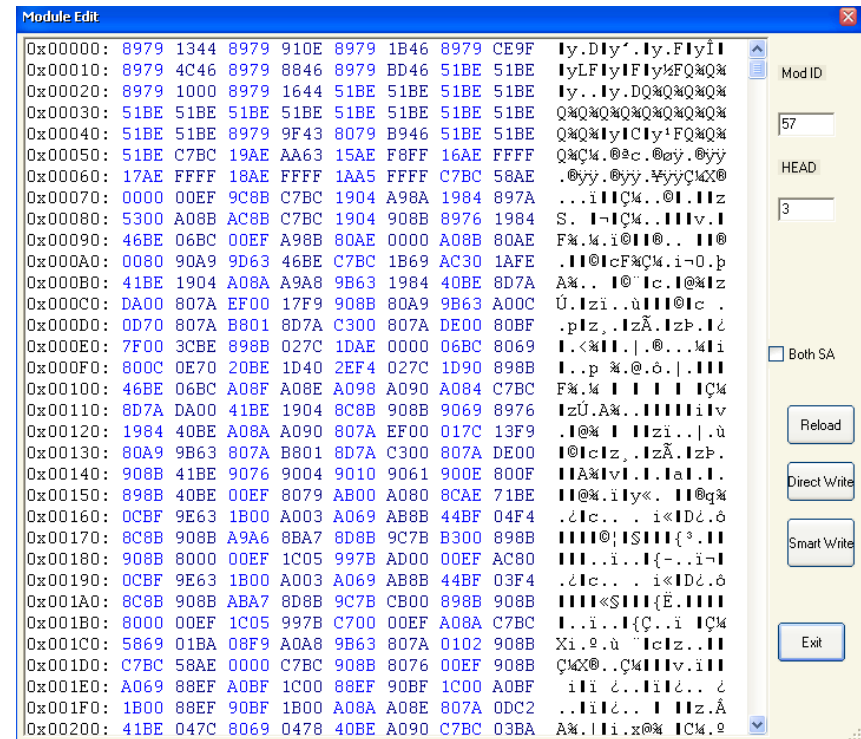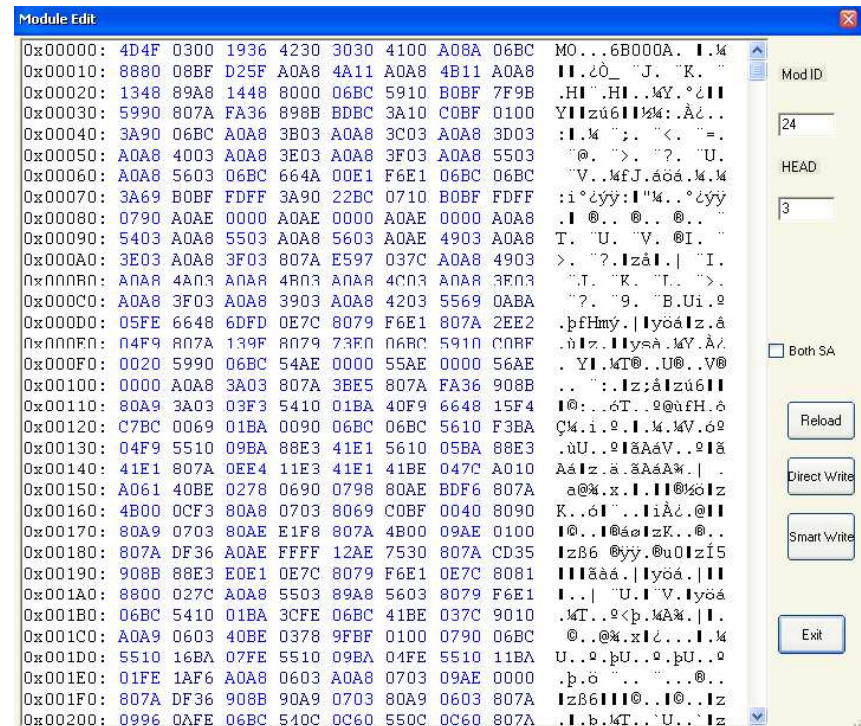
Maxtor FW Repair

- Key Mod 79
- **4D4F 0800 1936 4230 2E00 4100 0A8A A080 –** HDD LBA
- * Note: Module 56 57 79 - ATA Modules – belong to one group and need to be uploaded at the same time
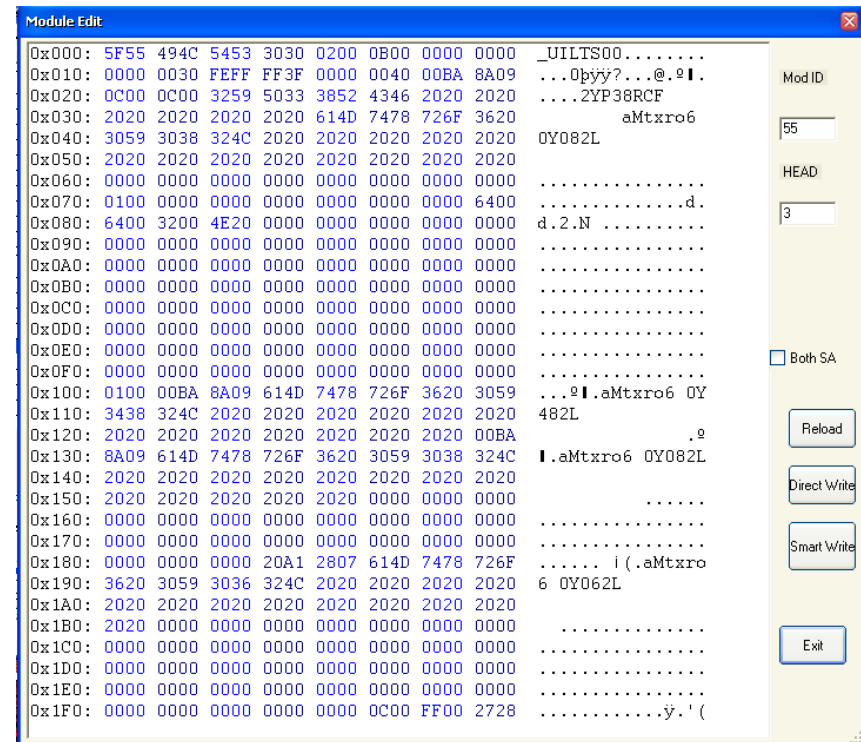
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- Key Mod 24

- P-List Module belonging to one group. This module can not be replaced by donor drive module

Maxtor FW Repair

- ## Key Mod 55

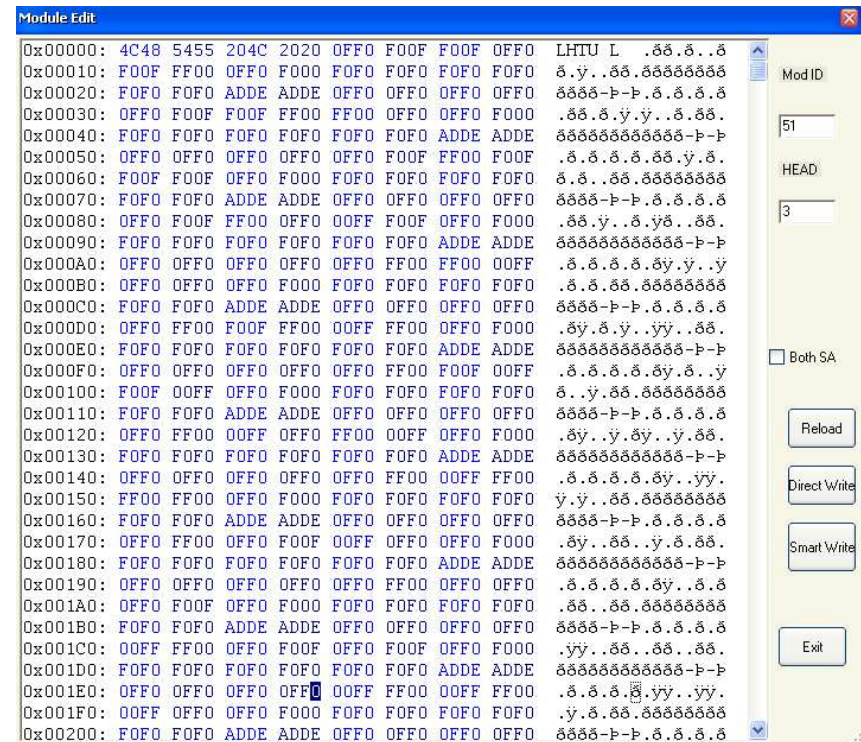- ## P-List Module belonging to one group. This module can not be replaced by donor drive module

Maxtor FW Repair

- Key Mod 120

- Module 24 55 120 –
  P-List Modules –
  belong to one group
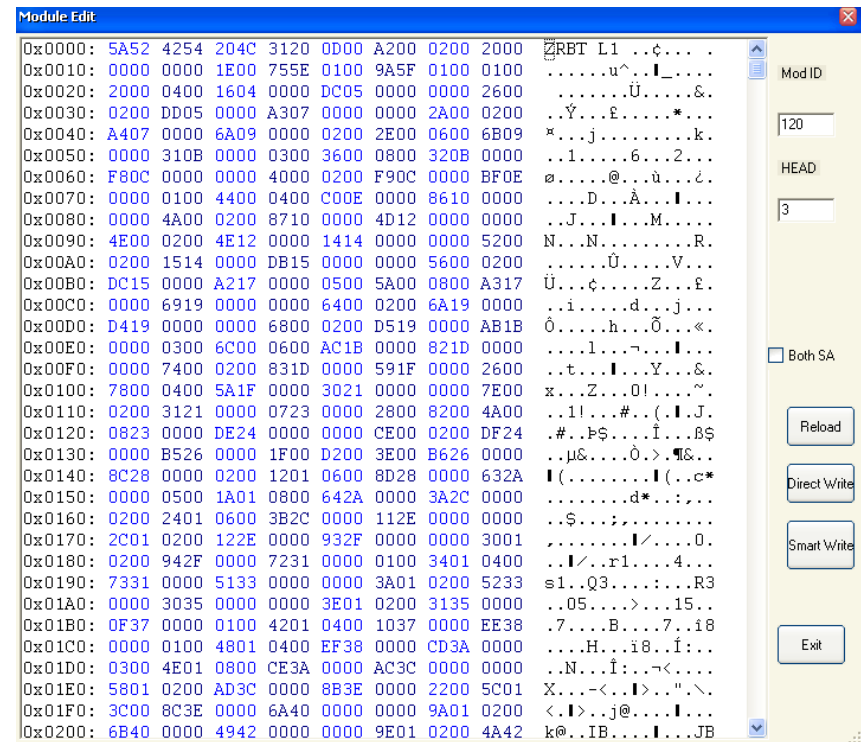
Maxtor FW Repair

- Key Mod 51 P-List Log
- The Module is unique to the HDD and can not be replaced by a donor module

Maxtor Adaptive Data

- Maxtor HDD has a number of unique modules containing adaptive data
- The data is used to fine tune reading/writing to the magnetic surface
- Overwriting the adaptive data with FW donor modules will result in loss of user data area
- Modules containing adaptive data are mod 30, 32, 79, 147
- Athena drives can easily be restore using the hot swap procedure. The N40P and Calypso HDD is impossible to write anything to the HDD. The reason could be caused by incorrect distance between the reading and recording head elements taken from the donor HDD adaptive settings. The distance will exceed track size by 2 to 3 times
- A HDD can only write to the SA after the translator and adaptive data modules are loaded
- Access to the SA require both adaptive data from reading and for recording

Maxtor Adaptive Data

- If the HDD translator is damaged during FW donor start the adaptive modules will be read without using the SA translator
- If adaptive modules in a HDD have been replaced it is impossible to write them back
- Only HDD using an alternative SA restoration is possible as long as there is a back up copy of adaptive data
- Recalculation of adaptive data using internal drive Self Test will help to repair the HDD.
- Self Test is not used in data recovery
- Recalculated adaptive data will prevent the reading of data recorded on the HDD using previous adaptive information
- Loading of known adaptive data to the HDD via the interface and not using the SA as the source. This allows restoration of SA functions. This method already exists in HDD with an alternative SA. But data will be lost
- Selection of matching adaptive data to enable reading of the information recorded during lost adaptive modules this also results in data loss.

Maxtor SA Emulation Technology

- Emulation technology duplicate the function of one system using different systems
- The second system behaves like the first system to imitate another program or device
- This technology has been applied to visual computer system networks, virtual partition, virtual workstation, and virtual storage system
- Virtual system is designed to accomplish a certain set of commands
- The command set is used to reallocate the software, hardware, data, network system and storage system.
- The emulator is achieved by the emulation of commands set defined by the system

Maxtor SA Emulation Technology

- Emulation can be categorized into different types: hardware emulation. Logical emulation, software emulation, and application emulation
- HDD uses a FW SA Emulation technology
- The emulator initializes the FW information of a special HDD by loading the predefined SA resources files into memory of the external emulator
- The HDD will boot from the information on the emulator rather than the native FW information
- Using SA emulation direct access to the data are can be achieved without repairing corrupted FW modules
- In hot swap the donor HDD achieves the emulation of the SA
- Due to adaptive information many modern HDD are not able to achieve a successful Hot Swap
- By using external SA emulation this will resolve the problem

Maxtor SA Emulation Technology

- A HDD can be compared to a small computer: employs microprocessors to control both the physical behavior of the various electro-mechanical components, logical operation that store and retrieve data as an arrangement of magnetic particles on the disk surface and operation are independent from a host PC.

- HDD needs its own software to control the operations of the microprocessor.

- The software is limited to the HDD operational functions and can not be altered by the end user

- The HDD software is the FW where the FW carries out a range of functions: controlling the spinning of the disk, positioning the read/write head, digital functions used to pass data files to and from the PC and keeps track of the location and parameters of data files stored on the HDD

- Without FW the HDD is simply a collection of electronic components

Maxtor SA Emulation Technology

- Problems in lost or corrupted FW can cause the HDD to fail
- FW problems are caused by: instability or failure of electronic components, accidental or inadvertent removal of power to the HDD, deterioration of the magnetic response to record data to the surface, and virtually inevitable over time, the deterioration will accelerator the longer the drive is used.
- HDD manufacturing is not perfect
- HDD leave the factory having problems with certain areas on the HDD
- The area where the HDD have problems correctly reading data are bad sectors
- Sectors that fail because the data stored on them has become corrupted and logical bad sectors
- Problems arising from magnetic response on the disk surface are known as physical bad sectors which cannot be repaired.

Maxtor SA Emulation Technology

- Both logical and physical bad in the data storage are part of the HDD
- The reserved area dedicated to the storage of the HDD FW called the SA
- Logical bad sectors can: cause loss of data files, corruption of data files, and reduce performance of the HDD
- Physical bad sectors in the FW area will cause the HDD to fail completely
- The FW area needs to be accessed every time the computer is switched on
- The chance of bad sectors in the FW area is consequently higher than the data area

Maxtor SA Emulation Technology

- The P-List is stored in the FW SA
- The P-List contains all known bad sectors detected as part of the post manufacture testing process
- The bad sectors contained in the P-List will not be used in the storage of data
- The FW sill automatically arrange the data by skipping the known bad sectors
- Bad sectors after post manufacture testing will be added to the G-List
- Bad sectors in the G-List will not be used for storage of data
- The adding of bad sectors to the G-List takes place automatically
- Logical and physical bad sectors cause problems to the HDD every time it is accessed
- Due to the intensive read actions required to recover usable files from the HDD this action cause increasing risk of data loss

Hitachi HDD Firmware and Service Area

- There are 2 categories of Hitachi HDD: 1) Hitachi 2.5 manufactured until 2003 and 2) Hitachi the purchase of IBM when they founded HGST
- Native Hitachi HDD are: AA, BA, CA, DA, EA, EB, FA, and FB
- Hitachi has the same typical features where the micro program is stored in the internal ROM or Flash memory on the ARM microprocessor manufactured by Samsung
- In C4K60 drive families the microprocessor is integrated into the Marvel chip in the BGA package
- The SA on the disk has no modules containing portions of the control micro program overlays, head map, HDD model name, drive capacity and other values are recorded in the microprocessor Flash ROM

Hitachi HDD Firmware and Service Area

- **The HDD SA** contains the recorded data: 4 to 6 SA modules depending on the drive family, SMART, and Self Test modules.
- Hitachi HDD family AA, BA, CA, and DA have adaptive data recorded on the disk surface
- **Drive family** EA, EB, FA, EB, C4K40, and C4K60 the adaptive data are recorded in the microprocessor Flash ROM
- Location of the adaptive data determines the PCB replacement and actual data recovery when the PCB fails
- **Drive families** AA, BA, CA and DA the PCB can be replaced with donor from identical drive
- **The other families** require the microprocessor with Flash ROM to be moved to the PCB donor

- **The SA information recorded in the following cylinders in the AA drive family**
- Cylinder 0 contains service information modules for all heads
- Cylinder 2.3 contain just zeros for all heads
- Cylinder 4 contains SelfTest logs
- Cylinder 1 cannot be read and remains unformatted
- User data area begins on Cylinder 5

Hitachi HDD Firmware and Service Area

- **The SA information recorded in the following cylinders in the BA drive family**
- Cylinder 0 contains service information modules for all heads
- Cylinders 2.4 contain just zeros fro all heads
- Cylinder 5 contains SelfTest logs
- Cylinder 6 is reserved for relocation of defects
- Cylinder 1 and 3 can not be read and remains unformatted
- User data begins on Cylinder 7

- **The SA information recorded in the following cylinders** In FB, FA, EB, EA, DA, CA, C4K40 and C4K60 drive families:
- Cylinders 0 and 2 contain service data modules. They contain duplicate copies for head 0 and 1. There are 4 copies in all
- Cylinder 4 contains jut zeros for all heads
- Cylinder 5 contains SelfTest log
- Cylinder 7 is reserved for relocation of defects
- Cylinder 1, 3, and 6 can not be read and remain unformatted
- User data area begins with Cylinder 8

Hitachi List of Service Data Modules

Model ID	Purpose
DR[1]	Serial Number
DP[2]	Adaptive Data
PD[3]	Primary Data, Plist
PD[3]	Grow Defect List Data, Glist
ID	Identification, serial number and Max LBA value in case of modification
PD[3]	Secure Data, Passworrd Module
10 00[3]	SMART, current values
10 00[3]	SMART threshold values

Hitachi HDD Firmware and Service Area

- Modules in the SA are protected with a checksum
- The HDD reads first the modules on Cylinder 0 using head 0
- If the checksum does not match then the HDD reads the modules using head 1
- If checksum mismatch occurs a second time in the drive family AA and BB will read the modules using heads 2 and 3 when present
- Drive family BA, FA, EB, DA, CA, C4K40 AND C4K60 will read the modules from cylinder 2
- If one copy has been read successfully the HDD switches to normal operations
- If none of the copies containing modules DR, SP, PD, GD and SD can be read the drive will switch to inoperability state and respond to all commands with ERR=04h Abort
- FW consists of microcode in ROM, configuration data in NV-RAM and FW overlays stored in the SA Ovl-SA as well as data ercorded in the SA of the HDD

Hitachi HDD Firmware and Service Area

- FW is identified by the version number and FW version code
- FW version number determines the microcode development while the version code actually represents a build or revision number
- FW is stored in masked ROM which can not be modified
- All FW modification is added to the NV-RAM and SA overlays
- The following rule has been adopted to follow: only FW version NUMBER gets changed while the FW CODE remains unchanged
- The change does not affect the entire number but only the last pair of characters
- If the FW version had been A46A prior to the modification then after an update the version will be changed to A4xx where xx will stand for two other characters
- Replacement with FW from another drive is not allowed

Hitachi HDD Firmware and Service Area

- The sets of ROM + NV-RAM + SA overlays firmware data will be compatible if they meet the following requirements:
- Firmware version CODE is identical for ROM, NV-RAM and SA overlays
- μ code in NV-RAM and SA overlays match
- Firmware version NUMBER recorded in ROM may differ from the number in NV-RAM and SA overlays in the last pair of characters only
- Hitachi HDD support the ATA commands 92h which is frequently referred to as the loader start
- The command is exclusively for updating the FW version
- It can not be used to start the drive in case of a serious corruption in the SA
- 2 or 3 ROM chips are present on the PCB
- Masked ROM integrated with the processor. It contains the executable processor codes and default setup values
- Flash ROM with serial access – NV-RAM. It contains setup parameters for access to the drive's firmware zone. It size may be 256, 512. or 1024 bytes depending upon the drive family
- The third ROM chip is not always present on the PCB. The Flas ROM chips were used in sample testing shipment of drives with firmware recorded in serial Flash ROM instead of masked ROM. This method allowed correction of errors in the ROM code. The socket for that chip is located near the NV-RAM. The size is 1 Mbit, and the type is 25FV101T.

Toshiba HDD Firmware and Service Area

- The Toshiba HDD has a peculiar construction which is not used by other HDD manufactures
- The Toshiba requires that all data required for drive operations is stored in the process, the entire FW micro program
- The SA contains no overlays, translator, or adaptive parameters
- The SA area contains nothing critical to the drives operations except the ATA password
- The HDD will enable the password presence bit if adaptive data turns out to be incompatible even though there is no password at all

Toshiba HDD Firmware and Service Area

- HDD has two protective fuses
- The fuses burn out very frequently but the electronics remains undamaged
- If one fuse burns out the jumpers need to be set instead of using the fuses
- Electronic damage rarely occurs
- In case of electronic damage keep in mind that all individual drive information such as FW, translator, and adaptive parameters are stored in the processor
- It is impossible to replace the PBC with a donor from another HDD
- The only possibility is to solider the processor to another functioning board and this will transfer the parameters critical to the drive to function
- Some micro program versions have the following problems:
- A drive does not reach ready state after connection, all LED are on despite the fact that the HDD functioned normally in a notebook. In order to active the drive and read the HDD certain jumpers might have to be enabled.

Fujitsu HDD Firmware and Service Area

- In Fujitsu HDD modules can be accessed for reading/writing to the SA of the disk where they are stored permanently and regularly loaded during drive start up when the power is switched on and the RAM on the PCB

- RAM accommodates the minimum set of modules required for FW operations

- During normal initialization the modules from the SA are copied to the HDD RAM

- If the HDD encounters problems reading the SA information the values loaded to RAM will display errors

- The only modules that are loaded to RAM that will not display an error are the ones from the ROM by default

- The HS and DM modules will be taken from ROM

- During the initialization process a drive replaces these modules with modules having the same name but copied from the SA of the disk

Fujitsu Module Importance

- A – Unique for the current HDD and can not be borrowed from another drive
- B – Can be borrowed from another HDD having the same versions at times the same model is required.
- C – Can be cleared from within the utility and recorded using a standard template
- D – Does not influence the firmware start for data access
- d – Influence data
- s – Influence system start it is an adaptive data modules
- r – Employed for self testing/ self recovery routine

- Variations:
- Ad – unique, influenced data this is the translator module
- As – unique, influences firmware start this is the adaptive data modules
- B – Can be borrowed from another drive having the same version these are code overlay and 3D modules
- C – Erasable which are log operations and SmartSelfScan
- D – Does not influence normal drive operation
- Dd – initial translation table
- Dr – SelfScan and similar modules

Fujitsu Module Importance

- In some drive families ROM contains adaptive data which is necessary for the HDD controller adjustment to work with the disk surface
- MHM2xxxAT and MHNxxxAT belong to the drive family that uses adaptive data
- When adaptive data is damaged a drive is unable to read the SA modules and starts to knock the head assembly against the limiting stop
- Modules are handled through a road map located in the ROM micro circuit on the PCB
- If information about the FW of the HDD is not found in the configuration file it is necessary to find the corresponding structure in the HDD ROM
- Corruption of the SA data modules is a frequent occurring fault in these drives
- The malfunction occurs when the drive spins up the spindle motor, recalibrates itself and outputs an ABR error
- It is necessary to test the modules in the SA to determine which modules is broken or corrupted
- Some modules in the SA can not be over written with donor modules if you need data from the HDD

Fujitsu Module Importance

- Modules DM, TS, and DR can not be over written
- The DM modules contains the exception table
- The TS module contains the track, cylinder, defect dynamic table
- The DT module contains the translator and represent a link between the logical space, defect table, and drives physical space
- The rest of the modules are not essential to the drives data are and can be over written
- If donor modules are needed it is recommended to find the modules from a HDD with the same model and service data version

Seagate HDD Firmware and Service Area

- The HDD service data is recorded in base ROM in the processor chip on the PCB
- External ROM on the PCB and the disk surface tracks
- There is no distinct modules table regulating HDD operations the HDD uses addressing the SA based on offsets precompiled in the device FW
- In Barracuda drives the number of cylinders containing individual FW objects are hard coded depending upon the number of the initial SA cylinders
- The number of SA cylinders can be calculated by adding the track index of the object to the number of initial SA cylinders
- Such an approach is adopted because of 7200.7 and newer HDD can alter their SA cylinder number in the process of starting the drive and can vary for each drive
- This makes the cylinder number concept incovenient when locating SA donor modules

Seagate HDD Firmware and Service Area

- Barracuda drives are subdivided into groups: drives with parallel flash and drives with serial flash
- The drives with parallel flash are: U5, Barracuda I / II / III / IV
- Drives with serial flash are: Barracuda V, U Series 7, 7200.7, 7200.8, 7200.9, 7200.10, and Momentus
- Firmware architecture parallel flash consists of the following parts:
- Embedded code – base code in microprocessor ROM on the drives PCB
- Parallel Flash on controller board microcode required to boot the HDD and contains commands for terminal mode. Identified by the FW version of the HDD label. For PBC swaps the FW version and exact layout are needed. Every drive family uses several PCB boards.
- Before performing a hot swap or replacing the PCB it is necessary to check the label fro an exact match
- When hot swapping the Barracuda II the donor drive can cause ROM reconfiguration on the donor PCB resulting in the inability to function properly
- Before hot swapping a complete FW and ROM back up should be done

Samsung HDD Firmware and Service Area

- **Samsung HDD malfunctions can be subdivided into:**
- PCB malfunction
- Damaged micro program in ROM
- Failure of reading/writing heads or read channel chip
- Corrupted SA modules
- Spindle motor malfunctions
- Bad sectors

- To determine the exact malfunction connect the HDD to terminal. If the problem to terminal. If the problem is in the PCB find a donor PCB from the same family and swap out the PCB
- This problem does not work all the time and the HDD fails to identify a faulty board
- ROM FW in the Samsung HDD contains adaptive information necessary to adjust the heads to perform reading/writing operations to the SA

Samsung HDD Firmware and Service Area

- VANGOPLUS, PANGO, VELOCHE, PALO, and MAGMA the newer HDD models preserve the head map in ROM
- If the HDD behavior changes after a PCB swap it is a good indication that the PCB is malfunctioning.
- The ROM chip needs to be soldered to the PCB donor board to test the new PCB on the patient HDD
- If the HDD does not spin up the spindle motor after power on and remains BSY this can indicate a serious corruption of the ROM FW when a mismatch of the checksum occurs
- Invalid data in ROM may prevent a drive from reporting ready after a soft rest making it knock and the PCB replacement did not change the behavior of the HDD
- On the other hand the drive can become completely functional after the PCB swap
- In some cases reading works normally while recording does not work – it is possible that written data will not be visible if this occurs the terminal output error is LED 13. If data needs to be recovered a PCB donor needs to be used to allow the HDD to reach readiness

Samsung HDD Firmware and Service Area

- Corruption of the SA modules can be identified in terminal code LED 5B – note in terminal output this error code is not always displayed
- If the error code is not display check the modules using FW Diagnostic to determine which modules are bad and need to be replaced
- HDD with corrupted or broken modules will spin up the spindle motor the HSA will knock against the limiting stop several times attempting to read the modules
- The HDD stops the spindle motor from spinning and outputs an error code to terminal
- Sending a soft reset normally allows such drives to reach readiness
- Some essential defect list modules can be restored with donor modules
- Important modules to the HDD and data area are hard to restore
- It is possible to run the HT test and BURN test to try and restore these modules

Samsung HDD Firmware and Service Area

- If the HDD encounters problems starting the spindle motor the terminal output code LED 16 will be displayed
- The spindle motor may fail to spin up because of motor seizure, coil break, or burnt out HA13627 motor control chip on the PCB
- In order to test the HA13627 chip use a donor PCB from the same family
- If the error code changes after the PCB swap and the motor spins up the chip needs to be replaced
- If the HDD has bad sectors up to 50-100 per zone a logical scan off the HDD is needed and the defects added to the defects list
- If the number of bad sector exceeds 100 per zone run the BURN test
- SpinPoint HDD series use a dynamic translator; the translator is built each time after the FW start based on the modules containing the defect list
- For hot swap the SLISTHDR, SLIST, TLIST, ALIST, CONFIG, AND CONFIG2 modules need to be written to the donor HDD
- The SLISTHDR module contains information about the number of defects in the SLIST module, and a table of the defects distribution among the zones and heads. Note: in VIIP and VICTOR HDD this module is not present

Samsung HDD Firmware and Service Area

- The SLIST module contains the records for the defects, sectors, and tracks that are not assigned logical address. In VIIP and VICTOR HDD the SLIST module beginning contains a record about the number of defects and a table similar to the one in the SLISTHDR module. All defects in the SLIST are sorted in the order they are used by the translator to assign logical address to the sectors

- The TLIST module contains information about the number of defective tracks, a table of the distribution according to the zones and head and records the defective tracks sorted by their numbers.

- The SLIST and TLIST modules are duplicate records of the defective tracks. The records must be identical to ensure correct translator functioning.

- The ALIST module contains a table that describes the beginning of the reserved space for each zone, records of reassigned sectors and their number.

Samsung HDD Firmware and Service Area

- The UNITABLE module found in VIIP, VICTOR, PUMA, VICTORPLUS, VERNA, VERNALITE and VANGO drives contain different configuration related data. The translator uses the zone allocation table of the user sectors stored in the modules or the sectors available for logical addressing. The table displays the number of sectors per each zone.

- The CONFIG module found in VANGOPLUS, PANGO, VELOCE, PALO, and MAGMA drives contain different configuration related data. The translator uses the zone allocation table of the user sectors stored in the modules or the sectors available for logical addressing. The table displays the number of sectors per each zone.

- The CONFIG2 module found in RUBICON, P80A, POSEIDON, DELPHI, CAESAR, P80M, and TRIDENT drives describes the order of the zone translator fro the different heads. Translation may start in the middle of the head stack. In some drive families there are 20 mln. of initial LBA located in the first 5 zones for a single head.

Western Digital Firmware and Service Area

- **Silver I series Firmware**
- Similar Model Number (same capacity is required)
- Same firmware version Silver II / Black I&II / ROYL series:
- Same model Number
- For newer WD HDD the model numbers consist of two parts (example: WD1600BEVS-22RST0). Donor HDD need to have the same drive ID: WD1600BEVS. A match of the third and forth number is also required: xxRSxx.
- Same firmware version
- See your manuals for the FW tables for different drive families. I have listed the FW modules and the importance inside your manuals.

Western Digital Firmware and Service Area

- Overlay Modules: Module 0010 – 001F are the Overlay Modules for ROM. When damaged they can not be loaded or detected.
- Defect Image: Modules 0020, 0023, and 0025 are the Defect Image modules and are important for hot swapping.
- SMART: Modules 0029, 002C, 002D, 002E, and 002F are the SMART table modules. When damaged they do not effect the HDD but can cause the drive to become slow.
- Module Map: Module 0041 is the Module Map and is located on Track 31. The Flash ROM reads from this module when the HDD first starts up. The module contains the absolute position of the structure of the module configuration. The LBA, Serial Number, and defects map is stored in the tracks.
- Parameter: Module 0042 is the Parameter module; this stores the model number, serial number, LBA, and password. When damaged, the module can not be loaded.

Western Digital Firmware and Service Area

- Selfscan: Module 00E0, 00E1, 00E2, 00E3, 00E4, 00E5, 00E7, 00E8, 00E9, 00EA, 00EB, 00EC, 00ED, 00EE, and 00EF store the factory SELFSCAN. When SELFSCAN is initialized on the HDD the drive uses these modules to repair the HDD.

- P-List: Module 0043 stores the factory P-List. If damaged it is impossible to recover data from the HDD.

- G-List: Module 0044 is the G-List module. When damaged can cause the HDD to click on start up and not initialize. It is possible to clear the G-List module and still retrieve data from the HDD.

Western Digital Firmware and Service Area

- WD uses the file system Little-Endian in the memory concept for reading and storing codes in the ROM and SA modules

- Little-Endian stores the least significant byte in the smallest address

- Little-Endian is an order in which the "little end" is stored first

- Example: in a big-endian computer, the two bytes required for the hexadecimal number 4F52 would be stored as 4F52 in storage (if 4F is stored at storage address 1000, for example, 52 will be at address 1001). In a little-endian system, it would be stored as 524F (52 at address 1000, 4F at 1001).