Fujitsu Co, Ltd

Contents

1. Introduction

This manual describes the drive family structure and methods applicable for repair of 2.5" and 3.5 hard disk drives manufactured by Fujitsu Co, Ltd. We have also explained methods for software restoration of HDDs using the PC-3000 suite.

The document contains descriptions of drive families with the main executable code stored in ROM only as well as families with additional overlay modules in service area loaded to RAM from disk surface during drive initialization. Beginning with the MHN2xxxAT 2.5" drive family and MPF3xxxAT 3.5" drive family, Fujitsu drives contain an overlay (3D module); beginning with the MHR2xxxAT family the manufacturer has added two modules: 3D and 3E. Therefore, in our utilities we have provided for an opportunity to load service information directly to drive RAM.

2. Explanation of model name

The range of Fujitsu products is represented with several functional lines:

- 2.5" <Hx> Notebook for the market of portable computers;
- 3.5" <Px> ATA Desktop for desktop PC;
- 3.5" <Ax> SCSI for workstations, servers and data storage systems.

MPF	3	102	AT
1	2	3	4

1 – Model

M Defined as the first character in the codes used with all models. The requirement was adopled at Fujitsu Corporation to distinquishOEM-products.

P The following signs are used:
3,5" SCSI – A
3,5" IDE – P
2,5" IDE – H

F The character inicates prosduct generation.

2 – Size

2,5" – 2
3,5" – 3

3 – Capacity

Multiplied by 100, the number indicates formatted drive capacity.

4 – Interface

AT = IDE, 4200 or 5400 rpm, UDMA 100
AH = IDE, 7200 rpm, UDMA 100
MP = Ultra 160, SCA-2 80 PIN
NP = Ultra 320, 68 PIN
NC = Ultra 320, SCA-2 80 PIN
FC = FCAL-2

3. Supported HDD

An updated list of supported models can be found in the FujContextHelp.chm help file of the utility. Here we shall list the supported drive families.

2.5"	MHD2xxxAT, MHK2xxxAT, MHM2xxxAT, MHN2xxxAT, MHR2xxxAT, MHS2xxxAT, MHT2xxxAT[1], MHV2xxxAT[2]
3.5"	MPA3xxxAT, MPB3xxxAT, MPC3xxxAT, MPD3xxxAT/AH, MPE3xxxAT/AE/AH, MPF3xxxAT / AH, MPG3xxxAT / AH / AHE

xxx here stand for three characters reflecting drive capacity. E.g., MPG3**204**AT.

4. Preparing for work

For 2.5" drives:

- Plug the IDE cable of your «PC-3000» tester board into the IDE connector of the PC-2" adapter.
- Connect the power cable to the corresponding connector of the PC-2" adapter. Power should be supplied from the PC-3K PWR2 power supply adapter or from a standard external PC power supply unit (then you will have to switch power off/on in accordance with the instructions displayed by the utility).
- Connect the drive being tested to the PC-2" adapter; please pay attention to the separate group of contacts on drive and adapter connectors.

For 3.5" drives:

- Plug the IDE cable of your «PC-3000» tester board into the IDE connector of the drive.
- Connect the power cable to the corresponding connector of the PC-2" adapter. Power should be supplied from the PC-3K PWR2 power supply adapter or from a standard external PC power supply unit (then you will have to switch power off/on in accordance with the instructions displayed by the utility).

Next step:

- Switch on the power supply to the drive being tested. If the PC-3K PWR2 adapter is available, you can control drive power using the Power icon on the utility toolbar.
- Use the utility entry menu to select the corresponding drive family, model and (when possible) operation mode for the drive and utility (Normal/Kernel).

Warning! Utility tests have many options. It is recommended that novice users work with default test options.

1 – This utility version does not support Flash ROM reading in Normal Mode for the MHT2xxxAT drive family.

2 – This utility version does not support Flash ROM reading in Normal Mode for the MHV2xxxAT drive family. Besides, password resetting is not implemented for the MHV2xxxBH drive family (SATA version of the MHV family). The feature is under study.

5. Launching the utility

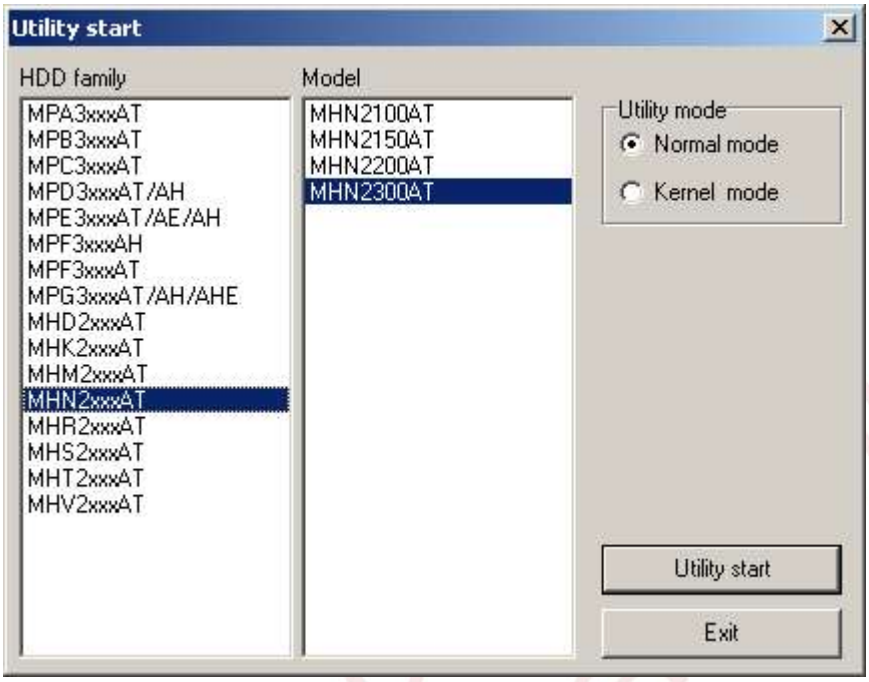

Fig. 5.1. Utility start.

After utility start, it displays a dialog for selection of drive family, model, and utility operation mode: *Normal mode* and *Kernel mode*.

- ***Normal mode*** – is the main mode of utility operation provided that drive ROM can be read.
- ***Kernel mode*** – is intended for writing/reading of FLASH ROM in cases, when ROM cannot be read, when ROM firmware version does not match the version of service data on disk surface or when ROM firmware contains adaptive data different from the original data for the head-and-disk assembly. Work in Kernel mode is supported for MHM2xxxAT, MHN2xxxAT, and MHT2xxxAT / AH, MPF3xxxAT, MPG3xxxAT drive families. A detailed description of work in Kernel mode can be found in the corresponding section of this manual (please see section 5.1).

After start, the utility reads HDD ROM header, identifies firmware version and tunes itself using the drive configuration tables from ROM (modules table, table of zone allocation, etc.). If the utility fails to read the ROM, it displays the following message:

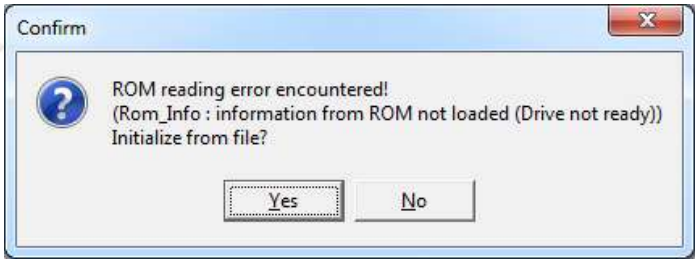

Fig. 5.2.

You will be prompted to click [Yes] to make the utility use settings from an existing file (ROM copy read earlier). In that case, you will have to specify a file containing ROM of the corresponding version[1]. If you select [No], the utility

[1] – You can check ROM version on the HDA label (see Chapter 13).

will use its default parameters (editable within the utility options dialog window, see section 9.2). If the utility has read the ROM but cannot recognize it (the ROM is not included in the list of supported versions), it will output a dialog box to search for the table of modules (and for the zone allocation table stored in ROM for some drive families). Having displayed the dialog, the utility will attempt to find the required table searching from the start of ROM image. You can perform the procedure manually using the «From beginning» button. If the table is detected, the utility will visualize its data. Drive ROM may virtually contain several areas matching the criteria used while searching for the required table[1]. Use the «Next» button to search for all possible offsets.

If the utility finds a new area matching the search criteria, it will analyze and display its data and show the offset in the right part of the dialog box under the «Current offset» label. If the next search attempt fails, the utility will output a corresponding notification. You can confirm your selection using the «OK» button, which will add the information about the new firmware to the utility settings storage. Then you will have to evaluate the data visually to confirm selection validity; use the report on SA structure for that purpose. If the information seems to be correct, enter the utility options dialog and click the «OK» button to save the new firmware version.

After reading the data structures from ROM, the utility reads from the drive its configuration tables and checks the conformity between the physical parameters of the selected model and the actual configuration tables. If the information matches, the utility switches to the normal mode[2].

The normal mode provides access to the following items of menu hierarchy:

1) Utility status

2) Service information:

- Work with ROM
  - View information from ROM
  - Reading ROM
  - Writing ROM
- Work with SA
  - SA structure test
  - Reserve HDD resources
  - Read modules
  - Write modules
  - Regenerate translator[3]
  - Security subsystem
    - View password information
    - Erase password
  - Disable heads
  - Edit SN
  - Work with adaptive data[4]
    - Transfer of adaptive data

3) HDD formatting

4) Logical scanning

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1 – In our practice, we have not encountered cases of several potential table locations.

2 – If you have selected the Kernel mode, the utility will not load the tables from a HDD switching to processing of menu commands immediately.

3 – This menu item is not available for HDD of the MHD2xxxAT family.

4 – This menu is available just for HDD of MHM2xxxAT and MHN2xxxAT families (the only drive families using adaptive data).

5) ***Clear SMART***[1]

6) ***Defect list***

Defect lists report

Grouping to tracks

Grouping to cylinders

Erase defect lists

The Kernel mode allows access to the following features through the menu hierarchy:

1) ***Utility status***

2) ***Service information:***

Work with ROM

View information from ROM

Reading ROM

Writing ROM

5.1. Kernel mode

First, we would like to mention that the utility currently supports the Kernel mode for MHM2xxxAT, MHN2xxxAT, and MHT2xxxAT / AH, MPF3xxxAT, and MPG3xxxAT drive families.

The need to record to a ROM detached from its HDA or to read data from it appears when you have to use an electronics board «borrowed» from another drive with incompatible ROM and HDA versions. When such a board is installed to a drive, the latter usually does not report on readiness so you cannot employ the standard tools of the utility to write anything to ROM. Here the Kernel mode of drive microprocessor may be helpful and, particularly, its embedded KERNEL CODE. That software code allows direct recording to ROM and reading of its contents without a HDA installed. Its behaviour has the following peculiarity: the microprocessor attempts to calculate ROM checksum while accessing it; if the checksum does not match, then the Kernel mode will be initiated providing access to ROM recording or reading.

If the ROM already contains normal firmware (of a different version, however) the checksum will match, of course. To prevent that, you will have to short-circuit ROM data lines using tweezers during initialization. Doing so will enable the Kernel mode; the board will immediately report on readiness (the DRD и DSC LEDs will light up). After that you may remove the tweezers. The general procedure is as follows:

1) Take the electronics board off the drive HDA case and connect it to the PC-3000 tester and power supply unit (the latter must be off)[2].

2) Use tweezers to short-circuit two I/O data lines of ROM chip (please see appropriate figure in the appendix in the end of this manual).Запустить утилиту, выбрать соответствующее семейство и режим работы Kernel mode.

3) Launch the utility, select the corresponding drive family, and enable Kernel mode as its operating mode.

4) Power up the drive. The board at that should immediately reach the ready status (the DRD` and DSC LEDs should be turned on). If the board fails to report on readiness, repeat steps 2-4 having connected other I/O data lines.

5) Then you may proceed to ROM writing or reading.

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1 – This menu item is not available for HDD of the MHD2xxxAT family (they do not support S.M.A.R.T.).

2 – Fujitsu drives can be switched into Kernel mode with an installed PCB as well. For 3.5” drives the procedure is fairly simple because ROM chip is soldered on the external side of the board. For 2.5” drives with ROM chip located on the internal side of the board you will have to find the checkpoints of ROM data lines connection to the external side of the PCB. Please refer to Appendix 3. Checkpoints for switching 2.5” Fujitsu drives to Kernel mode for the figures indicating locations of such checkpoints.

The manufacturer of Fujitsu drives uses several types of Flash ROM chips – SGS Thomson (M29F102BB), Sanyo (LE28F1101T-40), etc. If you encounter difficulties while working in the Kernel mode (they are especially likely with Sanyo chips) try to short-circuit other data lines while switching the board into the Kernel mode. The problem, which is possible here, follows from corruption of Flash ROM chip identification parameters used to tune the utility for further work with the chip.

Warning! To accomplish correct recording to Sanyo Flash chips you should short-circuit the 19th and 20th contact pins to enter the Kernel mode. Connection of other contacts will change the chip code and cause incorrect application of the recording algorithm. Recording should be performed on a board removed from its HDA case.

You can also prepare a temporary file containing just zeros (00) and write it to the chip first. After that, the board will switch to Kernel mode automatically because the checksum will be invalid. Then you can write the necessary data to the chip. It is essential to read the data after writing to Flash ROM and ensure (through file comparison) that the recording procedure has been successful.

Warning! HDDs of MHM2xxxAT, MHN2xxxAT, and MPG3xxxAT drive families use the so-called adaptive data, i.e. microstepping parameters of drive actuator individual for each HDD. Drive ROM contains the start-up adaptive data required for reading of service information from disk surface. Therefore, overwriting ROM contents of a HDD belonging to any of those families with data from another drive (even with the same F/W version), will leave it unable to read its service information. Thus, such ROM overwriting procedure should be followed by an ***adaptive data selection procedure***[1]. To avoid that difficulty, you should ***transfer the adaptive data*** from the original ROM image to the one to be recorded before actual overwriting of ROM.

6. Utilitu features

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

7. «Tests» menu

7.1. Utility status

This menu item displays the following dialog:

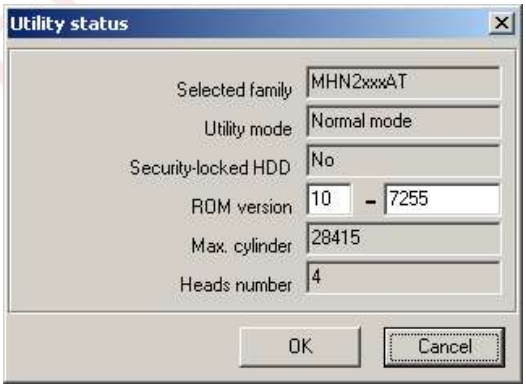


Fig.7.1. Utility status.

[1] – The procedure is not implemented so far in the documented utility version.

Here you can edit the «FW version» parameter. That might be necessary when drive ROM cannot be read. In such case, you should enter firmware version from the label on HDA case (see Chapter 13).

Warning! ROM reading/writing in Normal mode are not implemented in the current utility version for MHT2xxxAT drives; the utility notifies users about that at the start. Therefore, you should correct the FW version in the above dialog window immediately after utility start.

7.2. Service information

The «Service information» menu contains a group of commands for manipulating data in ROM and the service area of disk surface.

7.2.1. Work with ROM

Commands of that menu can be used to view data stored in drive ROM, read and record information to ROM chip.

7.2.1.1. View information from ROM

Selection of the ***«View information from ROM»*** menu item will tell the utility to read a portion of data from ROM of the drive being tested. Then the results of analysis performed using the information from read ROM tables will be displayed in the «Reports» window tab. A typical sample report is shown below.

```
ROM parameters
ROM recognized

Copyright.............................. : (C) FUJITSU 1999-
F/W.................................... : 0C-3E22
Date................................... : 17.10.20
Family................................. : H13L-02
CS..................................... : 00004480
Flags.................................. : 00

Report about modules table in ROM
  #  ID   Length   Name
  1  01       36   DM
  2  02       16   PL
  3  03        3   TS
  4  04        1   HS
  5  05        1   FI
  6  06       16   DT
  7  07        1   SI
  8  08        1   SN
  9  09        1
 10  0A        1
 11  0B        1
 12  0C        1   SM
 13  0D        1   SU
 14  0E        1   CI
 15  10        4   SCH
 16  11        1   SEQ
 17  12        2   WTP
 18  13        1   END
 19  14        1   ECT
 20  15       64   ERR
 21  16       24   SVE
 22  1D        3
 23  1F        7   REC
 24  20        8   TA
 25  21        2   TC
 26  22        1   ADT
 27  27        1
 28  28        1
```

```
    29   2A      32
    30   2B      32
    31   2C       2
    32   2D       1   FA
    33   30       1   ZP
    34   31       8   RE
    35   32       8   WE
```

The report contains a brief explanation of firmware header found in drive ROM and its modules table.

Firmware header contains its version (FW), date of code generation (Date), drive family name (Family), ROM checksum (CS) and flags byte (Flags) stored in hexadecimal notation.

The modules table defines service modules accessible and employed by the firmware for its operations. If the utility has not recognized the current firmware version (and notified you about that with a respective message at utility start-up), then it will use a default modules table depending upon the drive model selected during utility launch. In that case, the utility connects a default zone list for drive families storing zone allocation data in ROM.

The utility displays no information about modules table and zones table in its report on ROM contents while running with the default settings.

7.2.1.2. Reading ROM

The utility can read ROM contents both to files stored in drive profile folders or to the database of the PC-3000 suite. While reading a ROM image file into the database, the utility assigns to it a set of attributes, which simplify subsequent search for the required image and prevent recording of incompatible firmware. You are advised to save master copies of ROM images to the database keeping the current (customer) ROM images in drive profile.

7.2.1.3. Writing ROM

While recording from the database of the PC-3000 suite the utility performs data filtering by compatibility attributes, the user can control the set of applied filters from a corresponding dialog. Users have to identify the compatibility of the selected firmware individually while recording it from drive profile.

During ROM recording, a HDD stops its spindle motor, performs programming of its ROM chip, then resets itself, spins up the spindle motor, recalibrates and reports on readiness. If the recording process fails for some reason or produces invalid results, the spindle motor will not start and an error message will be displayed.

Warning! Version identity rule should be followed while recording ROM. It means that versions of ROM contents and firmware portion stored within the service area on disk surface must match. Recording an incompatible ROM version will render a HDD inoperative.

Warning! HDD of MHM2xxxAT, MHN2xxxAT, and MPG3xxxAT drive families use the so-called adaptive data, i.e. microstepping parameters of drive actuator individual for each HDD (see Chapter 18).

7.2.2. Work with SA

HDD of MHM2xxxAT, MHN2xxxAT, and MPG3xxxAT drive families use the so-called adaptive data, i.e. microstepping parameters of drive actuator individual for each HDD (see Chapter 18).

7.2.2.1. SA structure test

The SA structure checking procedure outputs to the «Reports» tab the results collected upon reading and analysis of data found in modules from the service area of disk surface. A typical sample report is shown below:

#	ID	Name	Sourse	Lenght	Read	Importance	Loaded	Header	Description
1	0101	DM	HDA	36	36	Ad	Yes	Ok	DM/DU, translator module
2	0102	PL	HDA	16	16	Dd	Yes	Ok	PL, single sector defect list module
3	0103	TS	HDA	3	3	Ad	Yes	Ok	TS, track defect list module
4	0104	HS	HDA	1	1	B	Yes	Ok	HS, head map module
5	0105	FI	HDA	1	1	D	Yes	Ok	FI, manufacturer information module
6	0106	DT	HDA	16	16	Ad	Yes	Ok	DT, translator module
7	0107	SI	HDA	1	1	B	Yes	Ok	SI, logical parameters module
8	0108	SN	HDA	1	1	B	Yes	Ok	SN, serial number module
9	0109		HDA	1	1	C	Yes	Ok	SMART module, Values
10	010A		HDA	1	1	B	Yes	Ok	SMART module, Thresholds
11	010B		HDA	1	1	B	Yes	Ok	SMART module, Values(reset)
12	010C	SM	HDA	1	1	B	Yes	Ok	SM, Master password module
13	010D	SU	HDA	1	1	B	Yes	Ok	SU, User password module
14	010E	CI	HDA	1	1	D	Yes	Ok	CI, HDD hardware list module (text log)
15	0110	SCH	HDA	4	4	B	Yes	Ok	SCH
16	0111	SEQ	HDA	1	1	B	Yes	Ok	SEQ
17	0112	WTP	HDA	2	2	B	Yes	Ok	WTP
18	0113	END	HDA	1	1	B	Yes	Ok	END
19	0114	ECT	HDA	1	1	B	Yes	Ok	ECT
20	0115	ERR	HDA	64	64	B	Yes	Ok	ERR
21	0116	SVE	HDA	24	24	B	Yes	Ok	SVE
22	011D		HDA	3	3	B	Yes	Ok	
23	011F	REC	HDA	7	7	B	Yes	Ok	REC
24	0120	TA	HDA	8	8	B	Yes	Ok	TA
25	0121	TC	HDA	2	2	B	Yes	Ok	TC
26	0122	ADT	HDA	1	1	B	Yes	Ok	ADT
27	0127		HDA	1	1	B	Yes	Ok	
28	0128		HDA	1	1	B	Yes	Ok	
29	012A		HDA	32	32	B	Yes	Ok	
30	012B		HDA	32	32	B	Yes	Ok	
31	012C		HDA	2	2	B	Yes	Ok	
32	012D	FA	HDA	1	1	C	Yes	Ok	FA, log module
33	0130	ZP	HDA	1	1	B	Yes	Ok	ZP, zone allocation table module
34	0131	RE	HDA	8	8	C	Yes	Ok	RE, log module
35	0132	WE	HDA	8	8	C	Yes	Ok	WE, log module
36	0201	DM	RAM	36	36		Yes	Ok	DM/DU, translator module
37	0203	TS	RAM	3	3		Yes	Ok	TS, track defect list module
38	0204	HS	RAM	1	1		Yes	Ok	HS, head map module
39	0206	DT	RAM	16	16		Yes	Ok	DT, translator module

```
Report about table HS "HS, head map module"
ID..................................... : 0104
Length (sectors)....................... : 1
Loaded................................. : Yes


Heads.................................. : 3
Head map............................... : 1  2  3


Report about table TS "TS, track defect list module"
ID..................................... : 0103
Length (sectors)....................... : 3
Loaded................................. : Yes


Filter by heads........................ : is not set up
Filter by zones........................ : is not set up

Total number of defects................ : 0

Report about table PL "PL, single sector defect list module"
ID..................................... : 0102
Length (sectors)....................... : 16
Loaded................................. : Yes

Filter by heads........................ : is not set up
Filter by zones........................ : is not set up

Total number of defects................ : 3

Distribution of defects by zones and heads:
zone   hd0   hd1   hd2
   1     0     0     0
   2     0     0     0
   3     0     0     0
   4     0     0     0
   5     0     0     0
   6     0     0     0
   7     0     0     0
   8     0     3     0
   9     0     0     0
  10     0     0     0
  11     0     0     0
  12     0     0     0
  13     0     0     0
  14     0     0     0
  15     0     0     0


Report about table SN "SN, serial number module"
ID..................................... : 0108
Length (sectors)....................... : 1
Loaded................................. : Yes

Serial number.......................... : 05000996


Report about table FI "FI, manufacturer information module"
ID..................................... : 0105
```

```
Length (sectors)..................... : 1
Loaded............................... : Yes

Date................................. : 00.11.13


Report about table CI "CI, hardware list module (text log)
ID................................... : 010E
Length (sectors)..................... : 1
Loaded............................... : Yes

000104  : CP004812-01
MEDIA   : HOYA            DD0B3720638
HEADS   : FUJITSU         IA0R9XUTF-DS
HD-IC   : TI              0AJA285
DCM     : NIDEC           204656F1


Report about table "ZP, zone allocation table module (formed from ROM"
ID................................... : 0130
Length (sectors)..................... : 1
Loaded............................... : Yes

Zones........................... : 15
Heads........................... : 3
Cylinders....................... : 19936

  #  Initial cyl   Cylinders in   zone SPT
  1          0             640        627
  2        640            1024        616
  3       1664            1920        594
  4       3584             896        572
  5       4480            1024        561
  6       5504             704        550
  7       6208            2368        528
  8       8576             960        506
  9       9536            1024        495
 10      10560             640        484
 11      11200            2176        462
 12      13376            1088        440
 13      14464            1280        429
 14      15744            2432        396
 15      18176            1760        363


Report about table SM " Master password module"
ID................................... : 010C
Length (sectors)..................... : 1
Loaded............................... : Yes

Master password...................... :

Report about SU "SU, User password module"
ID................................... : 010D
Length (sectors)..................... : 1
Loaded............................... : Yes

User password set up................. : No
Master password...................... :
Security level....................... : maximum
```

The first part of the report contains information about read modules,

where:

- ***ID*** – input/output identifier for a given module.
- ***Name*** – internal name of the module (from modules table).
- ***Sourse*** – location that the module has been read from (HDA means disk surface, RAM stands for drive random-access memory). Please see details further.
- ***Lenght*** – module length in sectors according to the modules table.
- ***Read*** – the number of sectors actually accessed on a drive while reading.
- ***Importennce*** – symbolic identifier showing module influence. Please see details further.
- ***Loaded*** – indication whether a module has been read.
- ***Header*** – indication of conformity between the name in modules table to the name specified in module body.
- ***Description*** – brief module description.

In Fujitsu HDD modules can be accessed for reading/writing both in the service area of disk surfaces (where they are stored permanently and regularly loaded during drive start-up when the power is switched on), and in drive RAM on its electronics board. RAM accommodates the minimum set of modules required for firmware operation. During normal initialization, the modules from the service area are copied to drive RAM. If a HDD encounters problems reading its service information from disk surfaces (HDA source), then the respective values in lines describing modules in RAM (RAM source) will display errors (except for the modules loaded to RAM from ROM by default). E.g., HS and DM modules will be initially taken from ROM; however, during the initialization process a drive replaces them with modules having the same names but copied from the service area on disk.

The importance identifier may take the following values:

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

Variations:

- **Ad – unique, influences data (e.g., translator module).**
- **As – unique, influences firmware start (e.g., adaptive data).**
- **B – can be borrowed from another drive having the same version (code overlay – 3D module).**
- **C – erasable (logs of operation, SmartSelfScan).**
- **D – does not influence normal drive operation.**
- **Dd – initial translation tables.**
- **Dr – SelfScan and similar modules.**

The second part of the report discloses information from some modules read earlier, e.g., HS, head map

```
Report about table "HS, head map module"
  ID..................................... : 0104
  Length (sectors)....................... : 1
  Loaded................................. : Yes

  Heads.................................. : 3
  Head map............................... : 1  2  3
```

where:

- ***ID*** – input/output identifier for a given module;
- ***Length (sectors)*** – module length in sectors according to the modules table
- ***Loaded*** – indication whether the table (module) has been read.
- ***Heads*** – the number of heads used by the drive during operation.
- ***Head map*** – map of electrical connections for active heads

The following modules are most typical for the service area:

- ***DM module*** [1] – contains translator for the user data area of a HDD.
- ***DT module*** [2] – contains the table of positioning adjustment settings for a HDD.
- ***TS module*** [3] (Track Skip) – the table of defective tracks in a drive.
- ***HS module*** [4] – (Head Select) – contains the total heads number and numbers of active heads.
- ***PL module*** – (Primary List) – the table of defective sectors in a drive.
- ***SN module*** – (Serial Number) – contains drive serial number.
- ***FI module*** – (Factory Information) – contains information about manufacturing cycle progress. The utility displays drive manufacture date only and skips other irrelevant data.
- ***CI module*** – (Components Information) – contains information about parts inside the head-and-disk assembly case: magnetic disks (MEDIA), heads (HEADS), read/write preamplifier chip (HD-IC), spindle motor (DCM).
- ***ZP module*** – (Zones Plane) – contains information about allocation of zones.
- ***SM module*** – (Security Master) – contains master password information.
- ***SU module*** – (Security User) – contains user password information.

7.2.2.2. Reserve HDD resources

This menu allows saving of complete HDD service information package to SABackup subdirectory of drive's profile. For Fujitsu HDD the collection includes drive modules (from service area and drive RAM) and ROM image. In addition, the selected folder will include a file containing a report on service data structure (see above) based on read modules and ROM report.

Attention! If the utility has recognized drive ROM [5], then it uses the list of modules from ROM for subsequent reading and recording of service information. However, a situation is possible when certain modules are skipped at the factory while recording service data to a totally functional drive. In such case, the utility will log a message telling that the module is unreadable. You can ignore the message if you are sure that the drive (being) used for reading of service information is operational. This peculiarity of drive functioning is caused by certain confusion sometimes occurring in the manufacturer's design project. Thus, for instance, the module list in ROM includes module ID=00h; however, in reality there is no such module in a drive, so the utilities will block it (see the black list of modules in the tab showing the list of supported FW within the utility options dialog).

---

1 – *Warning!* The module is essential for access to user data.

2 – *Warning!* The module is essential for access to user data.

3 – *Warning!* The module is essential for access to user data.

4 – *Warning!* In MHT and MHV drive families the module contains data unique for each HDD.

5 – If the utility fails to identify drive ROM, it uses a short list of modules selected by default; the list of default modules can be modified in the utility settings dialog.

Warning! In cases, when service modules are corrupt you should overwrite damaged modules only using copies from a service data package of a compatible version; select for replacement just modules essential for the operation of the drive being repaired. We do not recommend overwriting of all the service data (ROM and modules) with information from another drive since some parameters remain strictly individual for each specific drive (adaptive data; original defects influencing user data accessibility, etc.).

Warning! This version of the utility features limited opportunities for defect management. Therefore, you should preserve the original defect tables whenever possible.

7.2.2.3. Read modules

The operation allows reading of drive service information in the original form used for its storage in HDD service area – the so-called modules (integral blocks of data). The utility can read the data to profile folder or to the database of the PC-3000 suite. In the latter case, the utility will assign to it a set of attributes, which simplify subsequent search for necessary modules and prevent recording of incompatible firmware.

Filename for each generated module is generated as follows:

~ PR_ID NAME.rpm

where:**~** – special character indicating module presence

PR – module source code (01 – disk module, 02 – RAM module);
ID – module identifier, hex byte
NAME – его имя (из таблицы модулей), может занимать от 2-х до 3-х символов ASCII.

E.g.: ~010csm.rpm - SM master password module read from disk surface, ~ 0204hs.rpm – HS head selection table module read from RAM.

Prior to module reading procedure, the utility displays a list of modules available for reading. You should use it to specify the set of modules, which you wish to read. If the destination folder already contains modules with the same names, repeated reading procedure will overwrite them.

7.2.2.4. Write modules

The operation serves for recording of modules containing service information to the service area of a drive or its RAM. Prior to module recording procedure, the utility displays a list of modules available in the selected profile or suite database. In the latter case, the utility automatically filters out all incompatible FW versions. You can use the program dialog window to control the search filter as regards compatibility parameters.

Warning! The utility does not check module structure while recording. Please exercise extreme caution using the procedure, otherwise you may irreversibly damage the drive.

7.2.2.5. Regenerate translator

The menu option is meant for restoration of static translator part (DM module) using the PL table as the basis. The procedure is a prerequisite to restore access to data if the DT module becomes damaged for some reason (in that case it should be copied from another drive with a subsequent translator recalculation).

Warning! The action is not available for MHD2xxxAT drive family.

Warning! Correct completion of the recalculation procedure requires that the PL module (which should be accessible from service area of disk surface) must both have a valid structure and contain the original list of defects for the drive.

Warning! Please note that drive translator also includes a dynamic part (TS module) in addition to the static one. Correct access to user data requires valid information in the TS module about original defects of the drive.

7.2.2.6. Securety sabsystem

This menu item allows operations over the SM and SU modules, which control drive security subsystem. You can review specified passwords and clear them, if necessary, without losing user data.

7.2.2.7. Disable heads

Selection of this menu item launches the procedure of software isolation for malfunctioning drive heads. A reverse operation for activation of disabled heads is possible, too. Before the procedure, make sure that the drive defects table

contains no records for the heads being disabled, otherwise you should clear the defects table. In the mode selection screen the utility displays heads map and offers to disable malfunctioning heads or enable functional ones. You can disable any head unless there are limitations enforced by drive family.

The drive will automatically change model name after disabling/enabling of its heads (except for non-standard models, see Chapter 16).

7.2.2.8. Edit SN

This menu item allows correction of a drive's serial number. Changes enter into effect after switching the drive's power supply off and on again.

7.2.2.9. Work with adaptive data

In the utility version described in this manual, the submenu contains just one action – ***«Transfer of adaptive data».***

Warning! Adaptive data will be transferred between files stored in folders on the computer, where PC-3000 is installed; the procedure **DOES NOT AFFECT THE CONNECTED HDD UNDER TEST IN ANY WAY.** To use the results of that procedure you will have to record the file thus corrected. Please see below the dialog window used for transfer of adaptive data.

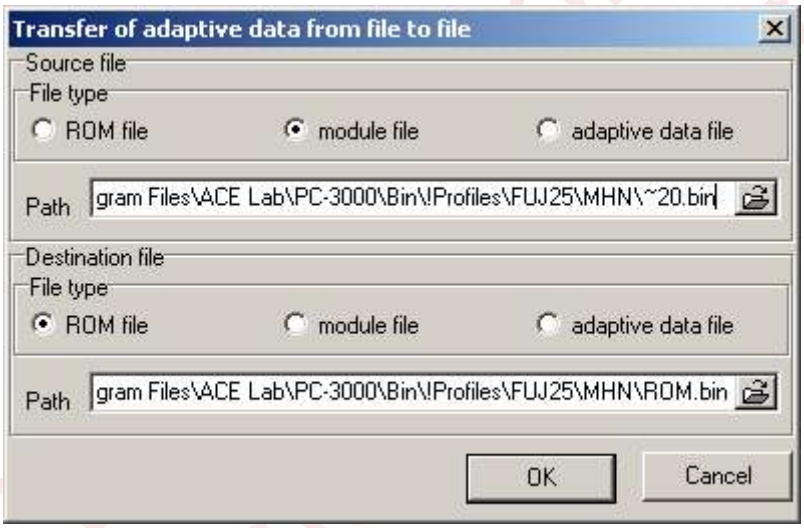


Fig. 7.2. Transfer of adaptive data.

«File type» here determines the default extension for the selected file and the algorithm employed for work with it. «Path» stands for actual file path. Transfer of adaptive data is accomplished by copying a block of data containing adaptive information from a source file (from the location determined by source type) to destination file (to the respective location determined by destination type). The said data block is 512 bytes long. In «module file» and «adaptive data file» object types the block is located at offset 0 from the file beginning while in a «ROM file» it can be found at offset FDE0h.

7.3. HDD formatting

HDD formatting starts the internal format procedure (Low-Level Format). Prior to the formatting procedure the drive will erase its translator tables, check the defect lists for quantity and accuracy and start actual formatting. In the process, the drive skips defective sectors and defective tracks, the numbers of which it reads from the defect lists. The formatting procedure cannot be interrupted since after its completion translator recalculation and recording takes place. If format ends in error, it means presence of corrupt servo information or incorrectly compiled defect list (illegal values or values exceeding limits). Then the drive's translator will not be recalculated and that will make impossible its work using the logical parameters. Therefore you are advised to save in a temporary file the service data modules prior to formatting start to allow their subsequent restoration, if necessary. Formatting takes approximately 20 minutes, but it depends on the model, condition of magnetic disks and it can take considerably longer with defective surfaces.

Formatting errors can occur immediately after the procedure begins in case of incorrect contents in PL or TS defect lists. For instance, that happens if some heads were disabled in the process while the PL and TS defects tables contain left-over records about defects for the deactivated heads. That will be indicated in PL and TS tables by the difference between the total number of defective sectors and their total amount for the remaining heads; a message about the

number of structural errors acts as another confirmation. The utility displays in red all records of defects that do not match the existing drive geometry. If such errors are detected, you will have to clear the defect lists for the disabled heads.

7.4. Logical scanning

This menu item initiates the logical scanning procedure performed by the universal utility of the PC-3000 suite. Please see the corresponding manual for a detailed description of that feature.

7.5. Clear S.M.A.R.T.

This command resets all the attributes to initial values except for just a few of them. For example, relocated defects count gets reset in case of successful formatting and regeneration of translator tables while the spindle motor spin up time attribute is calculated every time the power supply is switched on. The attributes reset does not work with some drives, in such case you can use the option for loading an external S.M.A.R.T. module. The actual resetting of attributes is accomplished by overwriting of model attributes' module (ID = 010B) over the current attributes' module (ID = 0109). Therefore, if the model attributes module becomes damaged, it should be copied from a matching profile set of service data.

7.6. Defect lists

The submenu allows both viewing and modification of PL and TS defect lists.

Warning! The utility version described herein has limited functionality for manual or automatic addition of defects. Therefore you are advised to evaluate the necessity of all actions required to modify the tables and consequences thereof.

7.6.1. Defect lists report

This command allows viewing the tables of relocated defects of a drive. First, track defects (TS) are displayed followed by sector defects (PL). Defects are represented in the tables by heads in PCHS (Physical CHS) format and ordered by heads, cylinders and sectors. You can select the table(s) for review before actual report output as well as the heads and zones to be displayed. While viewing the results you can also see drive's statistics: the number of defects for the selected heads and zones, their total number, displayed number, etc. Furthermore, the utility may display the number of «structural errors» (if present), i.e. records of defects for a non-existent head or located in a non-existent zone. Records identified as structural errors are highlighted using colour. This, in particular, allows quick identification of one typical problem causing formatting errors – invalid records in the defect lists. Viewing the defect tables allows the operator to estimate the quality and condition of magnetic disks used in the drive.

7.6.2. Defect lists editing

The submenu contains commands for addition of defects and editing of the PL and TS lists.

- **Grouping to tracks** is supported while adding defects or editing PL. This action allows the operator to group into defective tracks those defective sectors, which are already entered into the defect list. When the commands are selected, the utility displays its «Grouping threshold» dialog. Use it to enter the threshold number of the defects within a track; once the number is reached, the utility will group sector defects to track defects and move them to the TS list.

- ***Grouping to cylinders*** is supported while editing TS. The command allows reordering of track defects into cylinder ones. During the procedure all track defects present in the TS defect list will be automatically copied for all heads while the defects present in the PL list will be filtered by the added tracks. Such an operation allows better relocation of defects since it improves positioning to a cylinder if a track contains corrupt servo labels for one of the heads

7.6.3. Erase effect lists

You will be offered to reset the defects list(s). After the execution of this command the selected defects table(s) is cleaned-up – the number of defective sectors is set to zero. In case of TS table erasing it is necessary to switch off/on the drive power supply to force reloading of dynamic tables; if you use PC-3K PWR2 adapter the operation is performed automatically.

8. «Tools» → «Utility extensions» menu

This menu can be used to access an interactive tool – the «Modules table» wizard. Doing so will make one more tab appear in the utility workspace. Tab appearance is shown below.

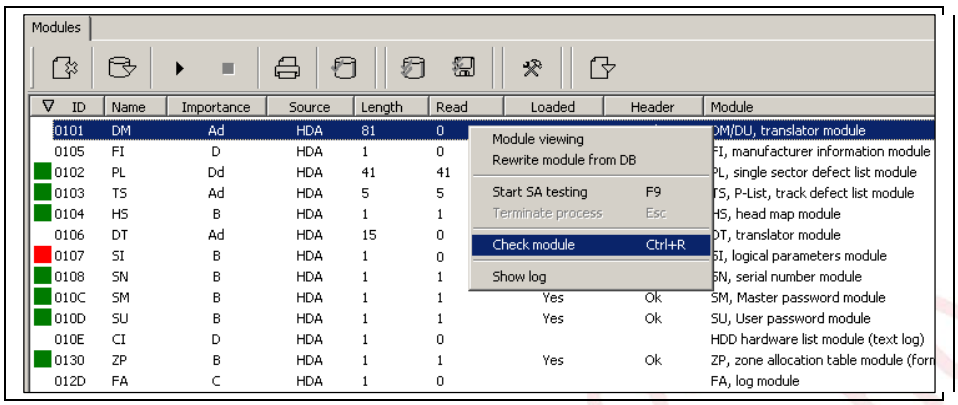


Fig. 8.1. modules table.

Here you can see the following displayed module parameters:

- identifier
- symbolic name from modules table
- source (HDA – disk surface, RAM – PCB memory)
- length in sectors according to the modules table
- the number of sectors actually read from the drive
- brief description
- module importance for the drive (see section 7.2.2)
- whether the module has been loaded (this is also shown by the colour square to the left of module identifier, red means reading or writing error)
- whether the names in modules table and in actual module header match (this is also shown by the colour square to the left of the identifier, green means a loaded module with a matching name while yellow stands for a loaded module with a name mismatch).

You can use the right-click menu to perform the following actions over any module:

- ***Module viewing.*** This menu item becomes available when a certain module is selected in the wizard pane and loaded. The viewing dialog is essentially a built-in HEX editor; you can modify the module while viewing it and record it to the drive.
- ***Rewrite module from DB.*** This menu item becomes available when a certain module is selected in the wizard pane. It opens a dialog for searching the required module in the database. Search filters can be adjusted as necessary.
- ***Start SA testing.*** Here the utility displays a list of modules accessible for reading; the user has to select the necessary set for checking.
- ***Terminate process.*** This menu item is available only while a certain wizard task is running. It allows task termination.
- ***Check module.*** This menu item becomes available when a certain module is selected in the wizard pane. The utility will attempt to read the module again from the drive.

Besides, the following actions can be performed using the wizard toolbar:

- ***Cloze*** (wizard).

- ***Module viewing.*** This menu item becomes available when a certain module is selected in the wizard pane and loaded. The viewing dialog is essentially a built-in HEX editor; you can modify the module while viewing it and record it to the drive.
- ***Start SA testing.*** Here the utility displays a list of modules accessible for reading; the user has to select the necessary set for checking.
- ***Terminate process.*** This menu item is available only while a certain wizard task is running. It allows task termination.
- ***Report.*** The utility outputs to the *«Reports»* tab a report on service data structure generated on the basis of currently loaded modules. The utility reads nothing from the disk. Modules, which are not currently loaded, will be interpreted as modules that the utility has failed to read.
- ***Rewrite module from DB***. This menu item becomes available when a certain module is selected in the wizard pane. It opens a dialog for searching the required module in the database. Search filters can be adjusted as necessary.
- ***Write a group of modules from HDD profile***. The utility displays a dialog with an offer to write to HDD a set of modules from the selected profile.
- ***Write a group of modules from DB.*** The utility displays a dialog with an offer to write to HDD a set of modules from the database. Search filters can be adjusted as necessary.

9. Brief technical description of Fujitsu drives

Fujitsu drives supported in the described utility employ a certain list of resident modules, which they keep in RAM while running. E.g., HS – the module containing the map of active heads. Therefore, while recording a set of modules, it is recommended to write resident modules to RAM first and then proceed to modules, which should be present in the service area on disk surface.

9.1. Drive families using adaptive data

In some of the described families, ROM contains the so-called adaptive data, i.e. individual HDD controller adjustments for work with disk surfaces. MHM2xxxAT, MHN2xxxAT, and MPG3xxxAT belong to drive families using adaptive data. When the adaptive data is damaged, a drive is unable to read service data modules from disk surface and starts knocking with the head assembly against the limiting stop. In such case, it is necessary to turn off drive's power supply to prevent further damage to the HDA, which may result from knocking. The procedure required for selection of adaptive data in that situation will be described, when the respective feature is added to the utility in future updates.

9.2. Modules table

Modules are handled through their road map located in the ROM microchip on the control board. The utility has a configuration file containing information about the location of modules table and some other tables in ROM. If the information about FW of the current drive is not found in the configuration file, the utility attempts to find the corresponding structures in HDD ROM. To accomplish that, it reads ROM contents and then offers to select the right variant out of all the detected possibilities. Throughout the period of utility testing we have not encountered cases of ROM containing more than one possible candidate for the sought structures. Below you can see a sample search window used for detection of module table.

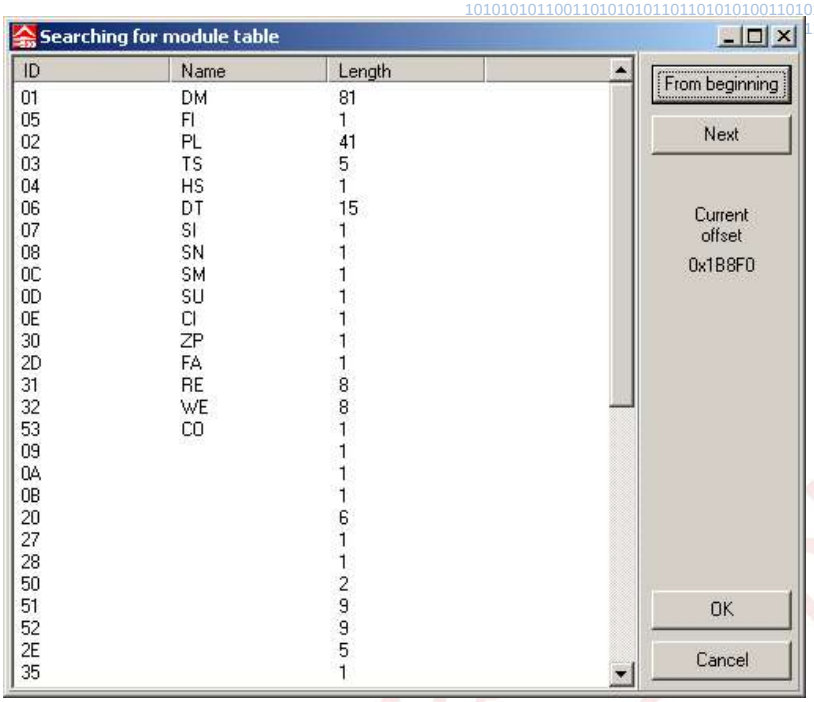


Fig. 9.1. Seaching for module table.

The dialog offers the button «From beginning» to search ROM for modules table beginning with offset 0 and the «Next» button to search for the next offset of ROM data area matching the search criterion.

If for some reason the utility fails to retrieve the information about modules directory (ROM cannot be read and there is no image file available for it, modules table has not been found, etc.), you can work with the default list of modules (located in the configuration file, too). You can edit the parameters for the selected FW or default parameters in general using the specific utility options dialog.

The specific utility options dialog is accessible from the general utility settings window opened from the main menu. The general utility settings dialog (its lower part) contains a button with a label matching the utility name and intended for opening the specific utility-dependent options. The tabs within the specific utility settings dialog are shown below.

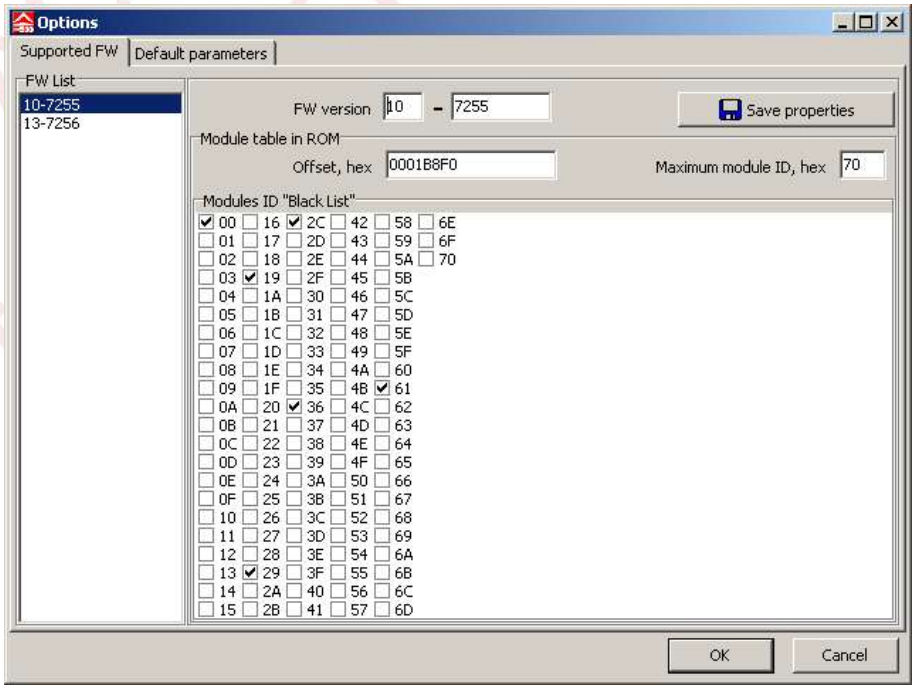


Fig. 9.2. Options.

The settings in the «ID shifts list» and «Black list» do not require corrections in the standard cases of new firmware addition. Modification of those parameters may be necessary to set up the existing utility for work with new drive families or specific firmware versions. The lists should be modified by experienced users only.

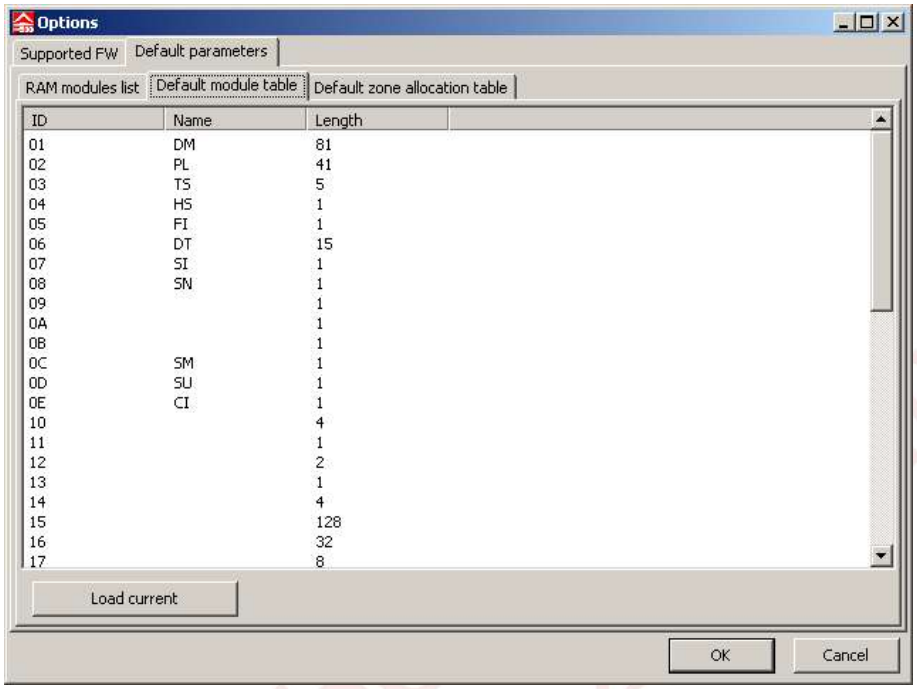


Fig. 9.3. Options.

9.3. Disk space organization

Logical disk space organization is represented in the Table below.

Some of Fujitsu drive families supported by the described utility provide for an opportunity to limit the logical disk space. To do so, you may use the ***«Set max LBA»*** command in the utility tools menu.

The drives utilize the principle of zone-sector writing, at that the whole disk space is divided into 12-15 zones (for MHR2xxxAT and newer drives – 30 and more zones). The initial cylinder of work zone may be both a zero (MHD2xxxAT, …) or a non-zero one (MHR2xxxAT and newer drives). That cylinder corresponds precisely to the zero logical cylinder.

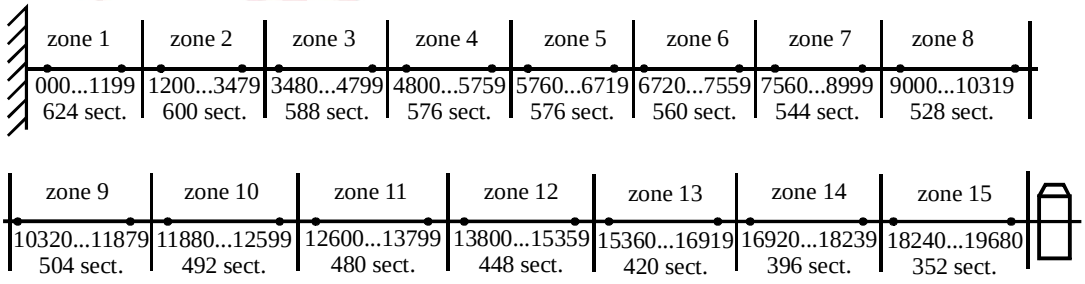


Fig. 9.4. General disk space structure of Fujitsu drives.

The service area is inaccessible in an apparent form and is represented by modules, available through their identification numbers (ID). Those modules contain essential configuration tables of the drive, and (for MHN2xxxAT and newer drive families) resident microcode for the controlling microprocessor in the overlay module identified as 3Dh (in MHR2xxxAT and newer drives it also includes module 3Eh). During initialization, that module is loaded to HDD RAM, and along with ROM it forms the drive controlling microprogram. Module 3Dh is registered as ROM (it has a corresponding header), and an absolute version match between that module and ROM firmware is an essential condition. If module 3Dh has not been loaded into RAM, the drive cannot be operated, besides, the commands to

write/read modules in the disk service area do not work. In such case, it is necessary to load hardware data into drive RAM first, and then write the data to the service area on disk.

9.4. Modification of drive configuration

Drive model in a certain family is determined according to the heads selection table (HS module). Initially, the module is generated in RAM from ROM, and then a drive reads it from the service area on disk surface setting itself up as a specific model depending on the number of active heads.

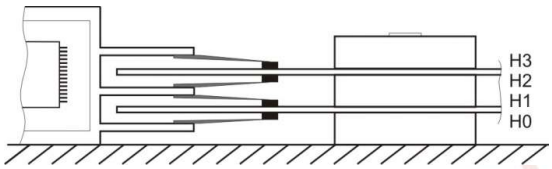


Fig. 9.4. Disks arrangement inside the package.

Reconfiguration can be performed from the top downwards by switching off defective sides and magnetic disks. Besides, not only top surfaces can be switched off but also those in the middle of the package. Junior models are thus created from the top ones. In case of configuration modification the model name, logical drive parameters and translator's operation are set up automatically. Upon completion of configuration modifications, it is necessary to switch the drive power supply off/on in order to initialize such drive with new parameters, and reload the utility, selecting a basic model at utility start.

10. Repair of Fujitsu drives

Repair of Fujitsu drives is characterized by some peculiarities. They include the presence of resident microprocessor code (overlay), a large number of incompatible firmware versions, and differences in the HDA construction and service data structure even in the same models with different dates of manufacture. All of the above complicates initial fault diagnostics and selection of control board for replacement in case of its malfunction. Still, there are some general methods applicable for malfunction search.

10.1. Hardwave repair

10.1.1. Initialization

The drive initializes itself at power-up as follows:

1) Power-up
2) Self-diagnostics 1:
   - data bus and MPU address test
   - writing/reading test of microcircuit registers via internal data bus
   - internal RAM writing/reading test.
3) Spindle motor start-up.
4) Self-diagnostics 2:
   - buffer RAM writing/reading test.
5) Stabilizing the spindle motor rotation speed.
6) Heads release from latch (magnetic heads' unparking).
7) Service data reading.
8) Recalibration start.
9) Setting itself in readiness mode (ATA command waiting).

10.1.2. Microcircuitry malfunctions

1) ***Flash ROM malfunction.*** Problems with Flash ROM microchip in the described drive families are relatively rare. However, data corruption or erasure still can happen to Flash ROM chips. The board in such cases demonstrates «no signs of life» or the drive operation may look erratic. Diagnostics of such malfunction requires reading the Flash ROM contents and its subsequent comparison to a reference value. If the drive starts operation and reports on readiness, Flash ROM can be read through the «Work with ROM» option of the utility. If the drive does not reach the ready status, then the ROM contents can be read in Kernel mode only (provided that the utility supports such an opportunity for the selected family) or you can read it in a ROM programmer having unsoldered the ROM chip first.

Attention! When you compare the Flash ROM contents to the reference value, keep in mind the flags byte (at 2Bh from ROM beginning) and adaptive HDA data (see sections 9.1, and 7.2.2) as they are individual for each specific drive model. That is why during comparison their contents may turn out to be different. Adaptive data are used in MHM2xxxAT and MHN2xxxAT drive families.

2) ***VCM (voice coil motor) & SPM (spindle motor) controller malfunction.*** The microcircuit suffers sometimes from the substrate separation defect and local overheating of the crystal. With such malfunction the drive spins up normally, reports on readiness, operates, and after a while the spindle motor stops (it is a defect similar to TDA5247HT chip in Quantum drives).

3) ***Integrated chipset*** contains a microprocessor in some drive families also including the reading/writing channel and interface controller. Malfunctions of that chip become apparent after circuitry heating (especially in summer period) during writing cycles. As a rule in such cases a drive corrupts its own service modules. One can indirectly judge about the microcircuit operability by activity in data bus lines, connected to ROM and buffer RAM chip. If there is none, you should check the presence of power voltage and clock generation or a steady «RESET» signal. Complete check of integrated chipset requires drive testing using PC-3000 universal utility in cyclic mode with writing enabled for at least 3 full passes. If a drive malfunctions, hangs (does not report on readiness), erases firmware modules, then the circuit is defective. In some cases, this can be corrected by microcircuit unsoldering, solder alloy replacement on board pads and the circuit, flushing the residue of old fusing agent and subsequent soldering the microcircuit back with obligatory flushing.

10.2. Software repair

10.2.1. Drive restoration algorithm

Basic distinction of the described families of Fujitsu drives is manifested in a wide diversity of incompatible firmware versions and service data versions. In addition, even similar ROM versions include a configuration flags byte and have an area of 512 bytes at the end, containing adaptive data (i.e. firmware adjustments for a specific HDD model in drive families using adaptive data). That leads to incompatibility even between similar ROM versions, causing both common operation slow-downs during reading and even knocking sounds during initialization (see details in Chapter 13).

Depending upon the condition of the drive being repaired, certain operations might be necessary for its restoration. For example, if at power-up the drive doesn't spin up the spindle motor, or spins it up and stops, then most probably the defect follows from a malfunction of the electronics board, which needs a repair. If spindle motor spins up, but instead of recalibration sounds you hear monotonous strokes of the actuator hitting against the limit stop, then the defect indicates incorrect drive servo system operation and may arise from:

1) ROM version incompatible with HDA (see Chapter 13)

2) invalid adaptive data in ROM or service area (see section 9.1)

3) malfunction of switching preamplifier chip of the magnetic heads stack inside the sealed head-and-disk assembly case

4) malfunction of HDA

5) heavy corruption of servo fields or a shift of magnetic disks' package after an impact (one sign indicating that the drive took an impact is greater noise of spindle motor operation and case vibration).

The first two cases allow software restoration of a drive while the remaining three do not.

If after switching power on the drive spins up the spindle motor and unparks the magnetic heads, but while entering the universal PC-3000 utility generates the ABR (04h) error, or errors appear one after another while reading drive surfaces, then it means that the drive cannot read service data from the disk. Such malfunction may be caused by:

1) corruption of service modules (see Chapter 11).

2) incompatibility between the service data version and the firmware recorded in the control board ROM (see Chapter 13).

3) defects of reading / data conversion channel of the drive.

In such case ensure that the control board is functional (board swap being the best method), the ROM and HDA versions are compatible, and begin the service data restoration.

Restoration should begin with analysis of report produced after SA structure test (see the corresponding menu item). If a drive hangs while reading a certain module, you can test all the remaining modules using the module table wizard – «Tools \ Utility extensions \ Modules table». You may run the wizard to read a specified set of modules and use it as the basis for subsequent report about service data structure.

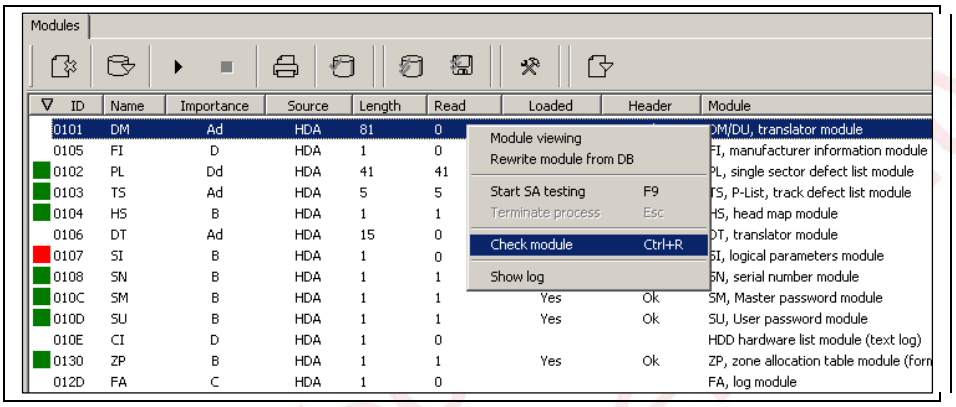


Fig. 10.1. Check module.

In addition to other information, you can see here a brief module description and characteristics of its importance for the drive (in particular, for data accessibility) – the «Importance» column.

If not all the modules are damaged, but just some of them, you can overwrite the defective modules using the methods detailed in Chapter 11.

If most of drive's modules turn out to be damaged including the overlay module 3Dh (MHN2xxxAT and newer models), then you will have to write the modules to drive RAM first and only then record them to disk surface.

Switch HDD power supply off and on to initialize the drive with new parameters.

Possibly, it may be necessary to reset S.M.A.R.T. attributes.

Possibly, it may be necessary to perform a low-level format procedure.

Warning! Performance of the procedure will definitely cause loss of user data.

11. Restoration of service data modules

Corruption of service data modules is a frequently occurring fault. The malfunction manifests itself as follows: the drive spins up the spindle motor, recalibrates itself and outputs an ABR error.

Diagnostics of such malfunction requires to select the «SA structure test» mode in the menu, and to identify the defective modules in the resulting report. Alternatively, you can visually examine and estimate the service area status in the module table wizard - «Tools → Utility extensions → Modules table». Here you can see at once, which modules have been read successfully and which failed, whether module header matches the name in the module table, module importance for the drive, etc. You may run the wizard to read a specified set of modules and use it as the basis for subsequent report about service data structure.

Some of the modules are critical for data protection and should not be overwritten if you wish to preserve the user's data, for example, the modules **01h (DM), 03h (TS) and 06h (DT)**. The DM module contains a table of exceptions, TS module contains the track (cylinder) defects' dynamic table, the DT module contains translator and represents a link between the logical space, defects lists and drive's physical space. The remaining modules are not so essential, and may be re-written, but it is recommended to copy them from the same HDD model with the same service data version, for example, the modules: 04h (HS), 3Dh. Some modules can be copied from any suitable drive, namely: 08h, 09h, 0Bh, 0Ch, 27h, 2Dh, 31h, 32h, 36h, 51h, 52h, 60h, 70h; however, in 95% of cases corruption influences not the whole list but

just a part of it. As a rule, the problem is in log modules, while all the rest cause read errors because of those malfunctioning modules. Rewriting those corrupted modules automatically restores access to the rest. Please see above the importance characteristics of various modules.

Attention! **Prior to starting the drive restoration, it is necessary to save all the modules and the ROM firmware** to have an opportunity to reverse the changes. Use the «Reserve HDD resources'» menu item to do that.

12. ROM data structure

Table 12.1 Represents the firmware structure in ROM, and Fig. 12.1. demonstrates its sample header.

Address	Length	Purpose
00 h	32 bytes	Keyword: © FUJITSU
20 h	4 bytes	Firmware version
24 h	4 bytes	Version date
28 h	2 bytes	Reserved
2A h	1 byte	Version prefix
2B h	1 byte	Flag byte (presence of adaptive data, heads' map and disks' map)
2C h	4 bytes	Checksum for the whole ROM including adaptive data but without header
30 h	16 bytes	ASCII family name
…	…	….
…	…	….
1FDE0 h	512 bytes	Adaptive data (checksum adjusted and equal to 0) (for families using adaptive data)
1FFE0 h	32 bytes	Keyword: © FUJITSU[1]

```
00000:  28 43 29 20 46 55 4A 49 54 53 55 20 31 39 39 39   © FUJITSU 1999
00010:  2D 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20   -
00020:  38 22 00 24 20 00 10 31 22 00 0E 00 00 00 DE 63   8" $   1".     _c
00030:  48 31 33 4C 2D 30 32 20 20 20 20 20 20 20 20 20   H13L-02
```

Fig. 12.1. Sample firmware header in ROM

The loaded firmware portion, the so-called overlay, has a similar header (MHN2xxxAT and newer). It is located in the service area on disk in the module ID=3Dh (besides, in MHR2xxxAT and newer drive families it is also stored in module 3Eh), and loaded to HDD RAM during initialization. The essential condition is an absolute match between the overlay version and the ROM firmware version. The overlay does not contain adaptive data, and may have different length depending on its version. Its last 32 bytes contain the keyword «©FUJITSU».

12.1. Flags byte in ROM

Among other purposes, those flags are used to select the number of the head that will be used to read service information when drive power is switched on. Therefore, when the original ROM is lost and a drive cannot load using a borrowed ROM, you should try selecting another boot head in the flags byte described in this section. The procedure can be performed in HEX editor since ROM header is not covered by the checksum (unlike main data).

Flags byte is located at offset 2Bh from ROM beginning and consists of 8 bits. The bits meanings are as follows:

[1] – For MHN2xxxAT and newer drive families. The keyword was not used in earlier drive families (the area used to be filled with FFh code).

D7	Sign of adaptive data presence in ROM, but the bit does not influence anything, it is purely informative;
D6, D5	Heads table used for hardware data loading;
D4	Purpose unknown. Usually = 0.
D3	Purpose unknown. Usually = 0.
D2	Purpose unknown. Usually = 0.
D1, D0	Binary presentation of disks number in a drive.

If ROM is re-written from a database during drive repair, please note the values of D6, D5, D1, and D0 bits. The rest either are set to 0 or influence nothing. For example, if a single-disk model uses head 0 and its firmware contains adaptive data, therefore the flags byte should read as follows: 10100001 = A1h. If the same model uses head 1, then it will look like: 11000001 = C1h. In case of a model with adaptive data we have A1h; a model without adaptive data is represented by 02h.

Meaning of D6 and D5 bits:

D6, D5 = 0 0 – a drive with two heads (it can also have two disks, see description of D1, and D0).
D6, D5 = 0 1 – a single-head drive with operating head 0.
D6, D5 = 1 0 – a single-head drive with operating head 1.

Meaning of D1 and D0 bits:

D1, D0 = 0 1 – single-disk drive.
D1, D0 = 1 0 – double-disk drive.
If bits D6 and D5 = 0, it is assumed that hardware data loading begins with head 0, i.e. value 01h (81h) and 21h (A1h) has equivalent meaning.

13. Compatibility between ROM microcode and service data modules (board compatibility)

The service data version recorded to HDA can be found on the drive label. Version number is indicated in its right lower corner, under the line (see the figure below) and consists of a prefix (3 or 4 characters) and an actual version number (4 characters) separated by dash. The first prefix character (or first 2 characters in 4-character code) is of no importance for compatibility. Therefore if you wish to determine exactly the ROM version that has to be recorded for current HDA you should read the necessary data from HDA label (see the figure) or check the version number in ROM dump (having read it first). You can identify firmware version from ROM dump as follows: check 4-byte ROM version number in the dump, note its first two bytes and note the prefix byte (see Chapter 12). Thus, you will have a 6-character number of a ROM version required for the drive.

Attention! Normal HDD operation requires matching versions of firmware in drive ROM and service data in its HDA.

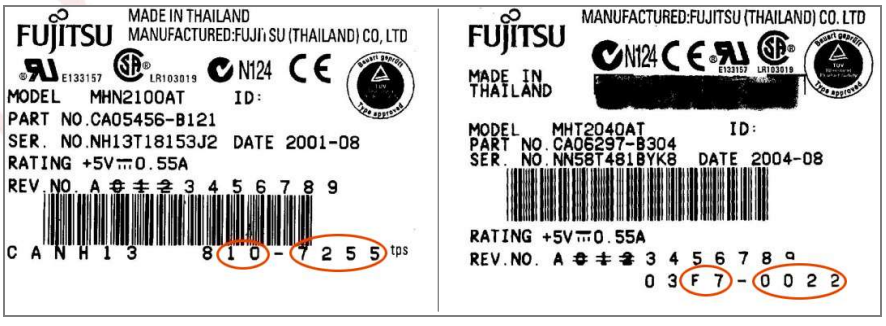


Fig. 13.1. Drives MHN2100AT and MHT2040AT.

In the left figure (MHN2100AT drive) ROM firmware version is **10-7255**; in the right figure (MHT2040AT drive) it is **F7-0022**.

If a drive reports on readiness, you can review ROM firmware version using a corresponding utility (see the «View information from ROM» menu item) or else you can read the board ROM in Kernel mode (for drive families, which support that feature) or in a ROM programming device (having unsoldered the chip from the board first).

The match of the version's number shown on HDA and the ROM firmware version number does not necessarily mean a trouble-free match between the HDA and the current ROM version. First, you should check in ROM (and correct, if necessary) the flags byte (see section 12.1). You should also take into account the presence of adaptive data in drive families that support them (MHM2xxxAT, MHN2xxxAT). Actually the adaptive data – individual HDA program settings – are recorded in ROM of some adaptive single-disk models. They are calculated during servo fields recording on a pushpin-free STW (Servo Track Writer)[1]. That means that use of a board other than native may cause «alien» adaptive data to be recorded to ROM. It may lead to poor reading quality, slow work of such drive or even «fidgeting» or heads knocking during initialization. However, it is quite possible to pick up a board with suitable ROM firmware for a specific HDA. Examples are shown in Chapter 19.

Each drive family except for MHD2xxxAT has its own code painted on ROM chip (see the table below). ROM chips of MHD2xxxAT drives contain an alphanumeric code of 8 characters. It is quite easy to identify a board of MHD2xxxAT drive – it is the only family using the AM29F010 chip (in wide case).

Drive families:	Code
MHK2xxxAT	HN-12
MHM2xxxAT	HN-13
MHN2xxxAT	HN-14
MHR2xxxAT	HRT
MHS2xxxAT	HSB
MHT2xxxAT	HTA
MPA3xxAT	PB10U
MPB3xxAT	PB11U
MPC3xxAT	PB12
MPD3xxAT	PDT
MPE3xxAT	PB14
MPF3xxAT	PFT
MPF3xxAH	PFHx
MPG3xxAT	PGT8
MPG3xxAH	PGH

14. Peculiarity of service information storage

Before any operation on a HDD it is essential to copy from it a complete set of its service data, i.e. ROM and service modules. The ***«Reserve HDD resources»*** menu item performs the procedure automatically. Service data can be saved to drive profile or to the utility database. During the procedure the utility will store in the selected folder a report on service data structure based on retrieved modules; the «ROM» subdirectory will contain a ROM image, the «Modules» subdirectory – the retrieved modules proper.

[1] – Adaptive data are recorded to ROM and to service module 20h.

15. Unlocking password-protected drives

The problem of disabling drive passwords can arise in case when a user set a password on a drive and has forgotten it, or when a password has been set by a malicious virus program. In the first case you can view the password in the «SA structure test» mode. In the second case, unprintable ASCII characters (beyond the 20h – 7Fh range) are frequently used. That is why the «Security subsystem» mode in the utility provides for a password resetting option.

The feature is accessible from the utility startup dialog or from the «Security subsystem» menu.

When the utility starts, it analyzes the HDD ID. If password protection is enabled, then the «Password unlocking» button becomes active.

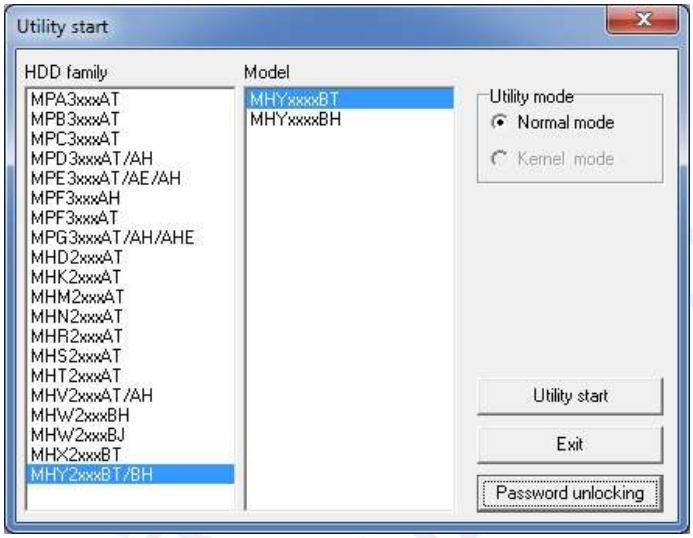


Fig.15.1 Password removal

Password removal is performed automatically for all supported drive families. For all families (except for MHV2xxxYY) the procedure only requires drive connection to the power supply and ATA cables (password removal in MHV2xxxYY drives will be explained in detail further). The following situations are possible after the procedure:

- The utility disables password protection successfully. Utility start in standard mode follows. You can analyze the drive firmware, user data are freely accessible.
- The utility fails to disable password protection. Then it displays a dialog suggesting possible actions. SA access will be limited in some drive families, user data cannot be accessed.

Dialog displayed by the utility in case of password removal failure:

Fig. 15.2. Error dialog.

- Clicking «Yes» initiates a new attempt to disable password protection.
- If you click «No», an attempt to launch the utility will be made in order to allow manual security override using tools unknown to the utility.
- Clicking «Cancel» exits the utility completing work with it.

15.1. Password removal at MHV2xxxYY, SATA

Correct operation of the password removal functionality with the MHV2xxxYY drive family (SATA) requires HDD connection to terminal. The drive must be connected using the MHV contacts. The connection scheme is shown in the Figure 15.3.

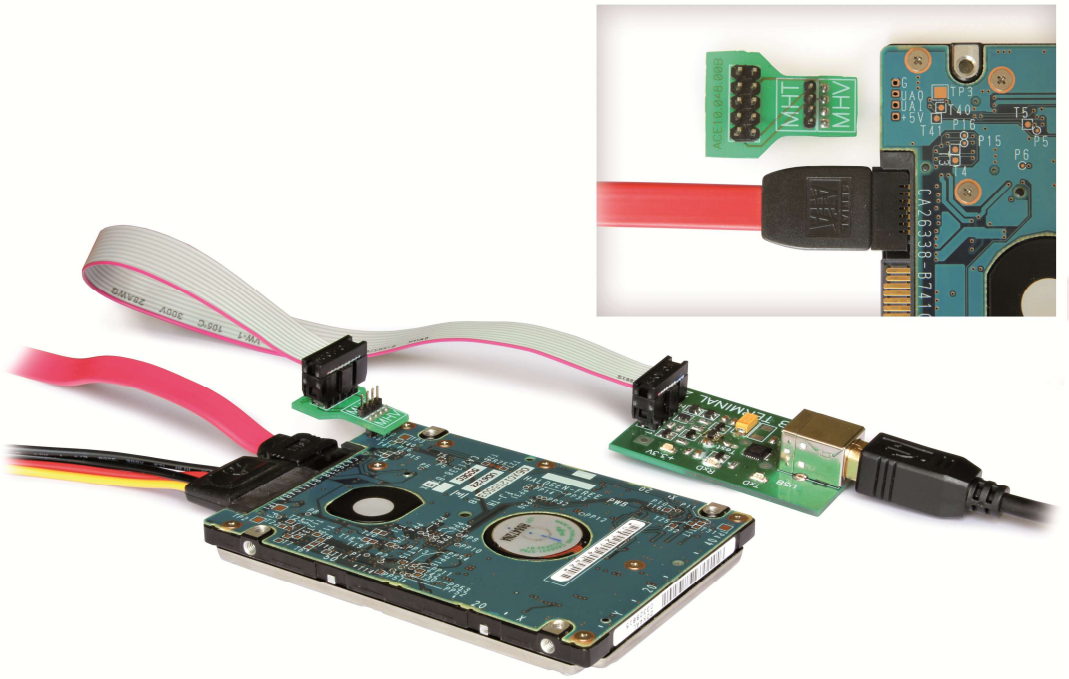


Fig. 15.3. The scheme of HDD connection to terminal.

If an attempt to reset the password via ATA fails, the following warning will appear:

Fig. 15.4. Warning.

If the terminal is not connected yet at the moment, connect it (Figure 15.4) and click OK. The utility will attempt to disable the password using terminal access to the drive. Since the connection to drive terminal is flexible, problems may occur during the data transfer stage (contact bouncing and/or jitter). Therefore, if a password reset attempt fails, manually press the PC-FUJ.SATA adapter closer to the drive and repeat the attempt to disable the password.

16. Patching the 3Dh module for creation of non-standart models in the MHN2xxxAT and MPG3xxxAT/AH drive families

The capacity miscount (understatement) problem often appears after software disabling of heads in Fujitsu drives. This problem is related to the capacity evaluation routine used in the Fujitsu drive firmware. Every firmware copy contains Max LBA values for all manufactured modifications of a given model (in that case modifications are understood as drives with a different number of heads). They are stored in a table and indexed specifically depending on the number of active heads in drive HDA. Thus, to ensure normal drive operation in case of heads over-commutation you have to correct the corresponding cell of that table into a model, which is not manufactured by Fujitsu.

The procedure of searching this table in the original (previously uncorrected) 3D module is very simple: you should search for the sequence of bytes corresponding to binary presentation of Max LBA parameter returned by the drive in its drive ID (hex notation, the first byte is a lower one) and replace it with a necessary string. During correction, you should reserve some disk space (a number of sectors corresponding to 5-10 cylinders) for the last connected zone.

Attention! Data in 3Dh module are stored in Intel format (the high significant data byte is located at upper address).

17. Regenerate translator

First, we have to note that MHD2xxxAT, MPA3xxxAT, and MPB3xxxAT drives have no such feature.

The menu option is meant for restoration of static translator part (**DM module**) using the PL table as the basis. A similar procedure is performed by the low-level format command after successful surface formatting. Achievement of complete translator's restoration requires also that you have to provide separately for the dynamic part accuracy (**TS module**). It is recommended to save all service data modules prior to translator recalculation.

18. Work with adaptive data

Please note that adaptive data can be used in MHM2xxxAT, MHN2xxxAT, and MPG3xxxAT drive families.

Adaptive data are individual settings of actuator microstepping calculated during servo fields recording on a pushpin-free STW[1] (Servo Track Writer).

In general, adaptive data are used in single-disk models, though not necessarily. You can tell whether a model uses them or not after looking at the model ROM (please see Chapter 12).

The described utility version supports only transfer of adaptive data from one file to another and only for drive families using the adaptive data.

Attention! Nothing happens to the currently connected drive during the procedure (see section 7.2.2 for details).

19. Data recovery

19.1. Board selection

Sometimes during data recovery you may encounter a situation when the «native» drive board is damaged beyond repair or its repair is too complicated or might take too long. In that case, board replacement (with another one borrowed from an operating «donor» HDD) might be helpful. Theoretical information required for board selection can be found in Chapter 13. Board swap requires a donor drive of the same family and model as the damaged HDD. Besides, firmware versions of the drives must be identical. We have to remark that the best results can be achieved by reprogramming or resoldering the ROM chip from the HDD being restored to a borrowed PCB. The factor becomes increasingly critical for the so-called adaptive drive families (see section 9.1) because each firmware of those drives is unique.

[1] – sometimes also referred to as Low-Cost Servowriter.

Sample procedure:

1) Find a suitable donor drive of the same family and preferably the same model with an identical firmware version.
2) Swap the boards and check whether that operation is sufficient to restore drive functionality (the ability to report on readiness, restore access to service data modules and to user's data in the best case).
3) If the drive malfunctions (produces knocking sounds, does not report on readiness, produces ABR errors) you should also transfer the «native» ROM firmware. That can be accomplished using any of the following two methods:
   - Solder the ROM chip from the damaged drive board to the borrowed PCB.
   - Use the Kernel mode or a programming device (having unsoldered the ROM chip) to read ROM contents from the damaged board; then record the firmware thus retrieved to the donor board.
4) Check drive functioning once again. During this stage you may discover that service data modules or data in «native» ROM are also damaged. If the modules are damaged, you should use the methods described in section 1). If the «native» ROM data turns out to be corrupted, try to record to donor board ROM a matching firmware version from the PC-3000 suite database. If the drive being restored contains adaptive data, you should try to transfer the data from the original ROM (assuming that at least the adaptive data is intact) or run the procedure for selection of matching adaptive data.

19.2. Damage to service information modules

A situation, when HDD service data modules become damaged is quite common. Such a drive cannot be identified in computer BIOS and after connection to the PC-3000 suite the latter displays a message informing about impossibility to read drive ID and an ABR error. Theoretical information necessary for restoration of the modules can be found in Chapter 11.

To search for damaged modules, you will have to check the SA structure. Module restoration should be started with log modules, particularly with higher identifiers (e.g., if modules 0132 and 0152 are damaged, you should start with module 0152), because that may cause the drive to regain access to the remaining modules. Each operation over the modules should be followed by a new check of SA structure. Restoration can be conveniently performed using the «Modules table» wizard accessible from the «Tools» → «Utility extensions» menu (see sections 8, and 10.2.1). The tool allows you to check drive modules and visually examine their status (read / failed reading, etc.) and a brief comment.

The wizard also provides an opportunity to record a selected module and search the suite database for version variations belonging to compatible firmware sets.

Attention! Some modules cannot be copied from other drives. There are certain modules critical for user data and drive functioning in general.

Attention! You should pay special attention to cases of damaged translator modules. Please see section 0 for details on translator regeneration.

19.3. Password protected

An OS failure, power supply failure or viral activity may enable password protection of a drive. In such cases, the HDD ID contains a record of password protection, but an attempt to read the drive using its logical parameters returns ABR errors for any LBA. Use the «Erase password» item in the «Security subsystem» menu to restore access to user data (see sections 7.2.2.6 and 15).

19.4. Regenerate translator

Translator damage occurs quite often during HDD operation. In such cases a drive either constantly produces a UNC reading error beginning with a certain LBA (which means that **DM translator module** is damaged, but can be read), or the drive cannot be identified (when DM module cannot be read). To restore access to user data you should recalculate the translator (see Chapter 17). Besides, in the second case you should restore DM module readability before the procedure by overwriting it with a new copy from a compatible service data version.

20. Appendix 1. ROM, chips used in 2.5" Fujitsu drives

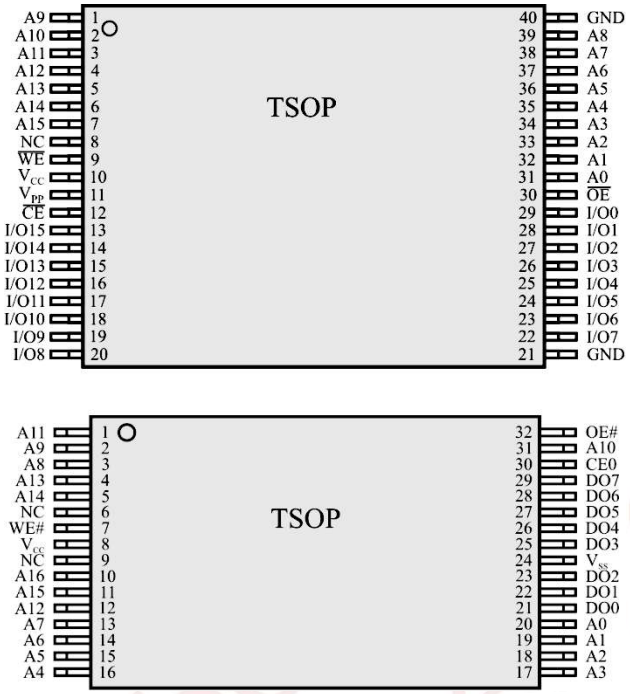
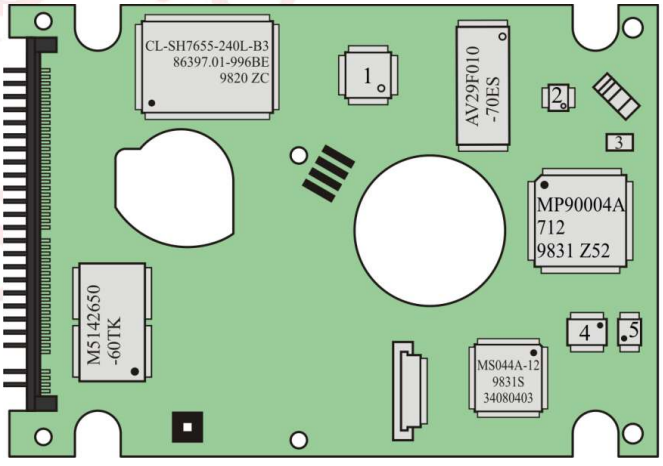


Fig. 20.1

21. Appendix 2. Schemes of controller boards 2.5" Fujitsu drives



1. 8H 13566
2. A128H
3. 30MHz
4. HA244 87K
5. 2904 868 JRC

Fig. 21.1. Fujitsu MXD2xxxAT.

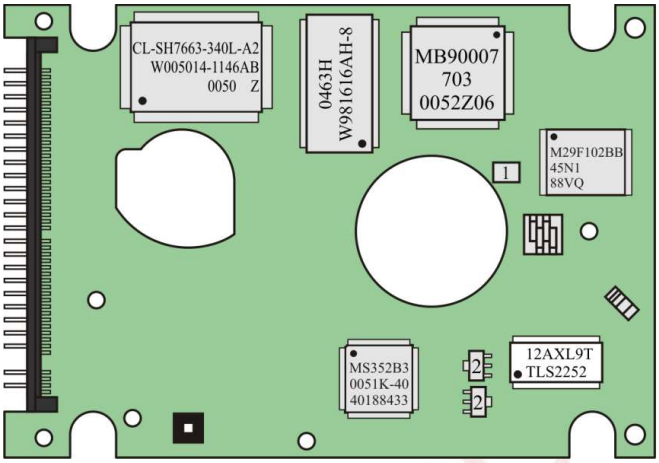


Fig. 21.2. MHM2xxxAT

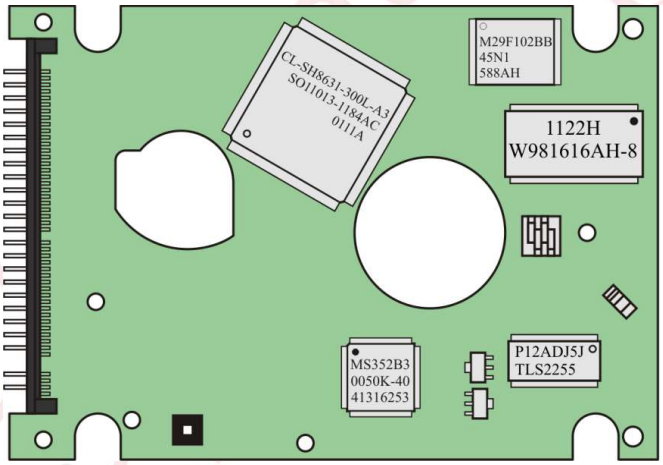


Fig. 21.3. MHN2xxxAT

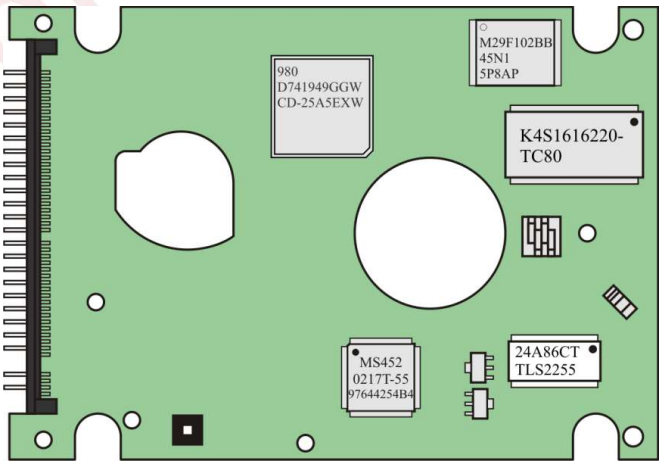


Fig. 21.4. MHR2xxxAT

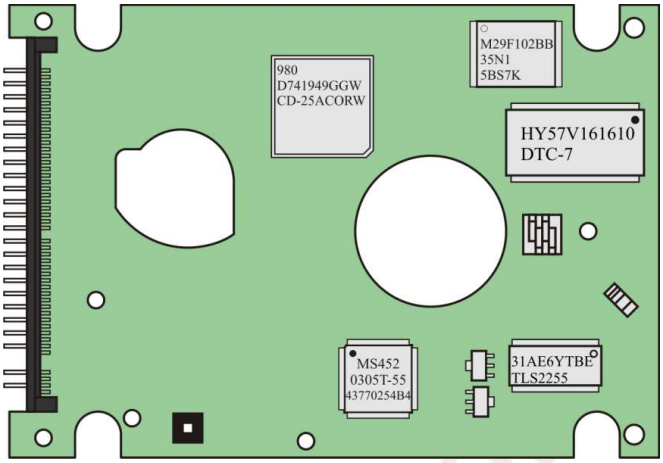


Fig. 21.5. MHS2xxxAT

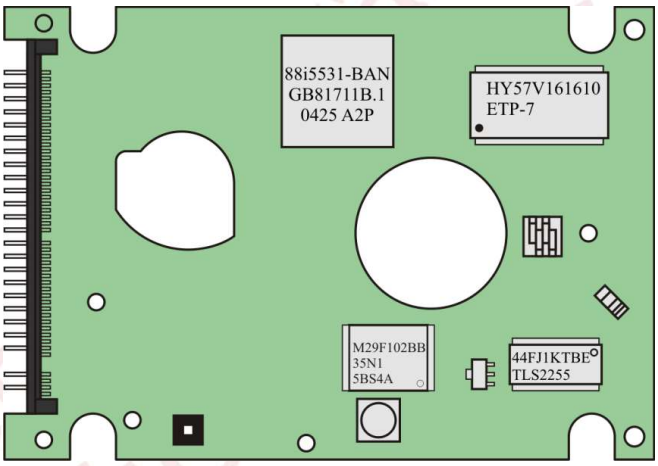


Fig. 21.6. MHT2xxxAT

22. Appendix 3. Checkpoints for switching 2.5” Fujitsu drives to Kernel mode

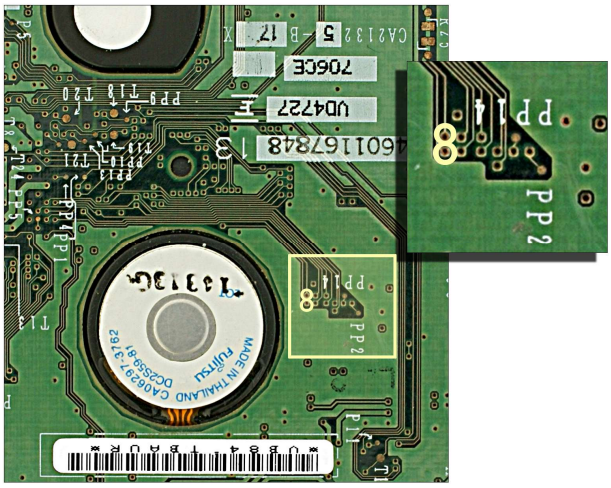


Fig. 22.1. Location of the contact pads that should be connected to switch MHT2xxxAT drives to Kernel mode.

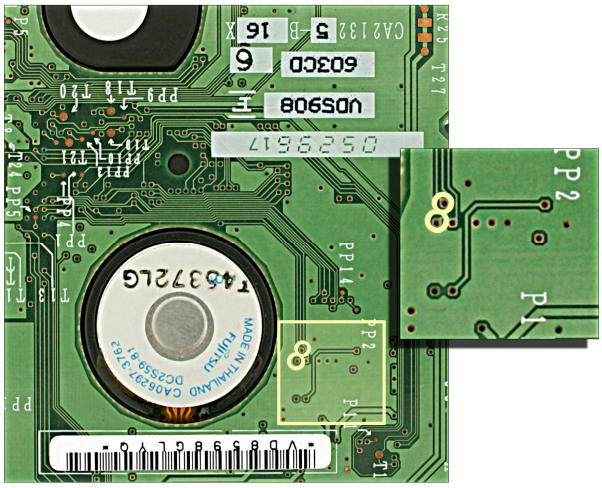


Fig. 22.2. Location of the contact pads that should be connected to switch MHT2xxxAH drives to Kernel mode.