TOSHIBA

Contents

1. Structure and naming of HDD families

1.1. Structure of HDD families

Toshiba manufactures 2.5" and 1.8" HDD with spindle speed of 4200, 5400 and 7200 RPM and ATA / SATA interfaces and several models of 2.5" Automotive HDD intended for operation at extreme temperatures.

HDD are assembled by factories in Japan, China and Philippines.

1.1.1. 2.5" HDD PATA

Drive family	Model	Capacity, Gb	Disks	Heads	Spindle speed, RPM	Cache Buffer, Mb
14GAP	MK1214GAP	12	2	4	4200	
16GAP	MK1016GAP MK2016GAP	10 20	1 2	2 4	4200	
17GAP	MK1017GAP MK1517GAP MK2017GAP MK3017GAP	10 15 20 30	1 1 2 2	2 2 4 4	4200	
18GAP	MK2018GAP MK4018GAP	20 40	2 2	4 4	4200	
18GAS	MK2018GAS MK3018GAS MK4018GAS	20 30 40	1 2 2	2 4 4	4200	
19GAX	MK3019GAX MK4019GAX	30 40	2 2	3 4	5400	
21GAS	MK3021GAS MK4021GAS MK6021GAS	30 40 60	1 2 2	2 3 4	4200	2
23GAS	MK2023GAS	20	1	2	4200	2
25GAS	MK3025GAS MK4025GAS MK6025GAS MK8025GAS	30 40 60 80	1 1 2 2	2 2 4 4	4200	8
26GAX	MK4026GAX MK6026GAX MK8026GAX	40 60 80	1 2 2	2 4 4	5400	
31GAS	MK1031GAS	100	2	4	4200	8
32GAX	MK4032GAX MK6032GAX MK8032GAX MK4032GSX MK6032GSX MK8032GSX	40 60 80 40 60 80	1 2 2 1 2 2	2 3 4 2 3 4	5400	8
33GAS	MK1233GAS	120	2	4	4200	8
34GAX	MK6034GAX MK1234GAX MK6034GSX MK1234GSX	60 120 60 120	1 2 1 2	2 4 2 4	5400	8

1.1.2. 2.5" HDD SATA

Drive family	Model	Capacity, Gb	Disks	Heads	Spindle speed, RPM	Cache Buffer, Mb
32GSX	MK8032GSX MK1032GSX	80 100	2	4	5400	8 16
34GSX	MK4034GSX MK6034GSX MK8034GSX MK1034GSX MK1234GSX	40 60 80 100 120				
35GSS	MK2035GSS	200	2	4	4200	8
37GSX	MK6037GSX MK8037GSX MK1237GSX MK1637GSX	60 80 120 160	1 1 2 2	2 2 4 4	5400	8
46GSX	MK8046GSX MK1246GSX MK1646GSX MK2546GSX	80 120 160 250	1 1 2 2	2 2 3 3	5400	8
49GSY	MK8049GSY MK1249GSY MK1649GSY MK2049GSY	80 120 160 200	1 2 2 2	2 3 4 4	7200	16
51GSY	MK8051GSY MK1251GSY MK1651GSY MK2051GSY	80 120 160 200	1 2 2 2	2 3 4 4	7200	16
52GSX	MK8052GSX MK1252GSX MK1652GSX MK2552GSX MK3252GSX	80 120 160 250 320	1 1 1 2 2	1 2 2 4 4	5400	8
53GSX	MK1253GSX MK1653GSX MK2553GSX MK3253GSX	120 160 250 320	1 1 2 2	2 2 4 4	5400	8
54GSY	MK8054GSY MK1254GSY MK1654GSY MK2554GSY MK3254GSY	80 120 160 250 320	1 1 1 2 2	1 2 2 4 4	7200	8
55GSX	MK1255GSX MK1655GSX MK2555GSX MK3255GSX MK4055GSX MK5055GSX	120 160 250 320 400 500	1 1 1 2 2 2	1 2 2 4 4 4	5400	8
56GSY	MK1656GSY MK2556GSY MK3256GSY MK5056GSY	160 250 320 500	1 1 2 2	2 2 3 4	7200	16

58GSX	MK4058GSX	400	2	4	5400	8
59GSM	MK7559GSM MK1059GSM	750 1000	3	6	5400	8
59GSX(P)	MK3259GSX MK5059GSX MK6459GSX MK7559GSX	320 500 640 750	1 2 2 2	2 4 4 4	5400	8
61GSY	MK1661GSY MK2561GSY MK3261GSY MK5061GSY MK6461GSY	160 250 320 500 640	1 1 1 2 2	1 2 2 4 4	7200	16
63GSX	MK3263GSX	320	2	3	5400	8
65GSX	MK1665GSY MK2565GSY MK3265GSY MK5065GSY MK6465GSY	160 250 320 500 640	1 1 1 2 2	2 2 2 4 4	5400	8
75GSX	MK1675GSY MK2575GSY MK3275GSY MK5075GSY MK6475GSY MK7575GSY	160 250 320 500 640 750	1 1 1 2 2 2	1 2 2 4 4 4	5400	8
76GSX	MK1676GSY MK2576GSY MK3276GSY MK5076GSY MK6476GSY	160 250 320 500 640	1 1 1 2 2	1 2 2 4 4	5400	8
MQ01ABB	MQ01ABB150 MQ01ABB200	1500 2000	4	8	5400	8
MQ01ABD	MQ01ABD025 MQ01ABD032 MQ01ABD050 MQ01ABD064 MQ01ABD075 MQ01ABD100	250 320 500 640 750 1000	1 1 1 2 2 2	2 2 2 4 4 4	5400	8
MQ01ABF	MQ01ABF032 MQ01ABF050	320 500	1 1	2 2	5400	16
MQ01ABU	MQ01ABU032W MQ01ABU050W	320 500	1 1	2 2	5400	16
MQ01ACF	MQ01ABF032 MQ01ABF050	320 500	1	n/a 2	7200	16
MQ02ABF	MQ01ABF075 MQ01ABF100	750 1000	2 2	4 4	5400	16

1.1.3. 1.8" HDD PATA

Drive family	Model	Capacity, Gb	Disks	Heads	Spindle speed, RPM	Cache Buffer, Mb
03GAL	MK1003GAL MK2003GAL	10 20	1 2	2 4	4200	0,5
04GAL	MK1504GAL MK3004GAH	15 30	1 2	2 4	4200	2
04GAL	MK2004GAL MK4004GAH	20 40	1 2	2 4	4200	2
06GAL	MK2006GAL	20	1	2	4200	
07GAL	MK4007GAL MK8007GAH	40 80	1 2	2 4	4200	2 8
08GAL	MK2008GAL MK4008GAH	20 40	1 2	2 4	4200	2
08GAL	MK3008GAL MK6008GAH	30 60	1 2	2 4	4200	2
09GAL	MK4009GAL MK8009GAH	40 80	1 2	2 4	4200	2 2/8
11GAH	MK1011GAH	100	2	4	4200	8
14GAH	MK1214GAH	120	2	4	4200	
25GAL	MK8025GAL	80	1	2	4200	
28GAL	MK6028GAL	60	1	2	4200	
31GAL	MK8031GAL MK1231GAL MK2431GAH	80 120 240	1 1 2	2 2 4	4200	
34GAL	MK6034GAL MK8034GAL MK1234GAL MK1634GAL	60 80 120 160	1 1 1 1	1 1 2 2	4200	8

1.1.4. 1.8" HDD SATA

Drive family	Model	Capacity, Gb	Disks	Heads	Spindle speed, RPM	Cache Buffer, Mb
16GSG	MK8016GSS MK1216GSG	80 120	2	4	5400	8
17GSG	MK8017GSG MK1617GSG	80 160	1 2	2 4	5400	8
29GSG	MK1229GSG MK1629GSG MK2529GSG	120 160 250	1 2 2	2 4 4	5400	8
33GSG	MK1633GSG MK2533GSG MK3233GSG	160 250 320	1 2 2	2 4 4	5400	16
35GSL	MK1235GSL	120	1	2	4200	8
39GSL	MK1639GSG	160	1	2	4200	16

	MK2039GSG MK2239GSG	200 220				

1.1.5. 2.5" Automotive HDD PATA

Drive family	Model	Capacity, Gb	Disks	Heads	Spindle speed, RPM	Cache Buffer, Mb
29GAC	MK3029GAC MK3029GACE	30	1	2	4200	8
36GAC	MK4036GAC MK4036GACE	40	1	2	4200	8
50GAC	MK4050GAC MK4050GACE MK6050GAC MK6050GACE MK8050GAC MK8050GACE	40 40 60 60 80 80	1	2	4200	

1.1.6. 2.5" Automotive HDD SATA

Drive family	Model	Capacity, Gb	Disks	Heads	Spindle speed, RPM	Cache Buffer, Mb
57GSC	MK8057GSC	80	1	2	4200	8
60GSC	MK1060GSC MK260GSC	100 200	1	2	4200	8
MQ01AAD	MQ01AAD032C	320	1	2	4200	8

1.1.7. 2.5" Hybrid HDD SATA

Drive family	Model	Capacity, Gb	Disks	Heads	Spindle speed, RPM	Cache Buffer, Mb
MQ01ABDH	MQ01ABD075H MQ01ABD100H	750 1000	2 2	4 4	5400	32
MQ01ABFH	MQ01ABF032H MQ01ABF050H	320 500	1 1	2 2	5400	32

1.1.8. 3.5" HDD SATA

Drive family	Model	Capacity, Gb	Disks	Heads	Spindle speed, RPM	Cache, Mb
MKxx02TSKB	MK1002TSKB MK2002TSKB	1000 2000	2 4	4 8	7200	64
MG03ACAxxx	MG03ACA100 MG03ACA200 MG03ACA300 MG03ACA400	1000 2000 3000 4000	N/D	N/D	7200	64
MG04ACAxxxx	MG03ACA200A/E MG03ACA300A/E MG03ACA400A/E MG03ACA500A/E MG03ACA600A/E	2000 3000 4000 5000 6000	N/D	N/D	7200	128

Note:
MG04ACAxxxA – Host: 4096 bytes/sector, Disk: 4096 bytes/sector
MG04ACAxxxE – Host: 512 bytes/sector, Disk: 4096 bytes/sector

1.2. HDD naming

1.2.1. Model names

Toshiba HDD model names are assigned in accordance with the following pattern: they begin with a prefix of 2 letters common for multiple drive families, followed by several alphanumeric characters indicating model-specific options.

MK is the prefix present in classic Toshiba HDD names beginning with the earliest drive families, and also in the names of some new families as well. It is used for designation of 1.8” HDD, Enterprise Performance HDD, Enterprise Capacity HDD, Enterprise SSD, Mobile HDD, Industrial HDD, and Automotive HDD.

MK	30	01	G	R	R	B
	1	2	3	4	5	6

1 – Capacity

2 – In PATA drives, the technology used for production of reading/writing heads and their revision:
01, 03, 05 = MR (= GMR if 1.8" HDD)
02 = TFH (= GMR if PCMCIA interface)
04, 06, 10, 12 = DSMR
07 = Perpendicular recording (1.8" HDD)
08 = New Form Factor, flexfoil interface connector (1.8" HDD)
09, 11, 14, 15, 16, 17, 18, 19, 21, 23, 25, etc. = GMR

Note:
MR = Magneto-Resistive Head
TFH = Thin Film Head
GMR = Giant MR Head
DSMR = Dual Stripe MR Head

In SATA drives, the series number.

3 – Capacity presentation format:
M = capacity < 10GB
G = capacity > 10GB
T = TB

4 – Interface:
A = PATA
C = CE-ATA
P = PCMCIA (1.8" HDD)
S = SATA
R = SAS

5 – Form factor, height, spindle speed and other options:
3.5":
K: 7,200rpm

2.5":
C = Automotive
F = 6.35 mm
M = 12.7 mm 5,400 rpm
N = 19 mm
P = 9.5 mm
R = 15,000 rpm
S = 9.5 mm 4,200 rpm
T = 8.45 mm
V = 12.5 mm

X = 9.5 mm 5.400 rpm
Y = 9.5 mm 7.200 rpm
Z = SSD

1.8":
A = 5 mm 3,600 rpm
B = 8 mm 3,600 rpm
G = 8 mm 5,400 rpm
H = 8 mm 4,200 rpm
L = 5 mm 4,200 rpm

6 – Options:
B: Enterprise Model
D: SED
F: Free Fall Sensor
G: Wipe Technology
R: Enterprise SED

Since around 2012 Toshiba started introducing for its fresh HDD models new naming systems different from classic designations.

MQ is the prefix used in the names of mobile SSHD, mobile Thin SSHD, mobile HDD, mobile Thin HDD, Video Stream HDD, large capacity HDD for external drives, and Automotive HDD:

MQ	**01**	**A**	**B**	**D**	**100**	**H**
	1	2	3	4	5	6

1 – The series number

2 – Interface:
A: SATA

3 – Spindle speed:
A: 4,200 rpm
B: 5,400 rpm
C: 7,200 rpm

4 – Height:
B: 15 mm
D: 9.5 mm
F: 7 mm
U: 7 mm (SED)

5 – Formatted capacity ×10 GB

6 – Options:
B: FIPS 140-2
C: Automotive
H: SSHD
V: Video Stream
VS: Security Pairing
W: Wipe Technology

MC is the prefix used in the names of Enterprise Cloud HDD:

MC	**04**	**A**	**C**	**A**	**500**	**E**
	1	2	3	4	5	6

1 – The series number

2 – Interface:
A: SATA

3 – Spindle speed:
C: 7,200 rpm

4 – Height:
A: 26.1 mm

5 – Formatted capacity ×10 GB

6 – Options:
E: Emulated 512 B/sector Format

MD is the prefix used in the names of 3.5" HDD:

MD	03	A	C	A	400	V
	1	2	3	4	5	6

1 – The series number

2 – Interface:
A: SATA

3 – Spindle speed:
B: 5,xxx rpm
C: 7,200 rpm

4 – Height:
A: 26.1 mm

5 – Formatted capacity ×10 GB

6 – Options:
V: Surveillance

MG – is the prefix used in the names of Enterprise Capacity HDD:

MG	04	S	C	A	60	0	E
	1	2	3	4	5	6	7

1 – The series number

2 – Interface:
A: SATA
S: SAS

3 – Spindle speed:
C: 7,200 rpm

4 – Height:
A: 26.1 mm

5 – Formatted capacity ×100 GB

6 – Transfer rate of the interface:
0,D: 6.0 Gbit/s
E: 12.0 Gbit/s

7 – Options:
A: Advanced Format 4 KB/sector Native
E: Emulated 512 B/sector Format

1.2.2. Serial number

Serial number contains several parameters:

M Y x x x x x x x

M – month of manufacture, digits from 1 to 9 stand for months from January to September, letters X, Y and Z stand for October, November and December respectively.
Y – year of manufacture, 8 - 1998, 0 - 2000, 5 - 2005.
Other digits contain encoded information about the manufacturing factory and production line and the serial number proper.

2. Utility features

The utility can perform the following functions:

- Reset HDD password.
- Clear G-List (regenerate translator).
- View and assign defects using G-List.
- View, clear and assign defects using P-List.
- Move G-List defects to P-List.
- Clear S.M.A.R.T.
- Read and write modules in ROM (CP).
- Disable drive zones and heads.
- Read the zone allocation table.
- Indicate the results of LBA-CHS, PBA-CHS, LBA-PBA conversion (translator inspection).
- Read and write service data tracks.
- Read and write microprocessor RAM and cache RAM.
- Read ROM.
- Work with HDD via terminal.
- Save and restore the password protection status.
- In combination with Data Extractor access user data on HDD with corrupted G-List.

3. Preparing for work

Attention! Toshiba HDDs support the terminal mode. At present it is only used for examination and serves no HDD recovery purposes. Therefore, a terminal connection is not mandatory. However, SATA drives beginning with the 46GSX family and newer and 1.8" micro-SATA drives allow using the terminal mode for CP reading and recording.

3.1. 2.5" PATA HDD connection

PATA 2.5” HDD connection scheme is shown in the Fig. 3.1.

1) Plug the IDE cable of your PC-3000 tester board into the IDE connector of the PC-2" adapter.

2) Connect the power cable from the PC-3000 on-board power control adapter to the power connector of the PC-2” adapter.

3) Connect the drive being tested to the PC-2" adapter. Set the jumpers in accordance with the on-board scheme for Toshiba HDD.

4) If you need to use the terminal, connect the PC USB TERMINAL adapter to the USB port and PC-2” adapter.

3.2. 1.8" PATA HDD connection

PATA 1.8” HDD connection scheme is shown in the Fig. 3.2.

1) Plug the IDE cable of your PC-3000 tester board into the IDE connector of the PC-TOSHIBA adapter.
2) Connect the power cable from the PC-3000 on-board power control adapter to the power connector of the PC-TOSHIBA adapter.
3) Connect the drive being tested to the PC-TOSHIBA adapter following the adapter marks.
4) If you need to use the terminal, connect the PC USB TERMINAL adapter to the USB port and PC-TOSHIBA adapter.

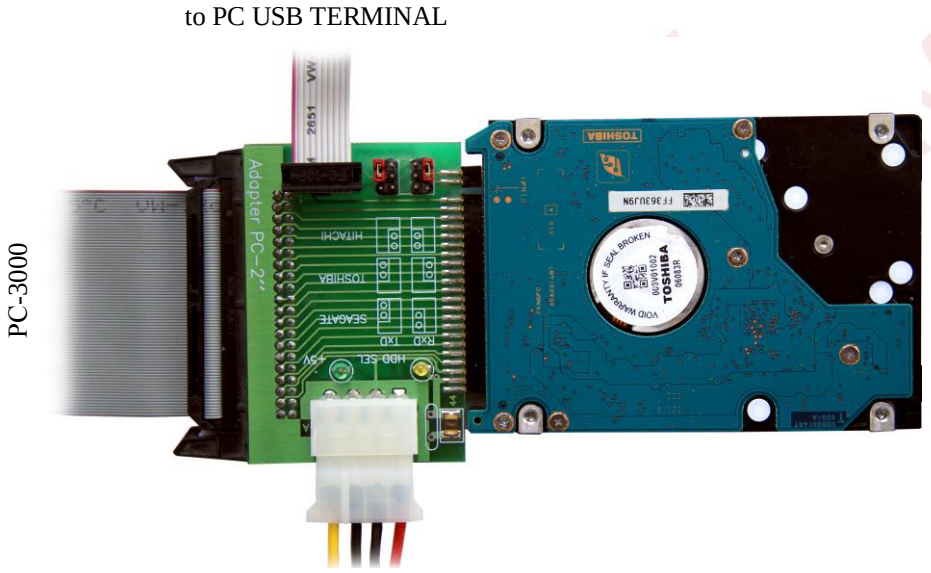


Fig. 3.1. 2.5” PATA HDD connection

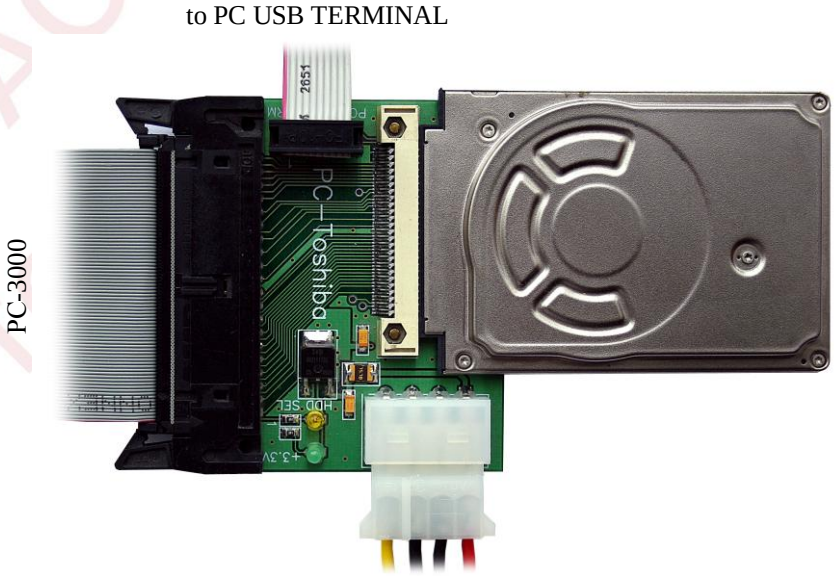


Fig. 3.2. 1.8” PATA HDD connection scheme.

3.3. Connection of 1.8" ZIF PATA HDD

Toshiba manufactures a line of 1.8" HDD with ZIF connectors intended for use in portable devices (video cameras, audio players, etc.). Such HDD use parallel ATA interface but they are equipped with a miniature ZIF plug. Therefore connection to PC-3000 requires a 1.8" ZIF – 3.5" IDE adapter.

The adapter is not included into the product package, but it can be purchased separately from third party vendors.

The scheme for connection of 1.8" HDD using ZIF is shown in the Fig. 3.3.

1) Plug the IDE cable of your PC-3000 tester board into the IDE connector of the 1.8" ZIF – 3.5" IDE adapter.

2) Connect the power cable from the PC-3000 on-board power control adapter to the power connector of the 1.8" ZIF – 3.5" IDE adapter.

3) Connect the drive being tested to the 1.8" ZIF – 3.5" IDE adapter with flexible cable. The cable end with the white mark must be plugged into the HDD.

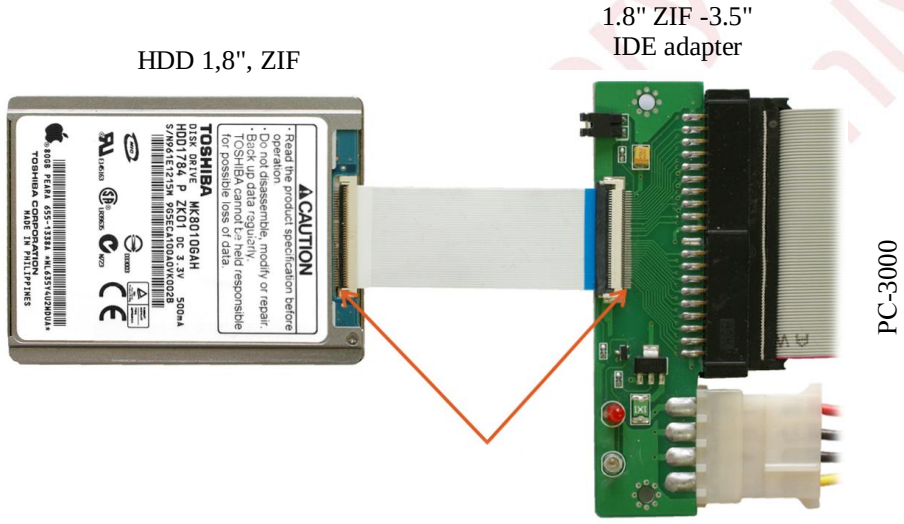


Fig. 3.3. Connection scheme for 1.8" ZIF HDD.

4) If you need to use the terminal, connect the PC USB TERMINAL adapter to the USB port and 1.8" ZIF – 3.5" IDE adapter in accordance with the scheme shown in Fig. 3.4. Terminal connection is arranged by soldering wires between contacts 1 and 2 of the ZIF connector on the adapter and the 10-pin connector on the PC USB Terminal. The scheme for terminal connection is shown in the Fig. 3.4 .

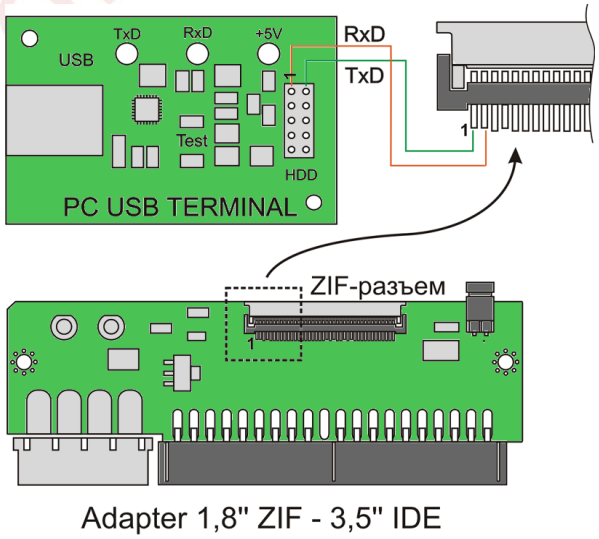


Fig. 3.4. Terminal connection scheme for 1.8" ZIF HDD.

3.4. 2.5" SATA HDD

SATA 2.5” HDD connection scheme is shown in the Fig. 3.5.

1) Plug the SATA cable from PC-3000 Express or PC-3000 UDMA to HDD SATA adapter.
2) Plug the power cable from PC-3000 Express or PC-3000 UDMA to HDD.
3) Plug the PC-TOSH.SATA adapter into the terminal connector of the HDD. If you need to use the terminal, connect the PC USB TERMINAL adapter to the USB port and PC-TOSH.SATA adapter. If you have no PC-TOSH.SATA adapter available, establish the connection to terminal using the scheme in Fig. 3.5.

to PC USB TERMINAL

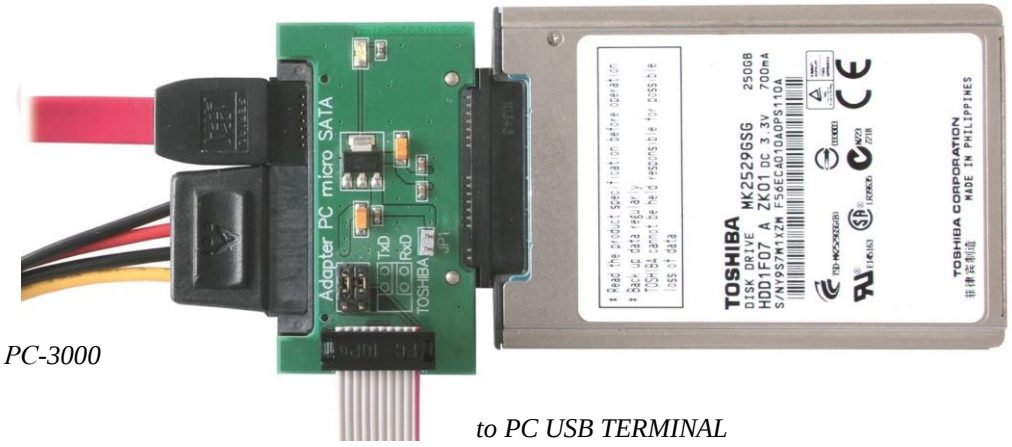
to the PC-3000

Fig. 3.5. Terminal connection scheme for 2.5” HDD.

3.5. 1.8" micro-SATA HDD connection

The scheme for connection of 1.8" micro-SATA HDD is available here: Fig. 3.6.

1) Plug the SATA cable of your PC-3000 tester board into the SATA connector of the PC micro SATA adapter.
2) Connect the PC micro SATA adapter to the PC-3000 on-board power control adapter using the power splitter included in the product package.
3) Connect the drive being tested to the PC micro SATA adapter.
4) If you need to use the terminal, connect the PC USB TERMINAL adapter to the USB port and PC micro SATA adapter.



to the PC-3000

to PC USB TERMINAL

Fig. 3.6. 1.8” micro-SATA HDD connection scheme.

4. Utility description

4.1. Launching the utility

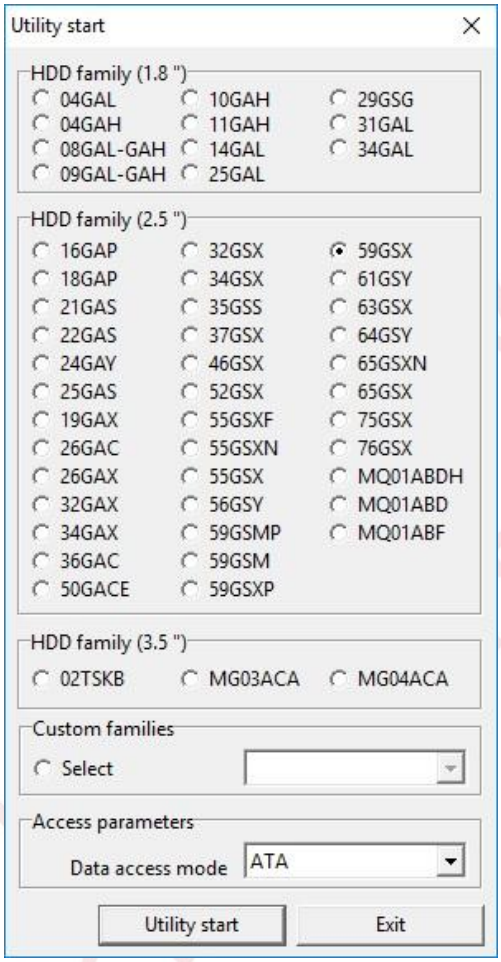


Fig. 4.1.

At the start the utility displays its drive family selection dialog with the pointer positioned over the family, to which the HDD being tested belongs. You can modify the choice manually if automatic drive detection fails.

If the connected HDD is not present in the list of available drives, you can specify a previously saved configuration under the «Select» option. Doing so activates the model selection field. The procedure required for creation of a new configuration is described in section 4.3.

After the «Utility start» button is pressed, the utility reads HDD ID, zone allocation table, identifies the number of defects in G-List and the list of available CP.

Sample log record after these checks:

Techno On..... : Ok
Zone table..... : Ok
Cyl num..... : 294 378
Head num..... : 6
Vendor..... : TOSHIBA
Model..... : MG03ACA400
Microcode..... : FL001A1E

Defects in G-List..... : 0

CP Avalable..... :

33,34,44,56,92,95,98,9A,9C,A2,A5,A7,A8,A9,AA,AD,AE,B1,B3,BB,BF,C1,C5,C6,C7,C8,C9,CB,CD,D1,D3,D4,D6,D7, D8,D9,DA,DB,DC,DD,EF,F1,F2,F4,F7,F8,FA,FB,FF

You can use the utility to start tests from the «Tests» menu or click the corresponding toolbar buttons to the same effect. Both start methods are equivalent. «Utility extensions» from the «Tools» menu will also become accessible.

If a HDD is password-protected, the utility will log a warning about the set password.

All messages output by the utility are displayed in the «Log» tab.

The «Terminal» tab allows the operator to work with HDD in terminal mode.

4.2. Terminal (COM port)

Toshiba HDD have quite advanced terminal; however, its practical use is limited.

Select the «Terminal» tab in the utility. The utility establishes 9600bps as the connection speed automatically at the start. COM port rate can be increased up to 230400 bps, see section 4.4.2.2.14, Set COM port data transfer rate.

HDD outputs no information to the serial port at power-up. To switch it to dialog mode, press [Enter]; the device will output the ">" command prompt if the connection has been established successfully. Basic commands available in terminal mode are listed in Table 1.

Table 1 Commands available in terminal mode

Command text	Description
BKxx	Set the size of the block output to terminal
BSxx	Set the segment of a memory block, xx – segment number
DB	Output buffer RAM dump at the current segment
DM	Output microprocessor unit (MPU) RAM dump at the current segment
HP	Output a brief list of terminal commands
LM	Start FLASH programming mode. Mode entry will require a key.
RS	Factory reset, exit from the terminal
SC	Output information about coordinates of the reading/writing heads
SD	Output information about physical HDD parameters
SF	Output information about the status of HDD Features
SI	Increase by 1 the index of the output buffer
SL	Output information about HDD security parameters
SO	Output extended information about HDD SMART parameters
SP	Switch ARRE mode
SR	Output information about HDD SMART parameters
STxxxx	Set a memory block address, xxxx – address
SW	Output information about HDD power parameters
VR	Output microprogram version
VM	Output microprogram version
WBxxxx	Write xxxx word to the address in buffer RAM defined by the ST and BS commands
WMxxxx	Write xxxx word to the address in MPU RAM defined by the ST and BS commands

There are a few more commands with unknown purpose.

4.3. Creating a custom configuration

If the HDD being tested is not present in the list of models available at utility start, you can create a new, custom HDD type. To do that, select «Toshiba utility» in the «Tools» - «Settings» dialog. The utility will display a window containing a list of available HDD (created earlier):

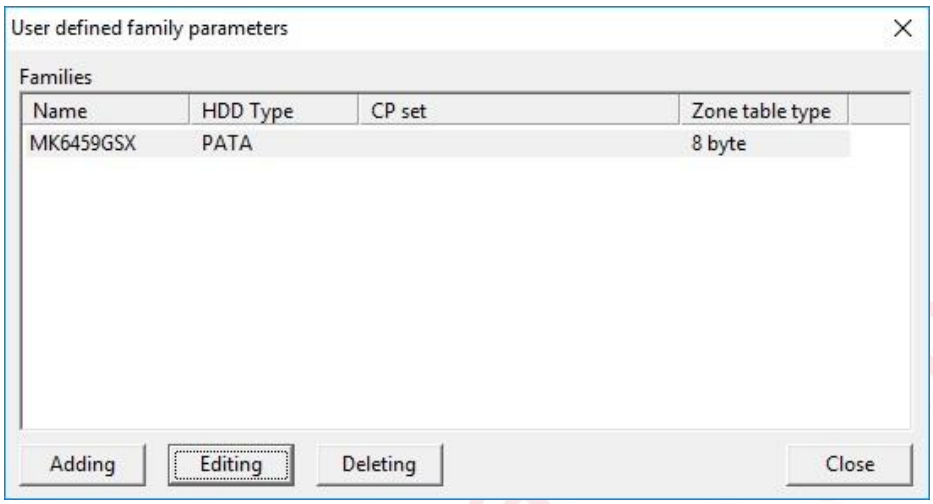


Fig. 4.2.

When an existing record is highlighted with the pointer, the «Editing» and «Deleting» buttons become active; they allow modification of the selected record or its removal.

To create a custom HDD type, the «Adding» button should be pressed. Then the following dialog appears:

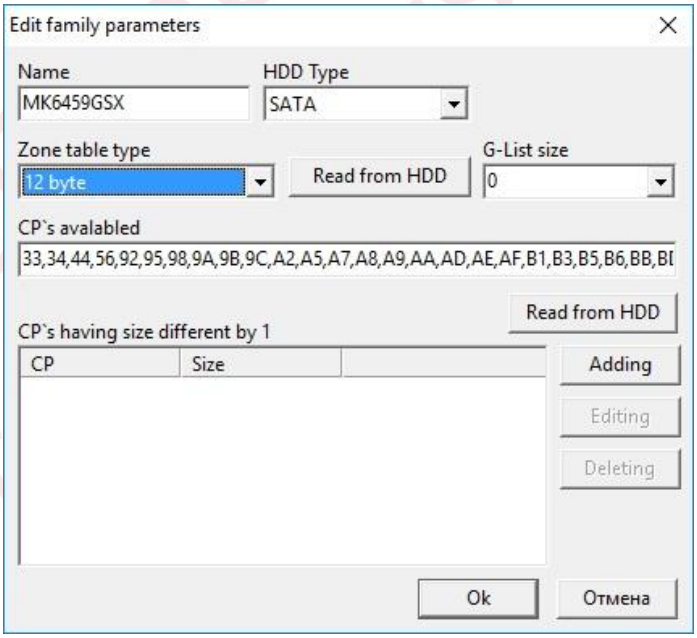


Fig. 4.3.

Correct utility operation requires a list of CP and their size; you also need to know the structure of the zones table (8 or 12 bytes). HDD or drive family name is entered in the «Name» field. The structure or the zone allocation table (8 or 12 bytes) should be selected in the «Zone table type» field.
You can obtain CP list by pressing the «Load from HDD» button. Almost all CP have the size of 1 sector except for CP AA, BB and DD, which may take up 3, 4 or 16, and 16 or 32 sectors respectively. You can use the form to add new CP or modify existing ones by pressing the «Adding» or «Editing» buttons. After pressing the OK button the new HDD type will be created in the «Supported families» field of the «Utility selection» menu.
Custom configurations are stored in the «Toshiba.ini» configuration file located in Toshiba utility profile – «\!Profiles\Toshiba\».

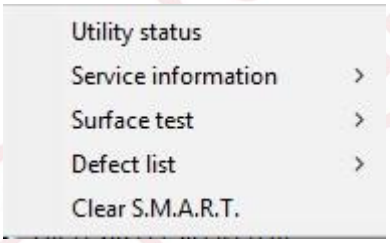
```
[F0]
Name=34GAX
Zone=1
CPSet=33,34,44,55,56,91,92,93,94,95,97,98,9A,9B,9C,9F,A2,AA,BB,C1,CC,DD
CPInfo=AA,3;BB,4;DD,32
GList=16
```

Field values in the file are as follows:
[F0] - section title, the next values will be F1, F2, etc.
Name - model or family name.
Zone - type of the zone allocation table structure, 0 - 8 bytes, 1 - 12 bytes.
CPSet - list of CP that have the size of 1 sector.
CPInfo - list of CP that are larger than one sector, the list includes CP numbers and their corresponding sizes.
E.g., «AA,3;» means that CP AA has the size of 3 sectors.
GList – G-List size.

You can edit Toshiba.ini file in any text editor adding new HDD types, removing or editing the existing ones. When the utility starts, it reads the file and displays HDD types saved in it within the «Custom families» field of the «Utility selection» menu.

4.4. «Tests» menu

The «Tests» menu allows access to the following items:



4.4.1. Utility status

This menu item displays the parameters read during utility start:

- HDD family
- number of cylinders
- number of heads
- microcode version

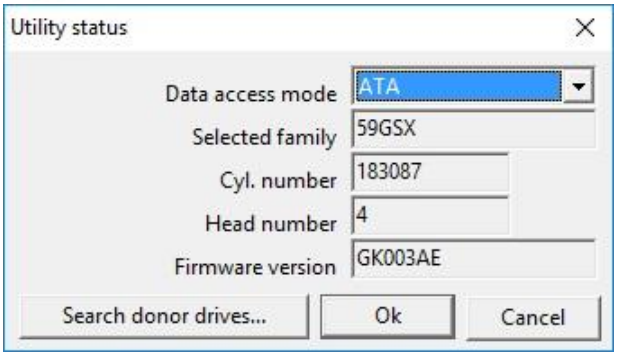
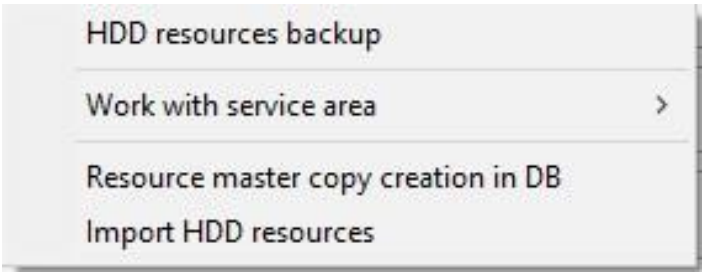


Fig. 4.4.

Here you can also select the 'Data access mode' in the corresponding field, if it is accessible: ATA or ATA/COM. As of the time of this publication, ATA is the preferred mode, the second method is no longer practically expedient but still can be used as an alternative for the first one.

4.4.2. «Service information» menu

The «Service information» menu allows access to the following items:



4.4.2.1. HDD resources backup

Backup of HDD resources allows you to save a drive's service resources to a profile folder. The utility saves configuration pages (CP). The default folder for saved data is «SABackup».

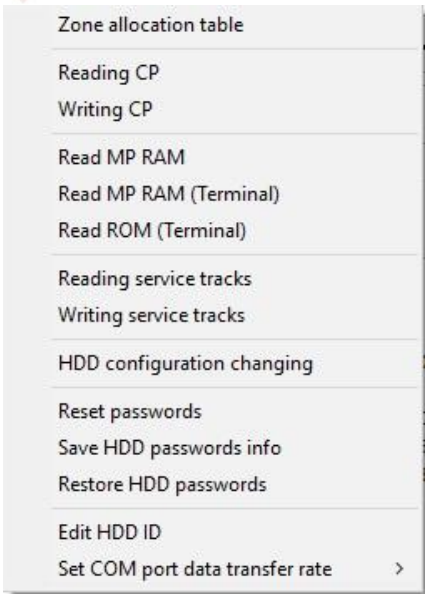
Selection of that item brings up the following dialog window:

Fig. 4.5.

If you backup new data to a folder used for that purpose earlier, previously recorded data will be replaced with the new files.

4.4.2.2. Work with service area

The «Work with service area» menu allows access to the following items:



4.4.2.2.1. Zone allocation table

Selection of the «Zone allocation table» menu item makes the utility log the table of zone allocation with indication of the initial (Beg Cyl) and final (End Cyl) cylinders of each zone and the number of sectors per zone (SPT – Sector Per Track).

The zone allocation table will also be used to read the model number and factory version of its firmware, which will also be added to log. The version obtained here will differ from firmware version from HDD ID, the difference is usually just one character.

4.4.2.2.2. Reading CP (configuration pages)

You can use this command to save all or some of the CP to a HDD profile folder or database for future use. The list of supported CP is generated at utility start.

Selection of that item brings up the following dialog window:

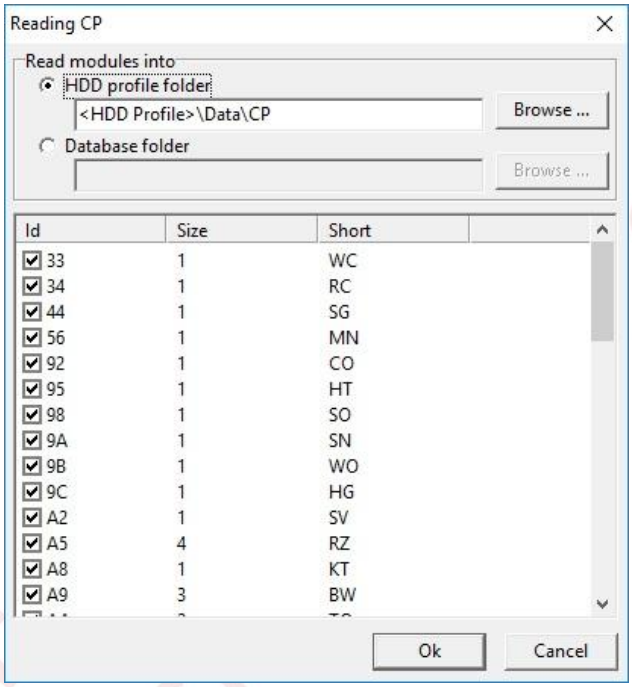


Fig. 4.6.

In the dialog you should select the CP for saving and the target location: HDD profile folder or database. You can select configuration pages manually or using the group operations menu, which appears after right-clicking the area, or use a hot key combination.

The «Mode» menu offers the following commands for test process control:

- ***Interrupt*** – Terminates the test procedure

4.4.2.2.3. Writing CP (configuration pages)

Recording allows the operator to write all or some CP from HDD profile folder or database.

Attention! The procedure is potentially dangerous for HDD. CP are recorded to ROM and incorrect recording can render a HDD inoperable.

Having launched the test, you will see a sequence of dialogs understandable from the context. First, you will be offered to select the data source: a HDD profile folder or your database. After selection of the folder containing necessary modules the following dialog appears:

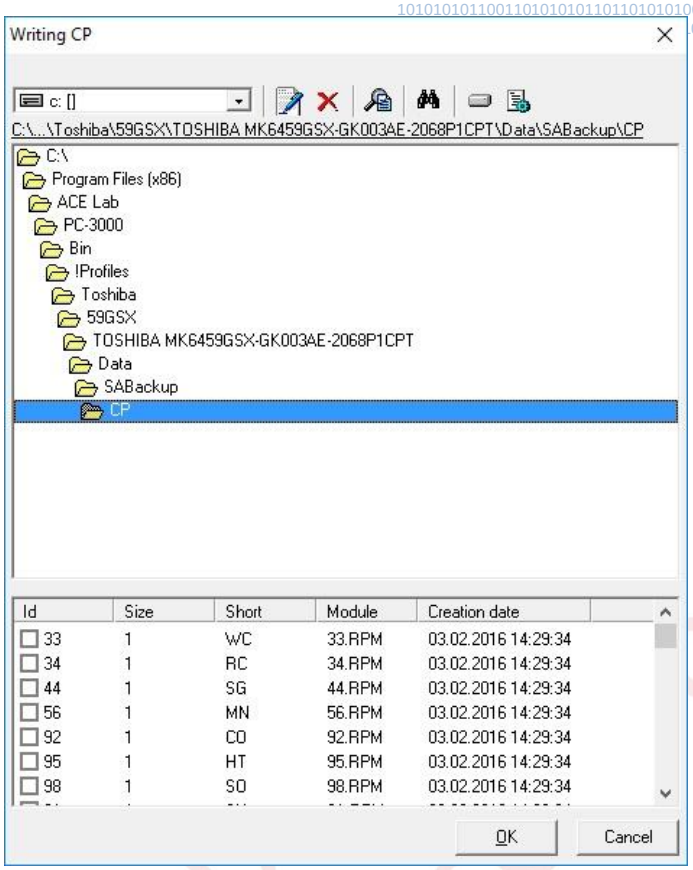


Fig. 4.7.

Use the dialog to select the necessary configuration pages from the list of available ones. You can select the required CP for recording manually or using the group operations menu, which appears after right-clicking the area, or use a hot key combination.

The «Mode» menu offers the following commands for test process control:

- ***Interrupt*** – Terminates the test procedure

4.4.2.2.4. Read MP RAM

MP RAM reading via the interface allows you to save a necessary data portion to the HDD profile folder for subsequent analysis. The RAM part contains a slightly altered ROM image used to load program data. MP RAM is read in byte mode. Here you can select the initial and final address of the memory area to examine and its size in bytes. MP RAM reading through the interface is possible for PATA HDD only. For SATA HDD reading is only available via the terminal.

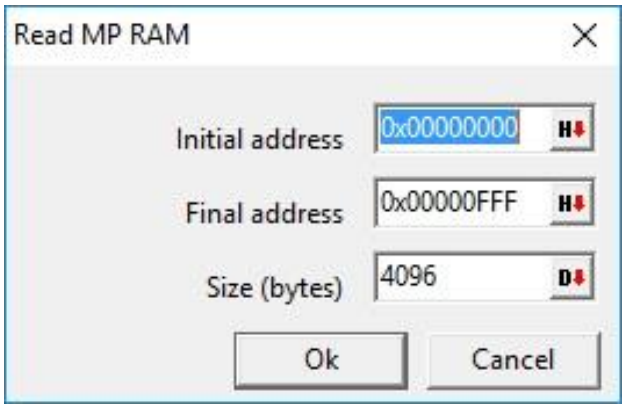


Fig. 4.8.

4.4.2.2.5. Read MP RAM (Terminal)

MP RAM reading via the terminal allows you to save a necessary data portion to the HDD profile folder for subsequent analysis. The RAM part contains a slightly altered ROM image used to load program data. MP RAM is read in byte mode. Here you can select the initial and final address of the memory area to examine and its size in bytes.

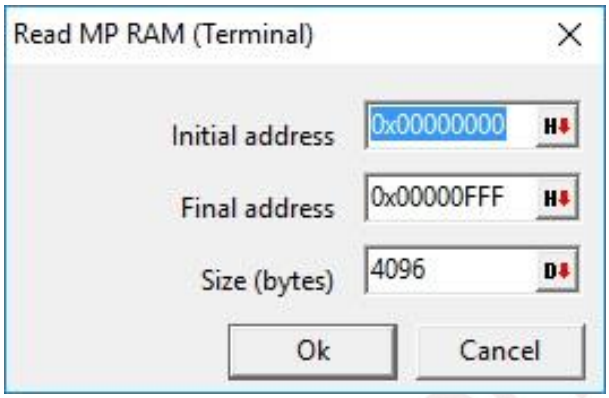


Fig. 4.9.

4.4.2.2.6. Read ROM (Terminal)

ROM reading via the terminal allows you to save a ROM image to the HDD profile folder for subsequent analysis.

Fig. 4.10.

Here you can select the initial and final address of the ROM area to examine and its size in bytes.

The utility establishes 9600bps as the connection speed automatically at the start. ROM reading at such rate is rather slow. To speed up the process, COM port rate can be increased, see section 4.4.2.2.14, Set COM port data transfer rate.

4.4.2.2.7. Reading service tracks

You can use this command to save all or some of the service tracks to a HDD profile folder or database for future use. While reading, the utility creates 2 files for each track, one of them has the *.trk extension, the other – *.map. The first file contains the copied track; the second one is a bit map telling, which sectors have been read with or without errors. The size of that file (bits) is equal to the size of the *.trk file divided by 512. Each bit in the file points to a corresponding sector. If a bit is equal to 1, then the corresponding sector has been read without errors; if it is 0, then an error has occurred. The utility uses the file while recording tracks. The generated files are named using the «0005_00.trk» format where the first number (here «0005») indicates the track number. The second number after the underscore indicates the head number.

Selection of that item brings up the following dialog window:

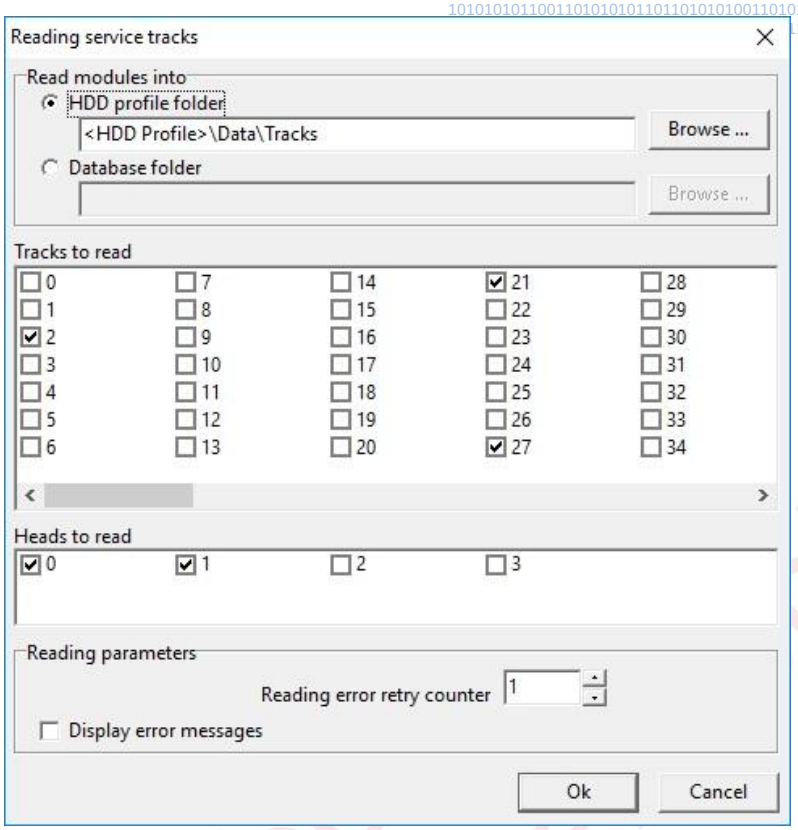


Fig. 4.11.

In the «Reading service tracks» dialog you should select the track and head number and the location for saving: HDD profile folder or database. You can select tracks manually or using the group operations menu, which appears after right-clicking the area, or use a hot key combination.

The number of service tracks in Toshiba HDD is 32 but many of them in fact are completely or partially unformatted. By default the utility selects tracks 2, 21, and 27 only as they contain the most essential data. Since service information is usually recorded using heads 0 and 1 only, so only those two heads are checked, the rest are disabled. However, you can select manually other tracks and heads to attempt reading as well.

Many sectors demonstrate unstable reading although they actually contain data. To ensure retrieval of all tracks that can be read, the utility reads each sector several times in accordance with the number of attempts specified in the «Reading error retry counter» field. If the utility reads a sector without errors, it proceeds to the next one, and it retries reading if an error has occurred. To read all sectors, you may often have to set the number of attempts to 20-30. The default value is 10.

«Display error messages» – when enabled, the field makes the utility output to log all notifications about reading errors. In most cases there is no such need, and so the checkbox is disabled by default. The utility then logs the total number of sectors, which could not be read.

The «Mode» menu offers the following commands for test process control:

- ***Interrupt*** – Terminates the reading process
- ***Skip*** – Skips reading of current track

4.4.2.2.8. Writing service tracks

Recording allows the operator to overwrite all or some service area tracks using the HDD profile folder or database as source.

Having launched the test, you will see a sequence of dialogs understandable from the context. First, you will be offered to select the data source: a HDD profile folder or your database. After selection of the folder containing necessary modules the following dialog appears:

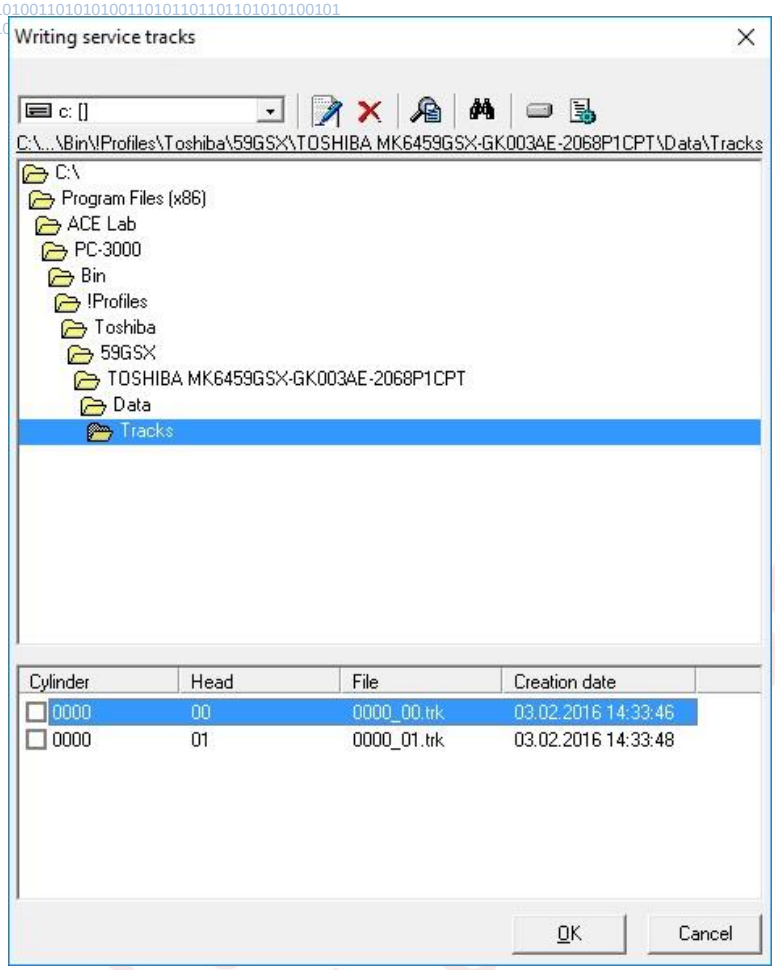


Fig. 4.12.

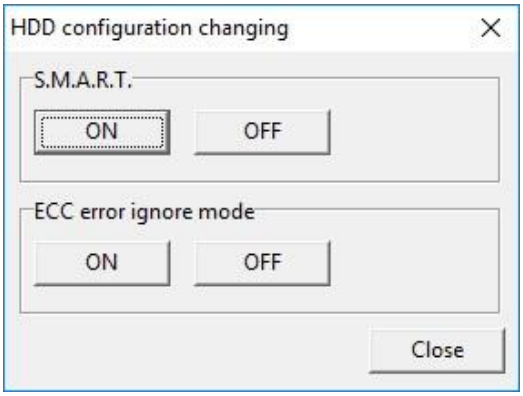
Use the dialog to select the necessary tracks from the list of available ones. You can select the required tracks for recording manually or using the group operations menu, which appears after right-clicking the area, or use a hot key combination. The utility will perform writing using the heads indicated in file names.

The «Mode» menu offers the following commands for test process control:

- ***Interrupt*** – Terminates the test procedure.

4.4.2.2.9. HDD configuration changing

You can use the dialog to modify two settings affecting the HDD behavior. They remain effective until the power is turned off/on.



S.M.A.R.T. ON/OFF – the setting enables/disables S.M.A.R.T. functionality. Current value appears in the "SMART Feature Set" line of the HDD ID.

ECC error ignore mode ON/OFF – the setting enables/disables reaction to ECC errors.

4.4.2.2.10. Password removal

The command allows resetting of the user ATA password without losing the user data. The feature functions independently from the fact whether a password has been set.

4.4.2.2.11. Save HDD Passwords info

Selection of that item allows to save the module with a password for next recovery.

4.4.2.2.12. Restore HDD Passwords

Selection of that item allows saving password modules from copy, saved before.
Running the test opens the dialog window of file selecting, where is necessary to choose the password module file. It is PSWInfo.bin by default. After file choosing the program starts searching of all valid password modules in service tracks. Chosen module is writing in service tracks.

4.4.2.2.13. Edit HDD ID

Selection of that item brings up the following dialog window:

Fig. 4.13.

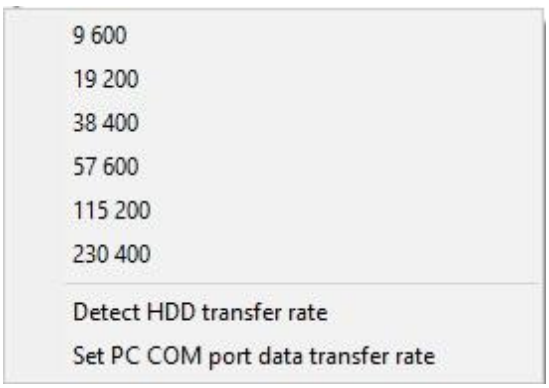
In the HDD ID you can modify the name of the vendor, model, its serial number and logical parameters of the HDD. After you modify any of the settings and click OK, the data will be automatically written to the HDD ROM.

Attention! HDD ID editing works for PATA and SATA HDD before 52GSX only! It also works for a new drives starting from 55GSX, but it works until power swithing. After power on there will be no data access.

4.4.2.2.14. Set COM port data transfer rate

Clicking the following toolbar button:

displays the menu where you can select the rate of data exchange via the COM port (terminal):



Any of the 6 available values can be selected, but some limitations may apply:

- PATA HDD up to - and including 25GSX support only the data transfer rate of 9600;
- PATA HDD beginning with the 26GAX family and SATA HDD up to - and including 52GSX, and 63GSX allow setting 9600, 19200, 38400, and 57600;
- all other SATA beginning with 55GSX and later allow selecting any rate in the list.

You can check the current transfer rate by selecting the 'Detect HDD transfer rate' command in the menu. The transfer rate will appear in the log, and the COM port data exchange rate will be set accordingly to match the value.

4.4.2.3. Resource master copy creation in DB

This command allows saving specified resources to your database. The utility saves configuration pages (CP).

Selection of that item brings up the following dialog window:

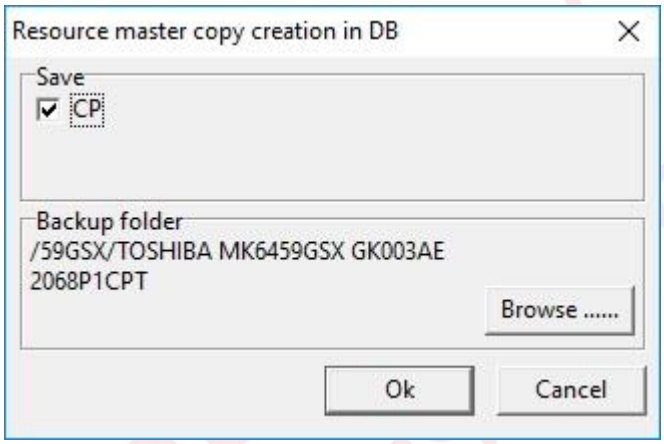


Fig. 4.14.

The utility saves CP to its database as soon as you press the OK button.

4.4.2.4. Import HDD resources

The functionality for import of HDD resources allows you to import the resources from a *.pcr file to the PC-3000 database.

4.4.3. Surface test

4.4.3.1. Logical test

The mode allows complex HDD testing including surface verification, random reading, writing, and reading. In that mode the utility allows to save revealed defects to a defect list in file and assign the defects. Here you can select the initial and final LBA of the range to be tested and specify the necessary tests. Use the 'Additional' tab to specify additional scan parameters.

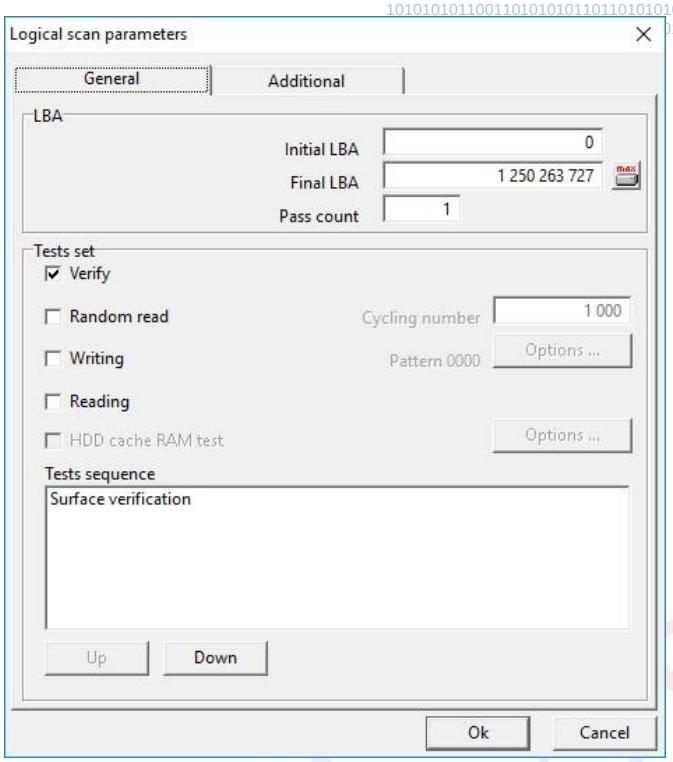


Fig. 4.15.

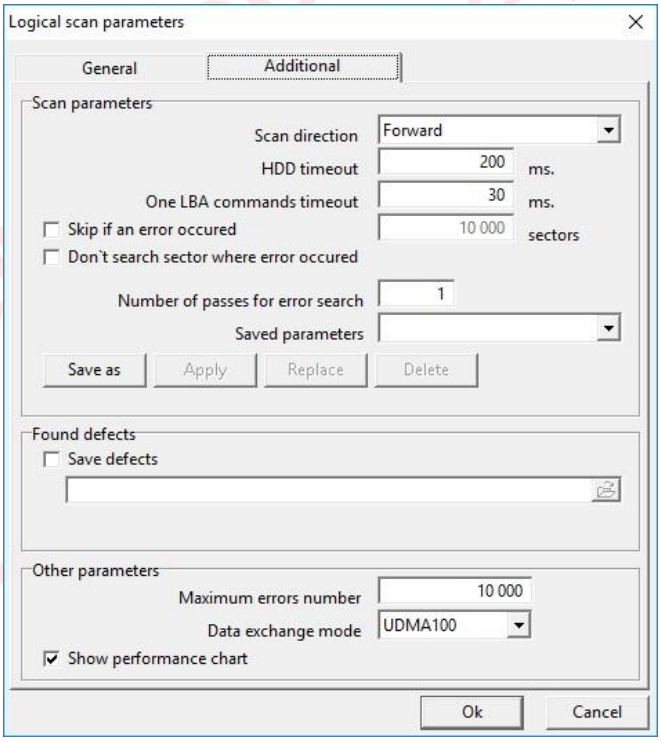


Fig. 4.16.

Enabling the 'Save defects' checkbox configures the utility to write the found defects to a file. If testing reveals defective sectors, then after test completion or termination the utility will display the corresponding dialog, Fig. 4.17. Affirmative response to the question will bring up the next dialog similar to the one in Fig. 4.18.

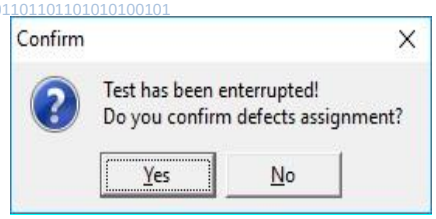


Fig. 4.17.

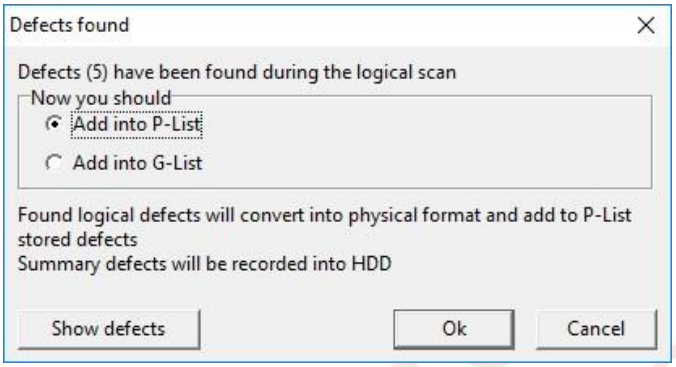


Fig. 4.18.

In this dialog you can select relocation using P-List or G-List. Clicking the 'Show defects' button opens the defects editor window, which can be used to modify the list of defects. As soon as you click the OK button, the utility reassigns the defects using the selected list of defects.

4.4.3.2. Physical scan

The mode allows you to perform surface testing using physical parameters. Revealed defects can be saved to a defect list in file, and assigned in P-List.

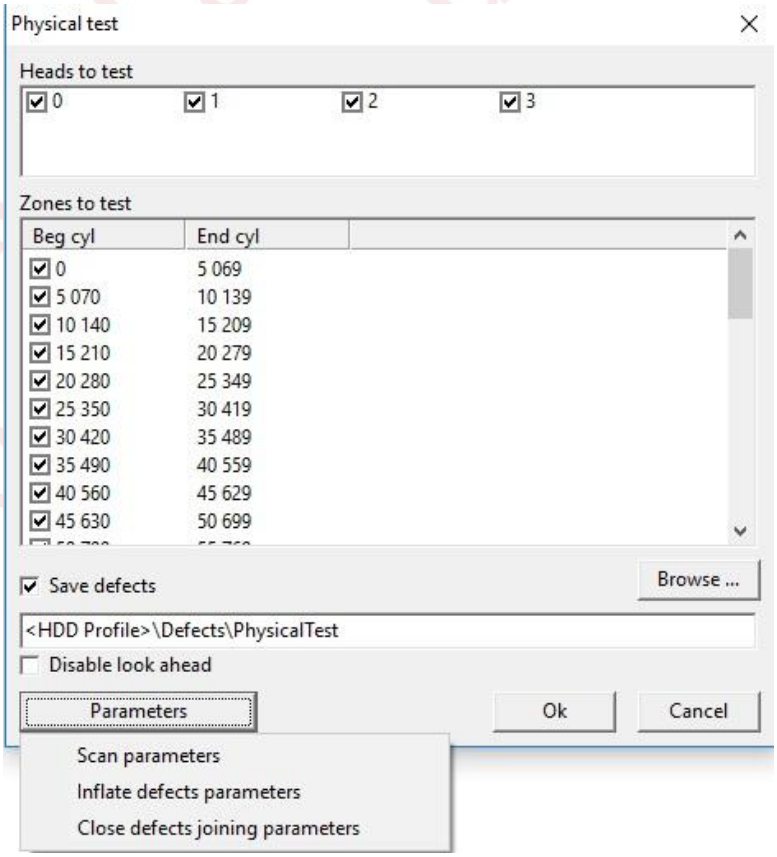
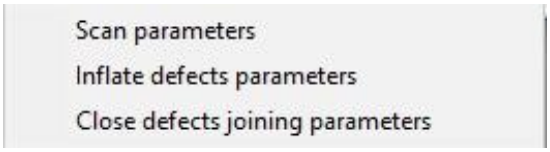


Fig. 4.19.

You can select the heads and zones for testing. If defective sectors are found during the test, 2 defect list files will be created after its completion - one in CHS format with the *.chs extension and the other in LBA format with the *.lba extension (provided the option to "Save defects" is enabled). The first file is intended for assignment of revealed defects in P-List, the second - in G-List.

You can click the Parameters button to modify the test settings. The following options will be available:



4.4.3.2.1. Scan parameters

Here you can select the surface scan settings (Fig. 4.20). The purpose of each field is intuitively understandable from context.

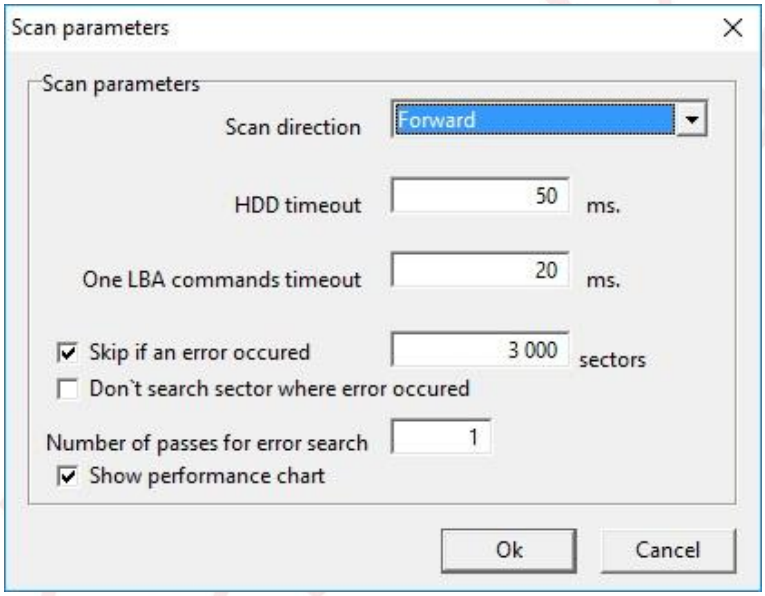


Fig. 4.20.

4.4.3.2.2. Inflate defects parameters

If surface scan in Toshiba HDD reveals a defective sector or a group of sectors, quite often adjacent sectors also demonstrate unstable reading. In that case after relocation of found defects and subsequent surface scan you are likely to encounter errors in the sectors located where the hidden ones used to be. Thus, to reveal all unstable sectors you need multiple surface scan passes with subsequent assignment of defects. To speed up searching for defects and their relocation, the utility uses by default a special rule to add to a single defect or a continuous group of defects a certain number of sectors preceding and following the discovered defects. Rules regulating addition of the sectors are defined in the "Inflate defects parameters" window, in the "Params table" field (Fig. 4.21).

E.g., if a single defect is revealed, the utility adds 5 sectors preceding and following it, as described in line 1. If a continuous group of 4-10 defects is found, 15 sectors preceding and following them will be added as described in line 2, etc.

You can edit these rules or add your own. This functionality is accessed by clicking the right mouse button:

If you click Saving, the utility will offer to select the name for new rules or save the existing ones.

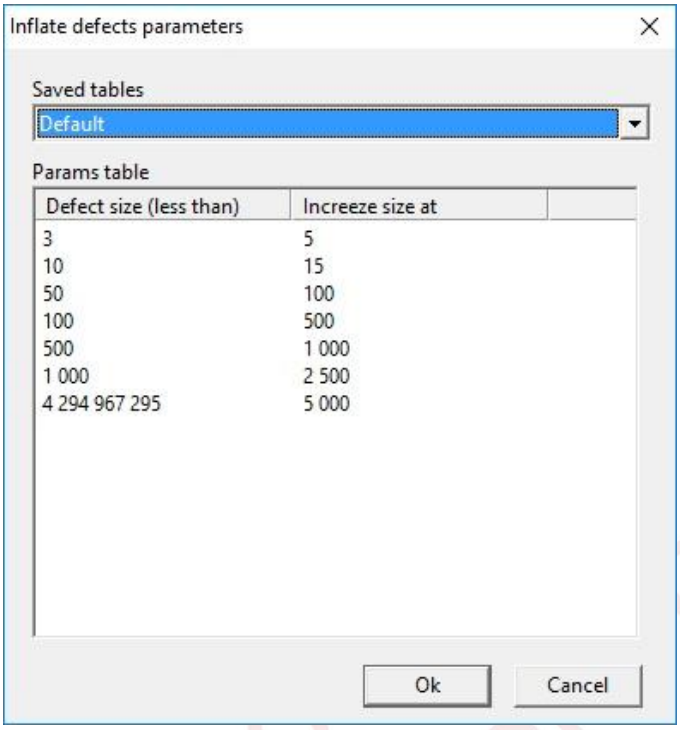


Fig. 4.21.

4.4.3.2.3. Close defects joining parameters

If surface scan reveals 2 single defects or 2 groups of close defective sectors, the sectors between them are very likely to demonstrate unstable reading. To exclude new defects in this area, you can combine these 2 groups of defective sectors in a continuous group of defects while generating the list of defects. This can be accomplished in the "Close defects joining parameters" dialog:

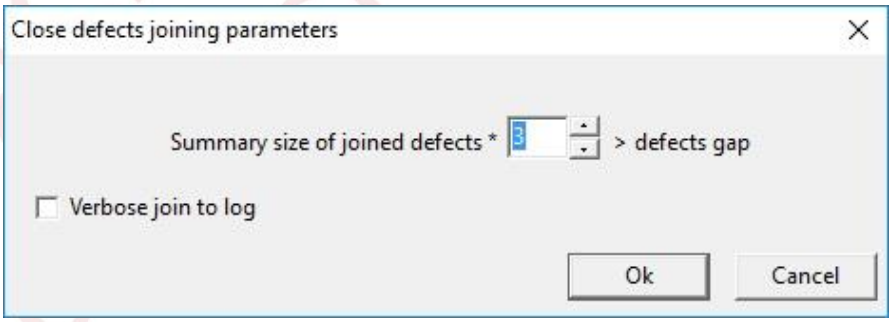


Fig. 4.22.

Here you can select the multiplier for the number of defects, in the sample figure it is set to 3. The size of the continuous group of defects is calculated using the following formula:

$$((num1 + num2) \times 3) > span$$

where:

num1 - the number of sectors in the first group of defects;

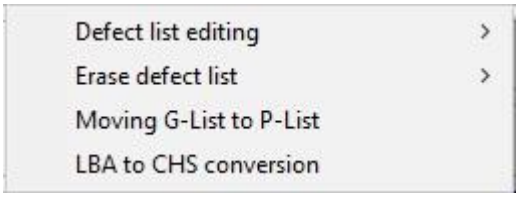
num2 - the number of sectors in the second group of defects;

(num1 + num2) - the "Summary size of joined defects" setting;

span - the number of sectors between two groups of defects ("defects gap").

4.4.4. Defect list

The “Defect list” menu allows access to the following submenus:



4.4.4.1. Defect list editing

The “Defect list editing” menu allows access to the “P-List” and “G-List” submenus.

4.4.4.1.1. P-List

The menu item opens a standard file selection dialog where you can specify the P-List file (the default name is “Plist.chs”). After selection the utility reads P-List and saves the file to HDD profile. Then it opens the defects editor window where you can view and modify the list of defects deleting and editing records, adding sectors or their groups, and group defects. Then you can write the modified list to HDD. Changes in P-List become effective immediately after recording. The commands for defect list management are available in the context menu that appears after right-clicking in the defects editor window. Essential functions can also be invoked with the toolbar buttons of the defects editor.

- ***Add (Ins)***. Here you can add a range of sectors in PBA or LBA format and an earlier saved list of LBA or PBA defects in G-List(*.lba) or P-List(*.chs) format respectively (Fig. 4.23). When a list is selected, the “Show defects” button becomes accessible. Clicking it opens the defects editor window where you can review or edit the list.

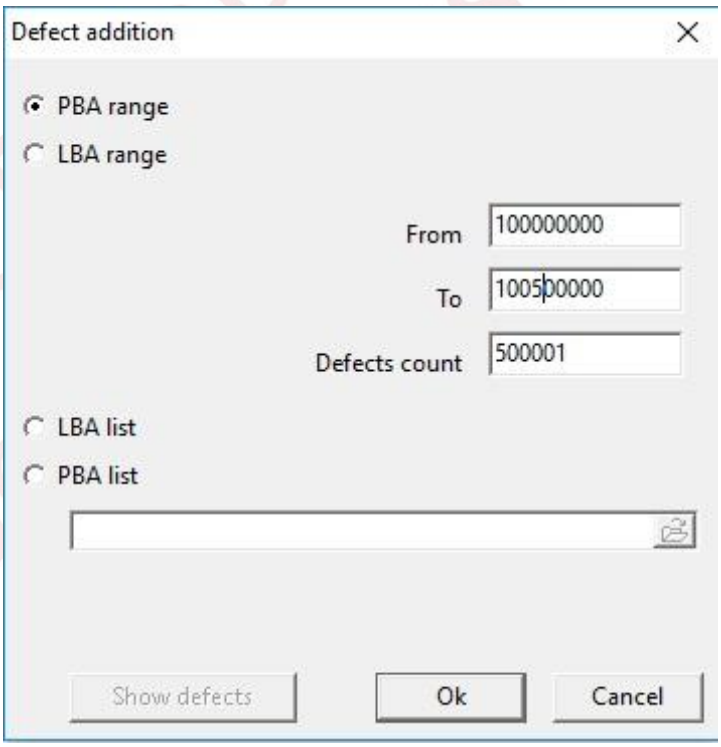


Fig. 4.23.

- ***Edit (F2)***. Selection of a defect in the defects editor window makes available the “Edit” button. Clicking it opens the “Defect editing” window, Fig. 4.24.

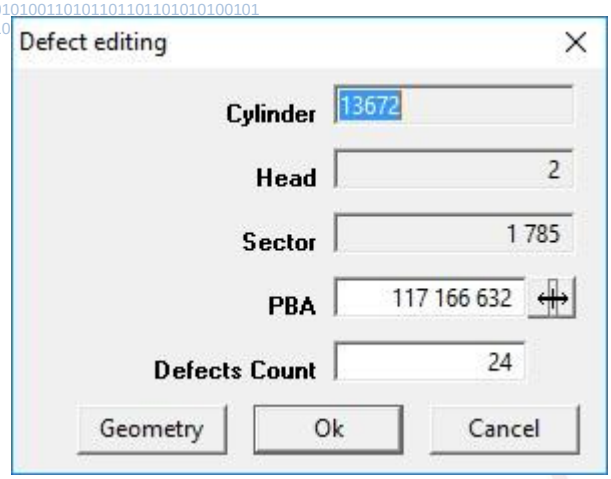


Fig. 4.24.

Editing is possible in the PBA format used to store defects in P-List. Here you have to specify the initial PBA for a group of defects corresponding to a cylinder, head, sector displayed in the corresponding fields, and the count of defects in the group.

Clicking the defect "expansion" button to the right of the PBA field opens a context menu, Fig. 4.25. You can use the menu to select the number of sectors that will be used before the initial PBA and after the last PBA in the group.

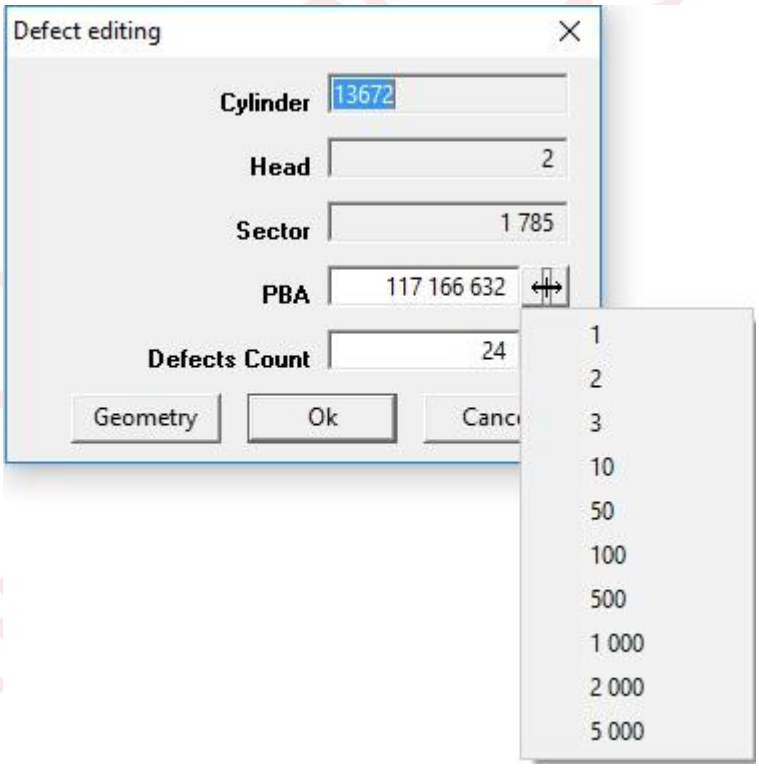


Fig. 4.25.

Clicking the "Geometry" button opens the window reflecting head-based distribution of defects in this particular group of defects (Fig. 4.26.). Here you can remove selected defects from the group. This opportunity may be useful, for example, when you need to leave just the defects corresponding to a specific head.

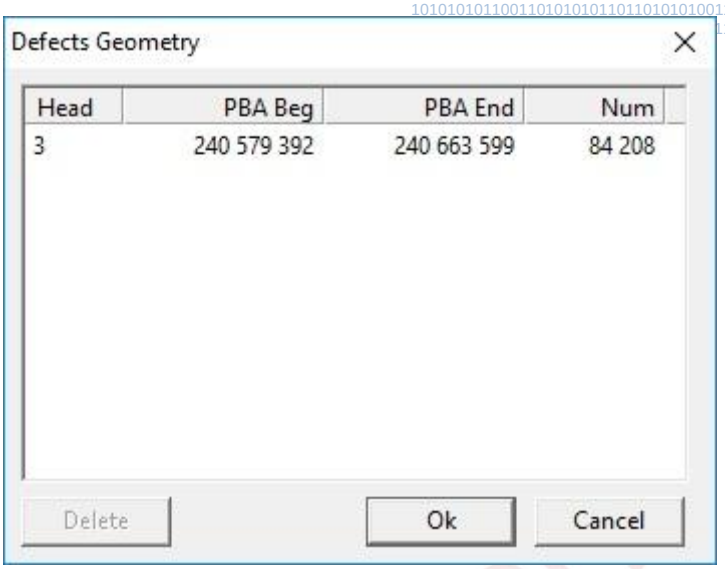
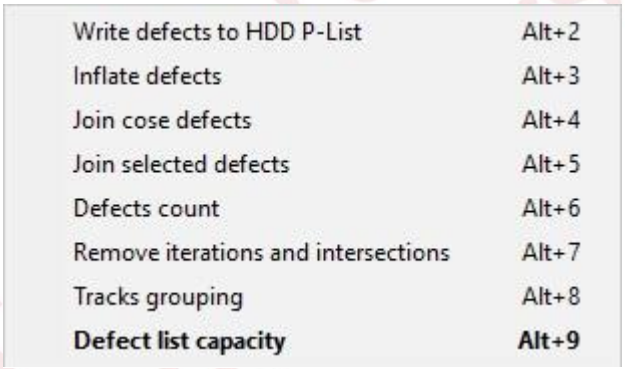


Fig. 4.26.

Another group of features for defect list management accessible from the context menu can also be invoked with a toolbar button:



- ***Write defects into P-List.*** Records the defects to P-List.
- ***"Inflate" defects.*** Selection of this menu item brings up the "Inflate defects parameters" dialog described in the corresponding section 4.4.3.2.2. After clicking OK the utility will perform the selected operation with the defect list using the rules defined in this dialog.
- ***Join close defects.*** Selection of this menu item brings up the "Close defects joining parameters" dialog described in the corresponding section 4.4.3.2.3. After clicking OK the utility will perform the selected operation with the defect list using the rules defined in this dialog.
- ***Join selected defects.*** If you select this menu item, the utility will combine the defects selected in the list. You can select the defects manually by checking their boxes in the first column of the list. Group selection can be performed from the context menu that opens after right-clicking within the editor window.
- ***Defects count.*** Selection of this menu item calculates the total number of defective sectors and displays the result in a separate window.
- ***Remove iterations and intersections.*** If you select this menu item, the utility will eliminate duplicates and intersections in the defect list.
- ***Tracks grouping***. If you select this menu item, the utility will combine all defects within a single track into a defective track.
- ***Defect list capacity.*** Selection of this menu item brings up the window demonstrating the number of records in P-List.

4.4.4.1.2. G-List

The menu item opens a standard file selection dialog where you can specify the G-List module file (the default name is "Glist.lba"). After selection the utility reads G-List and saves the file to HDD profile. Then it opens the defects editor window where you can view and modify the list of defects and write the modified list to HDD. Changes in G-List become effective immediately after recording.

In SATA HDD of the 46GSX and newer families, G-List viewing and editing are performed via the terminal, so they have to be connected through the PC USB TERMINAL adapter.

4.4.4.2. Erase defect list

The "Erase defect list" menu allows access to the "P-List" and "G-List" submenus.

4.4.4.2.1. P-List

Selection of that menu item brings up a dialog where you can confirm P-List clearing. If you confirm the operation, the utility will reset P-List and write it to HDD.

Attention! The operation is only used for examination or repair, not for data recovery. After P-List clearing, data will still be accessible but with a translator shift beginning with the first defect that used to be hidden in P-List.

Clearing the defects list may cause previously hidden defects to reappear; therefore after that you will have to perform recording and verification of the entire surface, and hide revealed defects using P-List or G-List.

4.4.4.2.2. G-List

G-List clearing is essentially a counterpart of the operation typically known as "translator regeneration". While clearing the G-List, the utility also checks the P-List structure. Therefore, if P-List contains logical corruption or if it is unreadable, G-List clearing will complete with an error.

Selection of that menu item brings up a dialog where you can confirm G-List clearing. If you confirm the operation, the utility will reset G-List and write it to HDD.

Clearing the defects list may cause previously hidden defects to reappear; therefore after that you will have to perform surface scanning and hide revealed defects.

4.4.4.3. Moving G-List to P-List

Selection of the "Moving G-List to P-List" menu item brings up the following dialog:

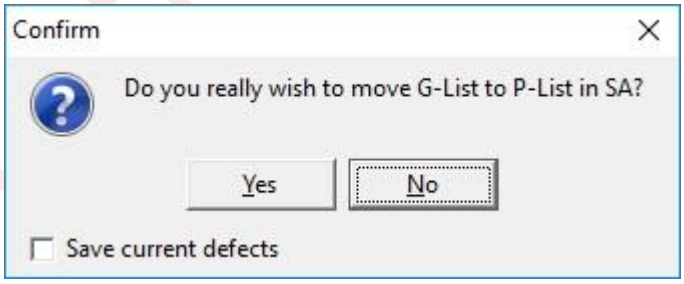


Fig. 4.27.

If you confirm the operation, the utility will read the defects from G-List and write them to P-List. G-List will be cleared after successful recording.

4.4.4.4. LBA to CHS conversion

The command makes the utility output to log the results of LBA conversion to CHS, i.e. it allows translator inspection. Selection of that item brings up the following dialog window:

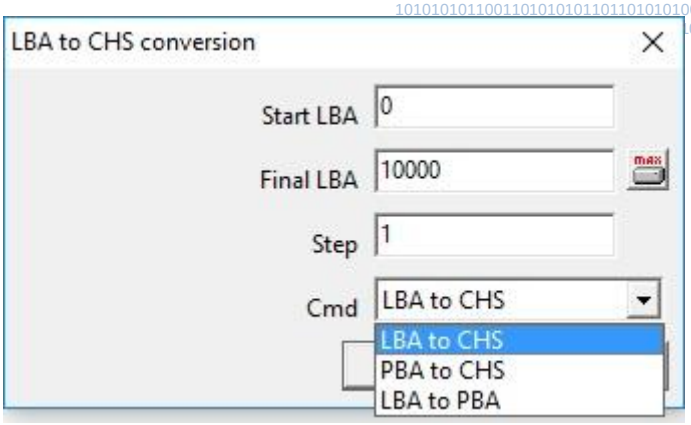


Fig. 4.28.

In the “LBA to CHS” dialog you can select the initial and final LBA of the conversion range as well as the conversion step, which represents the LBA increment that will be used for conversion. E.g., if you select initial LBA = 0, final LBA = 30, and conversion step = 10, then the log will contain the following result of conversion for LBA = 0, 10, 20, 30.

The “Mode” menu offers the following commands for test process control:

- ***Abort*** - terminates the test procedure.

4.4.5. S.M.A.R.T. erase

The “S.M.A.R.T. erase” command returns S.M.A.R.T. attributes to their initial values. In some cases a HDD becomes inoperable when the S.M.A.R.T. thresholds are exceeded, then the option can be helpful for restoration of its functionality.

5. Utility extension

The 'Tools → Utility extensions' menu provides access to features specific for the Toshiba utility only:

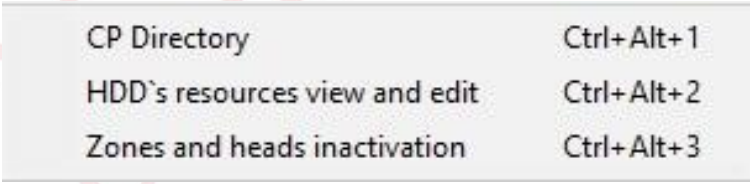


Fig. 5.1.

5.1. CP Directory

That menu item opens the CP selection window:

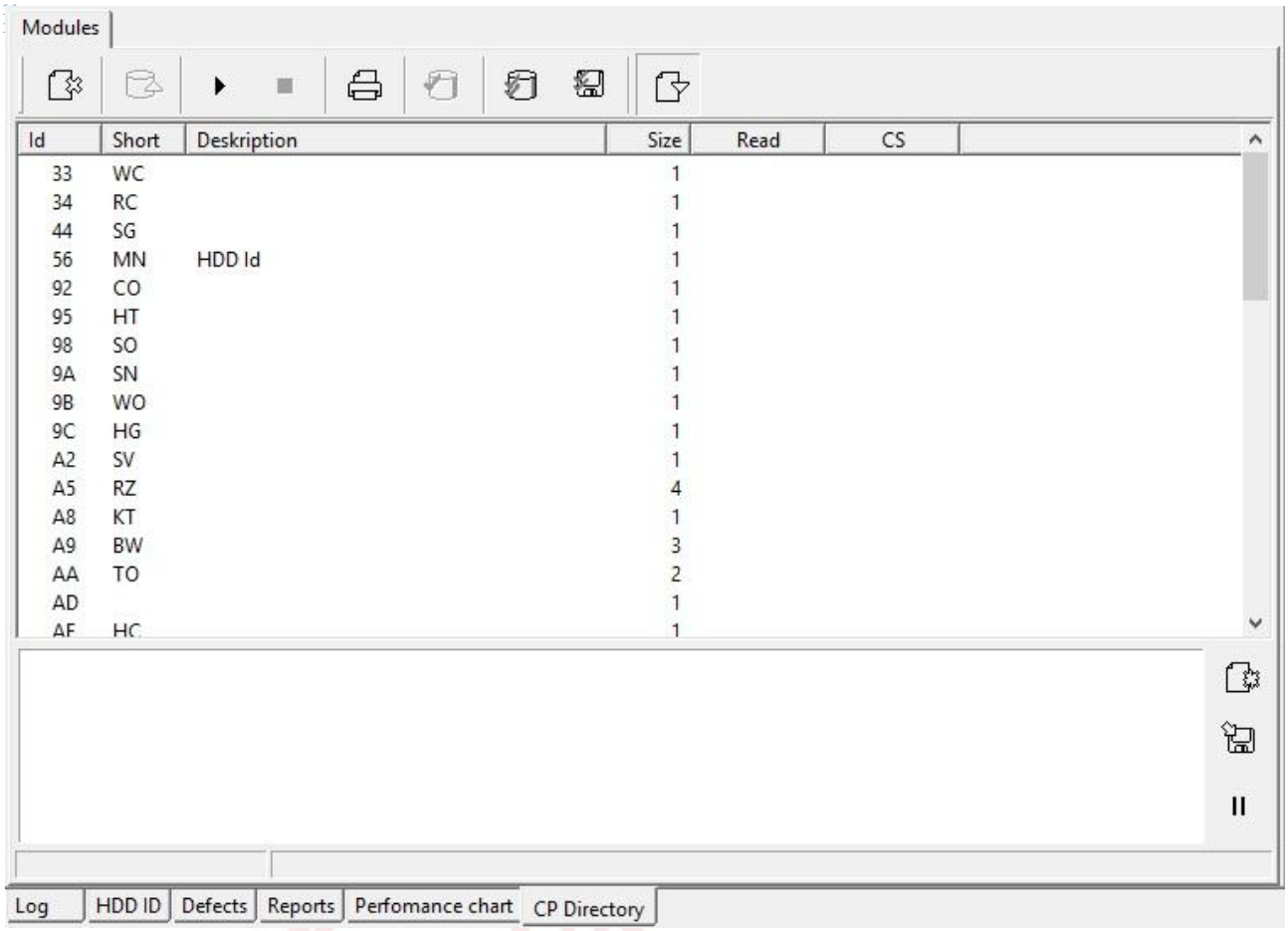


Fig. 5.2.

Here you can choose the necessary CP for further editing (Fig. 5.2). After selection of the required CP in the hex editor window you can review, edit, save the data to HDD or to a module file, and recalculate its checksum.

Modules referred to in the utility as configuration pages (CP) are stored in ROM (except for DD). These modules contain HDD ID, P-List, and different adjustment (adaptive) data specific for each individual HDD. Most CP occupy 1 sector or less; their byte checksum (CS) is appended to module end. The last non-zero byte of any CP is its CS. Just a few CP take more than 1 sector. In PATA HDD these are AA, BB, and DD. In SATA HDD a few more CP are larger than 1 sector. CP set and their sizes vary among different drive families.

CP size is determined at utility launch. For drive families that are not included into the startup menu, CP size and structure can be corrected when you select an available configuration (created earlier) or create a new one, please refer to section 4.1, *Launching the utility*. Toshiba HDD have no modules table. Therefore, when a new configuration is created, the utility reads all CP in the 0-FF range and adds to the list those configuration pages, which have been read successfully. Their size is assumed to be equal to 1 sector. CP size can be corrected.

Selection of the 'Plug-ins' menu item from the dropdown menu displayed after right-clicking within the hex editor window allows the following CS processing methods:

- Check CP CS - checks CS for the whole module.
- Check CP CS (Selected) - checks CS for the selected module part.
- Recalc CP CS (Selected) - recalculates CS for the selected module part and writes it to the last byte of that area.

Thus, if you need to correct a CP, then after required modifications you will have to select the whole data area including CS and choose 'Recalc CP CS (Selected)' in the menu. New CS will be written to the last byte of the selected data portion.

Purpose of some CP:

- 55h in older drive families, 56h in new families - HDD ID.
- 9A - serial numbers.
- DDh - P-List, it is stored on disk surface within service track 1 of SATA drives and service track 2 of PATA drives.

5.2. HDD's resources view and edit

That menu item brings up the 'Select HDD resource' window where you can choose the parameter to edit: CP, MPU RAM, G-List or a zone allocation table.

Once you select the required parameter and press the OK button, the utility will read it and open in the hex editor window where you can view and modify the read value. G-List and zone allocation tables are only available for viewing.

Access to MPU RAM is possible both through the ATA interface or the terminal, selection is performed in the 'Read method' dropdown menu.

The 'Select data' toolbar button in the editor window allows you to choose another parameter for editing. The 'Write to HDD' and 'Cancel' buttons allow you to record a modified parameter to a HDD or discard editing results respectively. You can only cancel an action as long as the modified data have not been written to HDD. If you have pressed the 'Write data to HDD' button, the modified data cannot be restored to the original state. Therefore, prior to editing any data you have to make its backup copies on another disk first in order to be able to cancel editing.

Right-clicking the workspace brings up a shortcut menu containing commands understandable from the context and identical to the sector editor (the same applies to the toolbar buttons).

5.2.1. CP tab

In the 'Available CP' field you can select a CP that you need to edit.

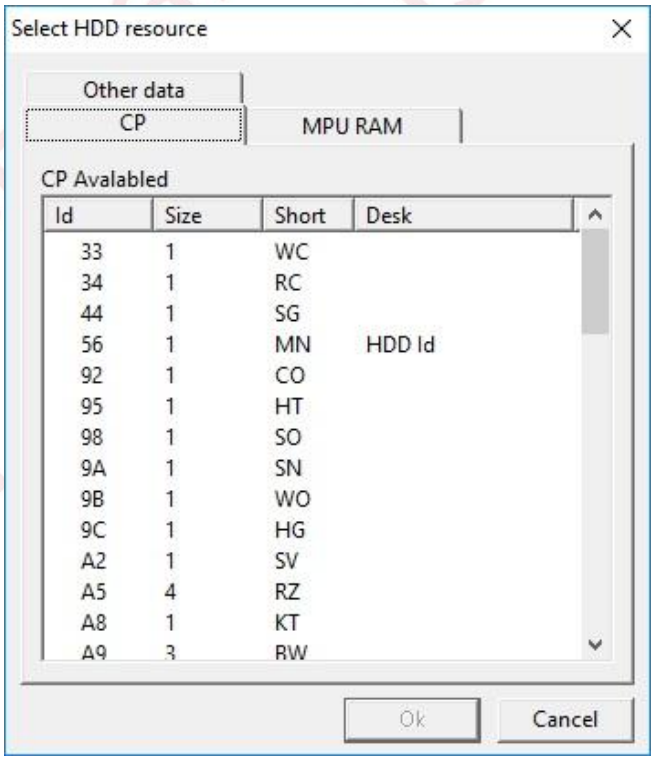


Fig. 5.3.

After selection of the required CP in the hex editor window you can review, edit, save the data to HDD or to a module file, and recalculate its checksum.

This item is identical to the 'CP Directory' (see section 5.1).

5.2.2. MPU RAM tab

MPU RAM size in HDD of older families with ROM integrated into the controller microprocessor is 40000h bytes, in new models with external ROM it is 80000h bytes, the newest models have 100000h bytes. The RAM part contains a slightly altered ROM image used to load program data.

MPU RAM is read in bytewise mode.

In the displayed dialog (Fig. 5.4) you can select the initial and final address of the memory area to examine, its size in bytes and the reading method for PATA HDD (through the ATA interface or terminal).

After selection of the required RAM area in the hex editor window you can review, edit, save the data to HDD or to a file.

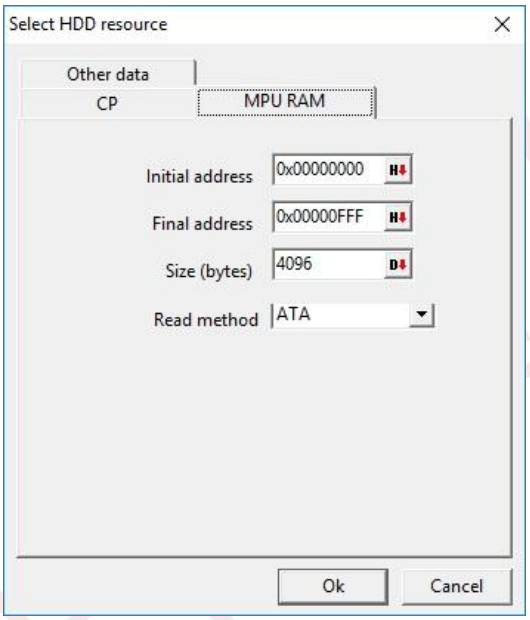


Fig. 5.4.

5.2.3. Other data tab

Here you can choose between the G-List or a zone allocation table. After selection of the required parameter you can use the hex editor window to review, edit, save the data to HDD or to a file.

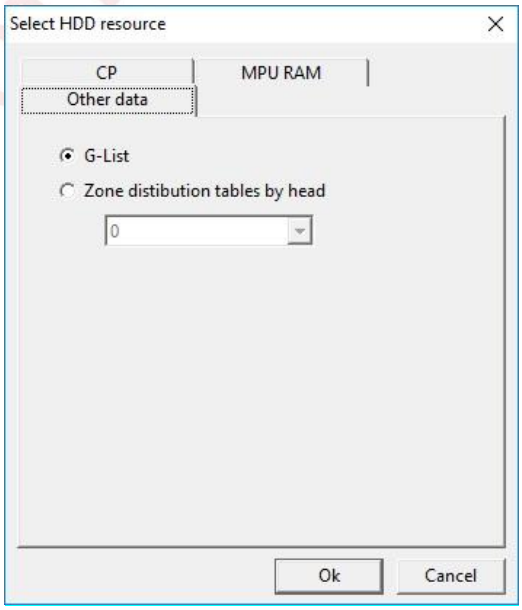


Fig. 5.5.

If you select G-List, the 'Decode G-List' feature becomes accessible on the toolbar. During the procedure the utility can determine the number of defects using the data counter or the size of selected data. In the first case, you have to select first the entire address space in the editor window, (for example, using the Ctrl-A keyboard shortcut), in the second case you will have to select with the mouse just the necessary data portion starting from its beginning. Clicking OK will open a dialog for selection of the decoded file name and destination, then the utility will create the defect list file and open it in the defects editor.

5.3. Zones and heads inactivation

Selection of this menu item opens the microzones editor:

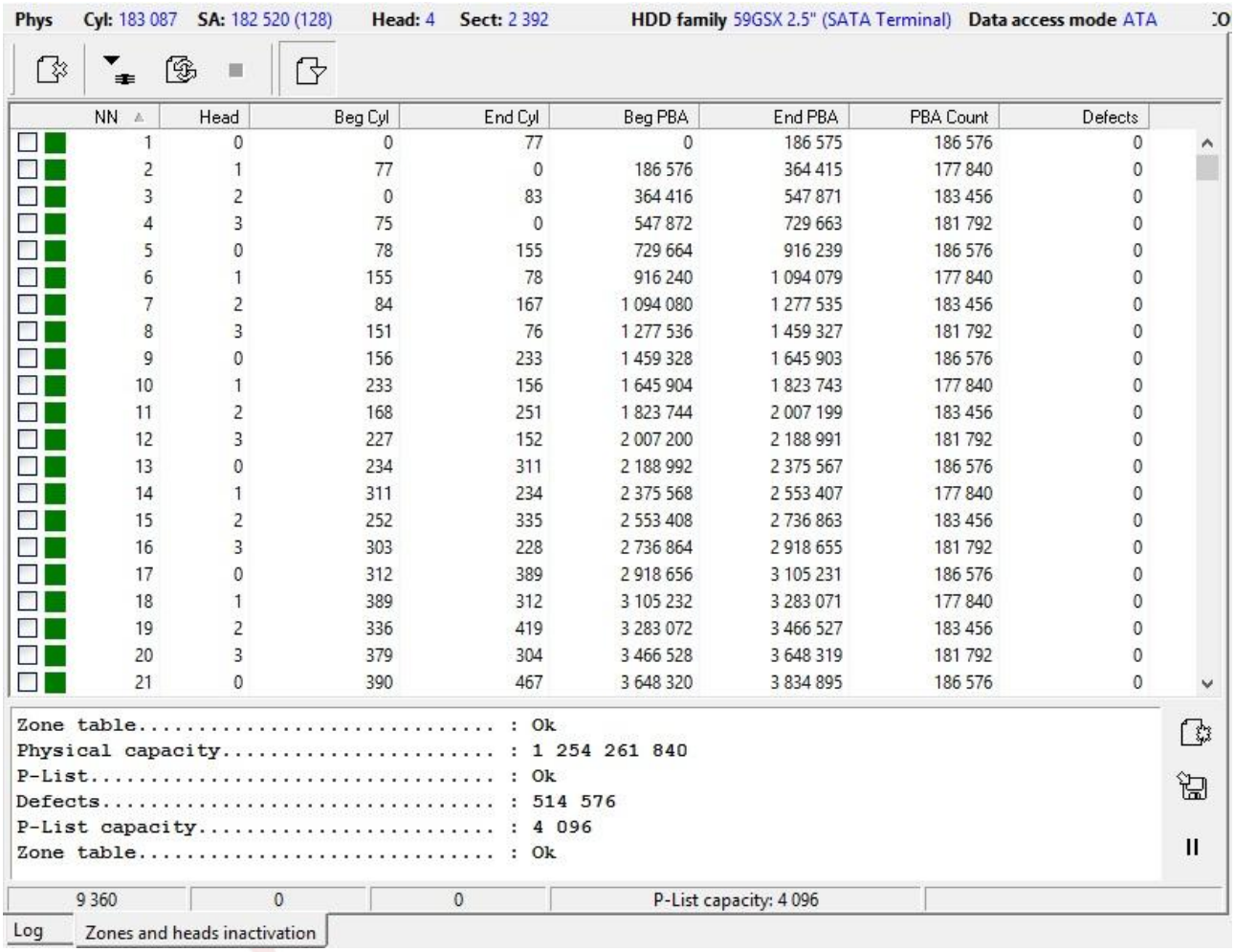


Fig. 5.6.

This window allows to perform group operations hiding large surface areas in P-List.

Disabling of individual heads and zones in the 'Zones and heads inactivation' form can be invoked from the shortcut menu displayed after right-clicking the workspace.

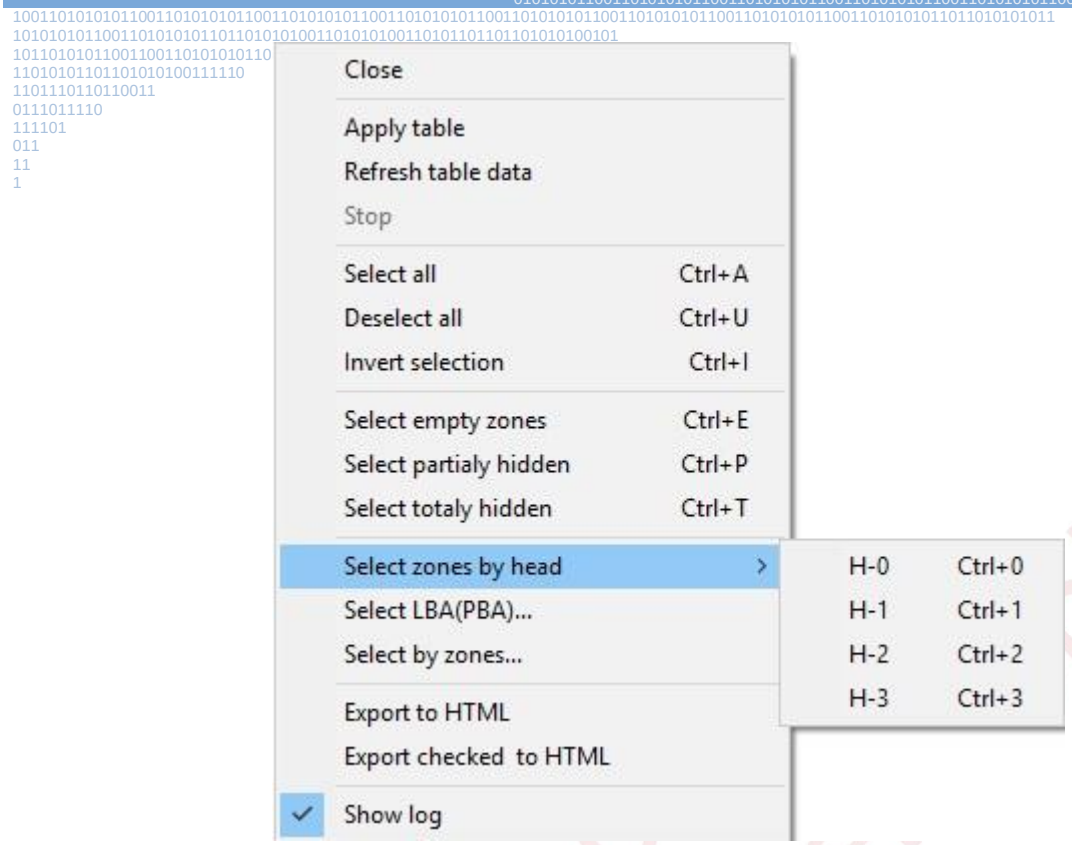


Fig. 5.7.

It contains all possible methods for selection of the ranges to be hidden via the P-List. You can choose an LBA or PBA range, load a scanned or previously created LBA or PBA list, mark all zones belonging to a target head (deactivate a head), mark the necessary zones corresponding to the selected heads. The form allows manual selection of the required microzones. Recording of the selected defects is performed upon selection of the 'Apply table' command in the menu or the corresponding toolbar button in the same window. Prior to P-List recording, the utility saves CP 56 and DD in the ZoneBackup\YY-MM-DD-HH-MM-SS folder to allow a roll-back to the original HDD state. YY-MM-DD-HH-MM-SS – the name of the created subdirectory will contain the year, month, day, hour, time and second when CP 56 and DD have been saved.
Bottom line of the window below the log pane contains 3 values. The first one represents total number of microzones, the second - the number of selected microzones, the third reflects the number of PBA in the selected microzones. The fourth 'P-List capacity' field contains the maximum number of defect records in P-List.

6. Principles of repair and data recovery for Toshiba HDD

Toshiba drives have a peculiar construction: all data required for drive operation is stored in its processor, namely: the whole firmware microprogram (the service area contains no overlays), translator, and adaptive parameters. The service area on disk surface contains just G-List, password, SMART and a few other non-critical modules, and also various logs.
Various configuration settings are stored in processor ROM in the form available for reading as CP – Config Pages.

6.1. Assignment of defects in user area

Defects in the user data area can be assigned via P-List or G-List.

Fundamental distinction between these 2 methods is in the fact that assignment in P-List hides a defective sector or group of sectors from translation while assignment via G-List replaces a defective sector with a sector from the reserved space. After hiding via P-List data remain accessible but a translator shift appears, which is unacceptable for proper user data handling. Hiding via G-List does not result in a translator shift, though reading and writing operations with the reassigned sectors become slower since access to them requires relocating the heads to the reserved space and back, which takes comparatively longer. Changes in P-List or G-List become effective immediately after recording, without a prior power toggling.

6.1.1. Hiding defects in G-List

G-List is located in the service area on disk surface. G-List can hold up to 1912 defects but actual physical space allocated for it allows 1024 records only. In new SATA HDD G-List is intended to contain 3960 defects, but in reality it only allows hiding approximately 1800. When more defects get hidden, a G-List reading error occurs, and the drive blocks further access to data. The problem can be fixed by clearing G-List and subsequently hiding a smaller number of defects. Only sector-sized defects are supported.

Defects can be hidden to G-List using two possible methods. The first approach is described in section 4.4.3.1, Logical test.

The second method is detailed in section 4.4.4.1, Defect list editing, it requires using the defect list editor. Once you select the G-List table, the utility opens the defects editor window where you can view and modify the list of defects.
The utility allows deleting or editing G-List records, adding individual LBA or LBA groups. Then you can write the modified list to HDD. Changes in G-List become effective immediately after recording.

6.1.2. Hiding defects in P-List

P-List is located in the service area on disk surface, it can be read as CP DDh.

The number of hidden defects depends upon the size of P-List, it is determined by the number of records, which the table can accommodate. In older drive families the number is equal to 1022 records, in newer drives it reaches 4094, the latest models can contain 16382 or even more.

The list allows to hide individual sectors, a group of up to 24 sectors within a single track, entire tracks, and groups of tracks. Each record can hide any significant number of PBA following each other consecutively. Thus, it follows that hiding a limited number of surface areas should not cause problems with P-List capacity no matter how large these areas are. However, hiding a large number of defects may exceed the capacity of P-List and result in a failure to hide all of them.

Many drive families do not allow hiding PBA=0 and more than 24 sectors within a track, consequently, the same applies to cylinder 0, the operation may be possible with some FW only which can be identified experimentally. Therefore hiding the space corresponding to head 0 completely is impossible on such HDD, though you can hide all PBA associated with it except for cylinder 0. You can try hiding them in G-List though.

32GSX and 37GSX drive families do not allow hiding more PBA than a certain limited number. For example, you may encounter a MK6037GSX model which can hide 17849743 PBA but not 17849744 or more. Perhaps, this behavior is typical of some FW versions only.

Defects can be hidden to P-List using three possible methods. The first approach is described in section 4.4.3.1, Logical test.

The second method is detailed in section 4.4.4.1, Defect list editing, it requires using the defect list editor. Make sure all CP are saved before you start hiding defects. Once you select the P-List table, the utility opens the defects editor window where you can view and modify the list of defects.

The utility allows deleting or editing records, adding individual sectors or groups of sectors, loading a defect list saved earlier, grouping defects into defective tracks. Please note that saving defects to P-List decreases the HDD capacity. The reserved space for replacement of defective LBA is rather small; therefore, the user data area has to be decreased to fit all defective LBA in P-List. If you need another P-List correction later, then prior to its recording to HDD remember to write there CP56 saved earlier to restore the HDD capacity.

Changes in P-List become effective immediately after recording.

The third method is described in the following section.

6.1.3. Zones and heads inactivation

Zones and heads can be deactivated by hiding large surface areas to P-List. See section 5.3, Zones and heads inactivation.

You can hide completely the space associated with specified heads, zones and large ranges of LBA or PBA. If you hide entirely the space corresponding to a certain head, that head will no longer participate in the translation process, and the drive will act as though the head has been physically disconnected. PBA ranges are split into microzones; their size and number reflect the translator structure of an individual HDD.

Hiding the zones following each other successively for all heads causes no problems for the hiding procedure. However, if you hide zones for just one selected head or for heads not immediately following each other (for example, heads 1 and 3 in a HDD with 4 heads), then P-List capacity may become insufficient. The situation depends on the number of microzones corresponding to the selected head and the number of records still available in P-List. E.g., in the

MK3263GSX model P-List may contain up to 1022 records, while the number of microzones per each head is 2196. Consequently, hiding entirely the space associated with a single selected head is impossible.

If you need to roll back to the earlier HDD state, which preceded hiding of its zones and space associated with selected heads, write to the HDD its CP 56 and DD saved automatically in the ZoneBackup directory.

6.2. Password removal

If a HDD is password-protected, the utility will display the following warning at startup:

ATTENTION!
HDD is currently locked.
You can use the "Work with service area" / "Password removal" command.

After «Password removal» selection the utility resets the password automatically.

6.3. Password information saving and restoring

There are saving and restoring of password information realized in utility, see 4.4.2.2.11 and 4.4.2.2.12. It was made for research purposes of password protected HDDs.

If the drive is password protected, tehre is a possibility to save the password module first, then clear the password. It allows to get an access to user area. After HDD research we can write the password module back to return the drive into it's initial state.

Of course, all these operations are possible if drive has no problems with platters, PCB and heads.

6.4. Problems resulting from damaged modules

6.4.1. Problems with G-List module.

G-List can hold up to 1912 defects but actual physical space allocated for it allows 1024 records only. When a defective sector is found during writing operations, Toshiba HDD hide such sectors automatically to G-List. Sometimes in that case list overflow or corruption occurs making further access to user data impossible. The «Clear G-List» command allows the operator to clear the G-List and restore its structure. The feature at the same time actually performs translator regeneration because G-List combined with some other modules is used to build the translator though unlike those modules it is located on disk surface. The clearing procedure restores access to data.

Please note that while clearing the G-List the utility also checks the P-List structure. Therefore, if P-List contains logical corruption or if it is unreadable, G-List clearing will complete with an error.

G-List clearing may fail in some cases. In such situations either the procedure completes with an error or, more frequently, it passes without errors but a new attempt to read G-List returns an error. To address these cases, the utility offers special functionality that allows data reading from HDD with such malfunction, please see the section 6.9 “Data recovery from HDD with corrupted G-List”.

6.4.2. Problems with S.M.A.R.T. module

HDD writes information to its S.M.A.R.T. module as necessary. Sometimes erroneous records can occur during the procedure preventing further access to user data. The «Clear S.M.A.R.T.» command allows the operator to clear the S.M.A.R.T. module and restore its structure.

6.5. Peculiarities of electronic printed circuit boards

Some microprogram versions of Toshiba HDD have the following problem: after connection to PC-3000 UDMA a drive fails to report on readiness; drive registers contain «garbage» in that state. The problem stems from the CSEL signal not connected to the common wire (GND). To control the CSEL signal in PC-3000 UDMA, you should use the «Tools» – «Cable Select control» menu at utility launch to choose the «ATA0» or «ATA1» channel depending on where the HDD is connected, ***Fig. 6.1.***:

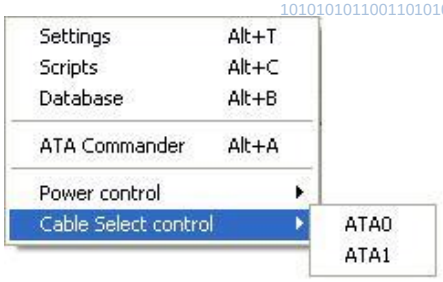


Fig. 6.1.

We should note that enabled CSEL signal will not affect operation of all other HDD.

Electronic boards of Toshiba HDD have two safety fuzes. They are marked as FUZE in PCB layout schemes. They burn out very frequently, although the electronics remains undamaged. You will have to set jumpers instead of the burnt fuzes. The role of the protective device in that case will be played by the fuze present on PC-2" adapter.

6.6. Opportunities for PCB replacement

You should consider the following aspect when drive PCB is damaged. Since all individual information (firmware, translator, adaptive parameters) required for HDD functioning is stored in its processor, simple replacement of the PCB is not possible. After PCB replacement calibration usually fails, HDD tries to position the heads for a long time and remains BUSY. However, you can solder the processor to another functional board for older models or the external ROM chip for models equipped with it - thus you will transfer all parameters critical for drive functioning. Some HDD have ROM chip installed in BGA case and its soldering can be quite difficult.

PC-3000 UDMA features allow replacing of the electronic boards without soldering of the microprocessor or ROM if you have an available donor drive for the HDD belonging to exactly the same model. The task can be accomplished with transfer of CP modules from one board to another.

First, you need to read all CP except for DD from the PCB of the malfunctioning HDD that we shall further refer to as the «target». To read CP from the «target» PCB, the board has to reach the readiness state. If the board is installed on HDA and it enters the readiness state, CP retrieval is quite easy - «Work with service area» - «Reading CP». DD CP should not be read because drives read that module from disk surface and so it is not required for recording to the «donor» PCB. If the «target» PCB cannot reach readiness with its «native» HDA freezing in BUSY state instead, there is a certain probability that it will reach the readiness state when you install in to «donor» HDA. If that happens, the utility reads CP similarly to the previous case.

If the PCB fails to reach readiness in this case, you can often make it enter the ready state and read CP by removing the PCB from HDA and connecting it to PC-30000. To do that, you will have to enter first the Toshiba utility using a «donor» HDD or any other HDD belonging to the same family, proceed to the «Terminal» tab, use the mouse to click in that window and press ENTER to make sure that the terminal is functioning. If everything works normally, the HDD will respond with a terminal prompt «>». Then disconnect the HDD, connect the «target» PCB and switch power supply on. Usually the board first responds with BUSY. Then press ENTER again in the terminal window. If the board has no critical damage, it will report on readiness immediately or 1-2 minutes after the power supply is switched on; then it allows CP reading. If that does not happen, the PCB has suffered damage preventing it from entering the readiness state.

After CP retrieval from the «target» board, connect the «donor» HDD to PC-3000 and write to it the recovered CP. Then switch the «donor» PCB to the «target» HDA, switch power supply on, exit the Toshiba utility and enter it again. The utility will display a warning about password protection enabled on the HDD. Remove the password using utility tools - «Work with service area» - «Password removal». Switch HDD power supply off and on again. After that you will have a completely operational HDD with HDA from the «target» and PCB of the «donor» drive.

6.7. Problems with HDA

Spindle motor seizure is a frequent cause of malfunctions in Toshiba HDD. During initial startup stages the spindle spins but either fails to spin up to necessary speed or its rotation is unstable and eventually it fails to spin up altogether. There are different methods used by data recovery experts for access to user data. General guidelines for typical cases are as follows.

The easiest method to make the spindle rotate at required speed is to warm it up. The method requires a heat gun with a thin tip to direct the air stream to the spindle motor shaft which is rather small. Put malfunctioning HDD with the PCB up, remove label from the spindle, and connect the drive to PC-3000 UDMA suite, which must be prepared for data copying. Switch on the heat gun, set the temperature to 230-270 centigrade (it can be checked experimentally), and direct

the air stream at the spindle shaft. You are advised to prepare a metal screen preventing the hot air from contacting the PCB. When the spindle is warmed up sufficiently, switch on the HDD power supply. Usually the spindle starts rotating with the required speed and HDD reports on readiness. Start data copying immediately. Do not stop heating the spindle during the procedure, maintain stable high temperature until the utility retrieves all data. It is also important to avoid overheating the spindle and the PCB. The quality of that operation is highly dependant upon the expert performing it. After data retrieval HDD operation cannot be guaranteed but in some cases such HDD work quite long.

If heating does not help, you can attempt spinning up the spindle manually. To do that, insert into a portable drill a screwdriver bit for the screw that fixes the platters, remove the HDA cover, insert the screwdriver into the slot of the screw cap and try to spin up the platters rotating them in alternate directions in turns. Please exercise caution during the procedure to avoid screwdriver sliding to platter surface. In some cases such polishing of the motor shaft after quite long rotation removes burrs and then the spindle begins to rotate.

If the methods used to release the spindle do not work, you can access user data replacing the platters together with drive heads and PCB to another HDD. You will need the same donor drive. Disks in Toshiba HDD can be replaced quite easily with minimal alignment required. If there are two platters, then their relative positioning should be preserved, but small shifts do not affect the possibility of data recovery in most cases.

Operations with open HDA should be performed in a special clean room because dust particles inside the case certainly will not increase HDD reliability or extend its life.

6.8. Surface and heads testing

Before actual data recovery, you can perform diagnostics of the drive heads and their corresponding surfaces. To do that, select Physical scan from the “Surface scan” menu. The mode is described in detail in the “Physical scan” section. You can use it to initiate reading from the selected heads and zones in order to reveal malfunctioning heads.

6.9. Data recovery from HDD with corrupted G-List

If G-List in a HDD is unreadable and cannot be cleared, there is no way to access the data using regular methods. For such HDD we developed a method for data recovery in Data Extractor using the Toshiba utility.

The data recovery procedure is as follows:

1) Start the Toshiba utility for the drive containing the data to be recovered.

2) Launch Data Extractor in data copy creation mode and select the HDD as the source.

3) Use the “Settings” → “Task options” → “Command to read” tab to select the command to “Read from active PC-3000 Utility”. In the displayed dialog, select “PBA access (solve G-List damage)”:

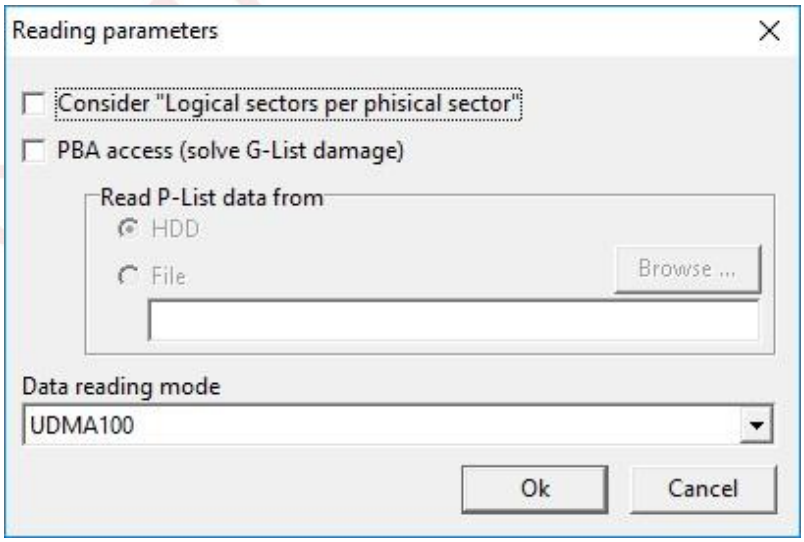


Fig. 6.2.

If the drive uses 2-sector or 8-sector format and does not allow reading of one sector at a time, you have to enable the option to “Consider “Logical sectors per physical sector””. Here you can also choose the data reading mode: UDMA or PIO. The latter may prove necessary for drives with problems.

You will also need the drive's P-List to use this mode. You can read it from the HDD or load a copy saved earlier. A P-List from another HDD or an empty P-List can also be loaded in cases, when P-List is unreadable, too.

Clicking OK will initiate creation of a virtual translator. Once it completes, click Apply in the Task params dialog.

Please note that the virtual translator will be built correctly provided that P-List of the drive is readable and native. Otherwise, for example, if the P-List has been cleared accidentally, or loaded from a non-native file, data reading will work, but the virtual translator may be built incorrectly and the recovered data may contain shifts, which will have to be fixed using the functionality and methods available in Data Extractor.

The same window will appear in the sector editor of the Toshiba utility when you click the 'Read/write options' toolbar button to ensure correct sector viewing.

Once all the steps above are completed, Data Extractor will be ready to read data from the drive and further work with the HDD will be performed in standard Data Extractor mode.

6.10. Work with HDD models using several logical sectors per single physical one

A few Toshiba drive families have sector arrangement based on 2 or 8 logical sectors within a single physical one. When you launch the universal utility or Toshiba utility, it outputs the following warning to the log:

Attention! Physical sector of the HDD contains 8 logical sectors.

In the HDD ID the parameter appears as follows:

Multiple logical sectors per physical sector..... : [YES]
Logical Sector Longer than 256 Words..... : [NO]
Logical sectors per physical sector..... : 8
Words per Logical Sector..... : 256 512 b

Please keep in mind that the 59GSX drive family using 8-sector format supports reading any number of sectors with a single operation. 10GAH and 31GAL drive families using 2- and 8-sector formats respectively support reading just the number of sectors divisible by 2 or 8. As a result, while viewing the sectors in the sector editor (which reads one sector at a time), each read operation causes an error creating impression of a malfunctioning drive. During all sequential reading procedures manipulating by default portions consisting of 256 sectors (i.e. the number divisible by 2 and 8), the program switches to reading sectors one at a time whenever it encounters an error. In such cases all subsequent sectors will be read with an error even if no actual errors occur.

To avoid that obstacle, open the “Read/write options” in the sector editor of the Toshiba utility by clicking the corresponding toolbar button, select the option to “Use the utility” in the “Read options” dialog and click OK. The following dialog will appear:

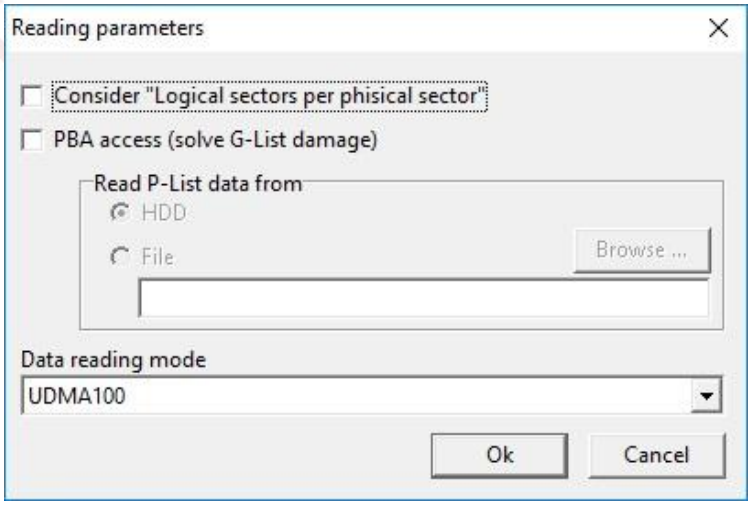


Fig. 6.3.

Select here the option to "Consider "Logical sectors per physical sector"". After that the sector editor of the utility will perform reading taking into account the HDD ID setting of "Logical sectors per physical sector", so no further errors should occur.

To ensure correct reading of such drives in Data Extractor, you can also select in its settings the option to "Consider "Logical sectors per physical sector"" (please see the previous section).

6.11. Reading and writing of service tracks

Reading and recording of service tracks is performed in the 'Tests - Service information - Work with service area' menu by selecting the 'Reading service tracks' and 'Writing service tracks' menu items respectively.

Toshiba PATA HDD and the earliest SATA drives have 32 service tracks. In SATA HDD (beginning with the 55GSX drive family) there are 128 such tracks, in latest families the number is even higher. However, many of them are in fact completely or partially unformatted. By default the utility selects tracks 2, 21, and 27 only as they contain the most essential data in PATA HDD. In SATA HDD these are tracks 1 and 20 for the head 0, and tracks 107 and 126 for the head 1. Since service information is usually recorded using heads 0 and 1 only, just those two heads are checked, the rest are deselected. In the latest drive families service information is located on even tracks beginning with track 20 (head 0) and on odd tracks beginning with (max_track-20) and less. However, you can select manually other tracks and heads to attempt reading as well.

To ensure retrieval of all service information tracks demonstrating unstable reading, the utility reads each sector several times in accordance with the number of attempts specified in the 'Read retry count' field. If the utility reads a sector without errors, it proceeds to the next one and it retries reading if an error has occurred. To read all sectors, 1 reading retry is typically sufficient.

For data recovery purposes, operations with service data modules on disk surfaces are not required in most cases. Still, it is recommended to save tracks 2, 21, 27 for the HDD with 32 service tracks, and tracks 1 and 20 for the head 0, as well as tracks 126 and 107 for the head 1 for HDD with 128 service tracks. In case of the most recent SATA HDD with more than 128 service tracks, save even tracks for head 0 beginning with track 20 and odd tracks for head 1 beginning with the track (max_track -20) and less. Distribution of essential information in these HDD is studied incompletely so far.

Modules within the PATA HDD service tracks:

Track 2: G-List - GL identifier.
Password module - S identifier.
S.M.A.R.T. modules, no identifier.
P-List module, no identifier.

Track 21: a group of modules containing adaptive data; they are copies of the corresponding modules stored in ROM.

Track 27: several modules containing serial numbers.

Recording of service tracks, when necessary, is performed in accordance with the map of retrieved sectors and only to the sectors marked as readable.

6.12. Peculiarities of data recovery from 1.8" HDD of the 10GAH family

1.8" HDD of the 10GAH drive family are manufactured for Apple, which uses them in iPod players. To write data to iPod with PC-compatible firmware, FAT32 file system is used. iPods with MAC-compatible firmware use the HFS file system. Data reading and writing in the 10GAH drive family has a peculiarity: both reading and writing operations can only be performed with an even number of LBA. Therefore, for data recovery from drives belonging to this family a Data Extractor plug-in using the features of the Toshiba utility has been developed. To recover data from a HDD with the FAT32 file system:

1) ***Start the Toshiba utility***. Displayed "Utility start" dialog will automatically have its focus on the 10GAH drive family. Click OK. If the utility starts successfully, the following information will be output to log:

Techno On.....: Ok
Zone table.....: Ok
Cyl num..... : 65222
Head num.....: 4
Vendor.....: TOSHIBA
Model..... : MK8010GAH
Microcode.....: VK002B2
CP Avalable..... : 33,34,44,56,92,93,94,95,97, 98,9A,9B,9C,A3,A4,A5,A7,A9,AA,BB,C1,C2,CC,DD

The utility supports for this family password removal, CP reading and recording, clearing of G-List and S.M.A.R.T., HDD ID editing.

2) ***Use the "Windows" menu to switch to the "Utility selection".***

3) ***Start Data Extractor and create a new task.*** In the "Source device selection" window choose the channel 0 used to connect the HDD. In the task settings window, select the option to "Make data copy". In the "Selection of the copy destination device" window, select «File image», if the data have to be saved to a file, or channel 1, where a destination drive for data copy creation should be connected. Please note, if it is an identical 10GAH drive, recording is only possible to an entirely functional HDD without bad blocks. If the HDD has bad blocks, their presence may result in incorrect recoding.

4) ***Once the main Data Extractor window opens*** use the "Command to read" tab of the task settings to select "Read from active PC-3000 Utility". In the displayed dialog, select the option to "Take into account "Logical sectors per physical sector" and set UDMA33 mode. Click Apply to make the changes effective.

5) ***Open the Explorer and use the mouse to select PC3000 ATA0 in its Folders window.*** Right-click the selection to open the context menu and proceed to "Add virtual partition". In the displayed dialog, specify the settings as shown in ***Fig. 6.4***. The "Final LBA" field value will depend on the drive capacity. The value in the figure is for the MK8010GAH model. Click OK.

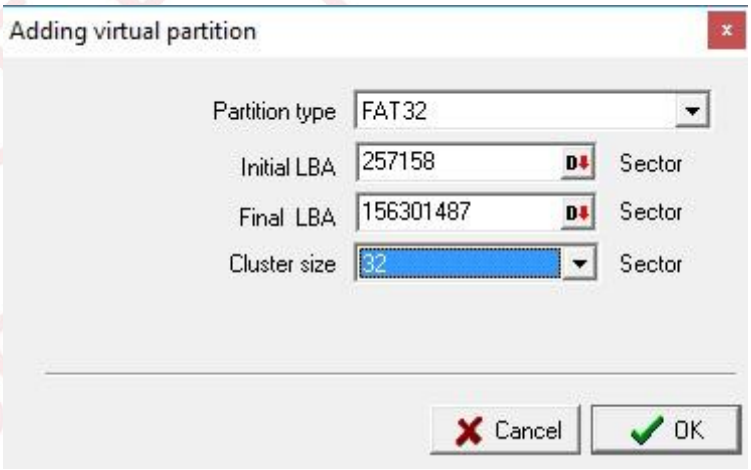


Fig. 6.4.

6) ***In the next window, define the settings*** as shown in the figure below by correcting the "SectorPerCluster", "Reserved Sector", and "BigSectorsPerFat" fields:

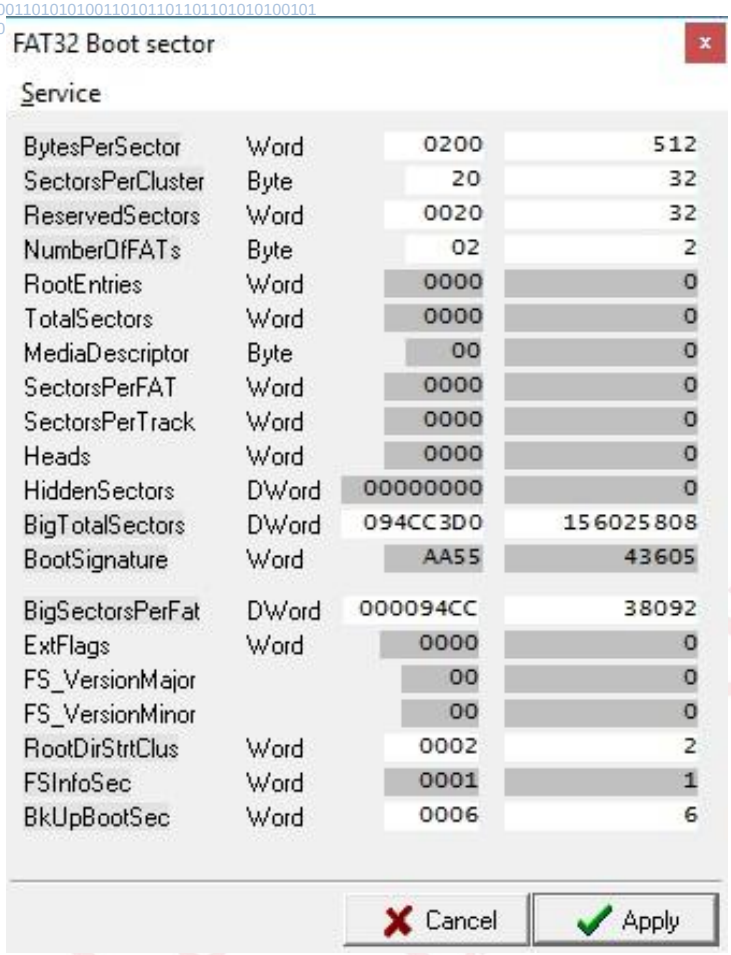


Fig. 6.5.

7) ***Then you can review the directory tree in Explorer*** and save the entire partition or just necessary files and folders:

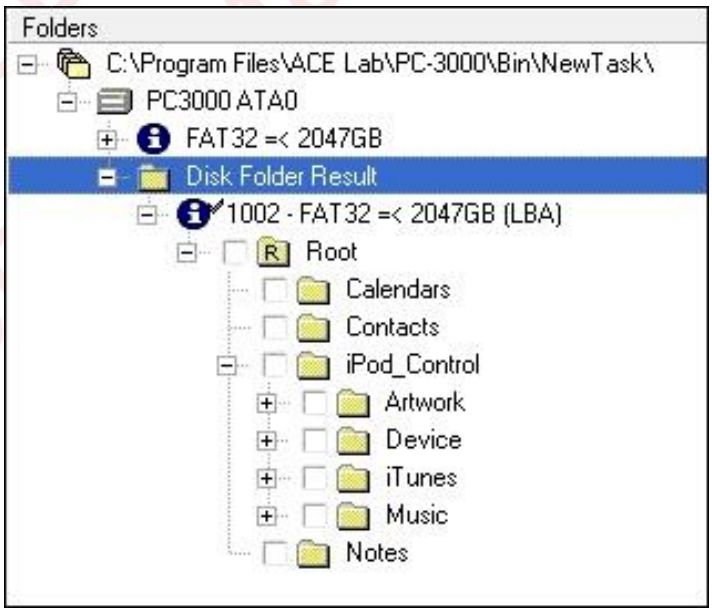


Fig. 6.6.

7. Appendix 1. Appearance of the controller boards in Toshiba drives

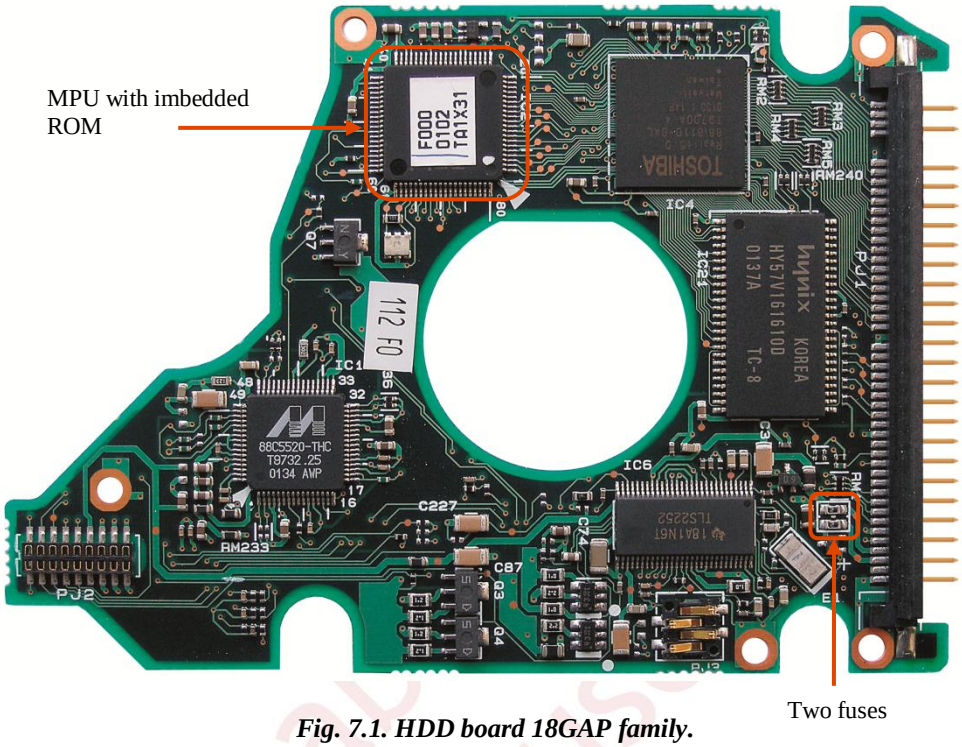


Fig. 7.1. HDD board 18GAP family.

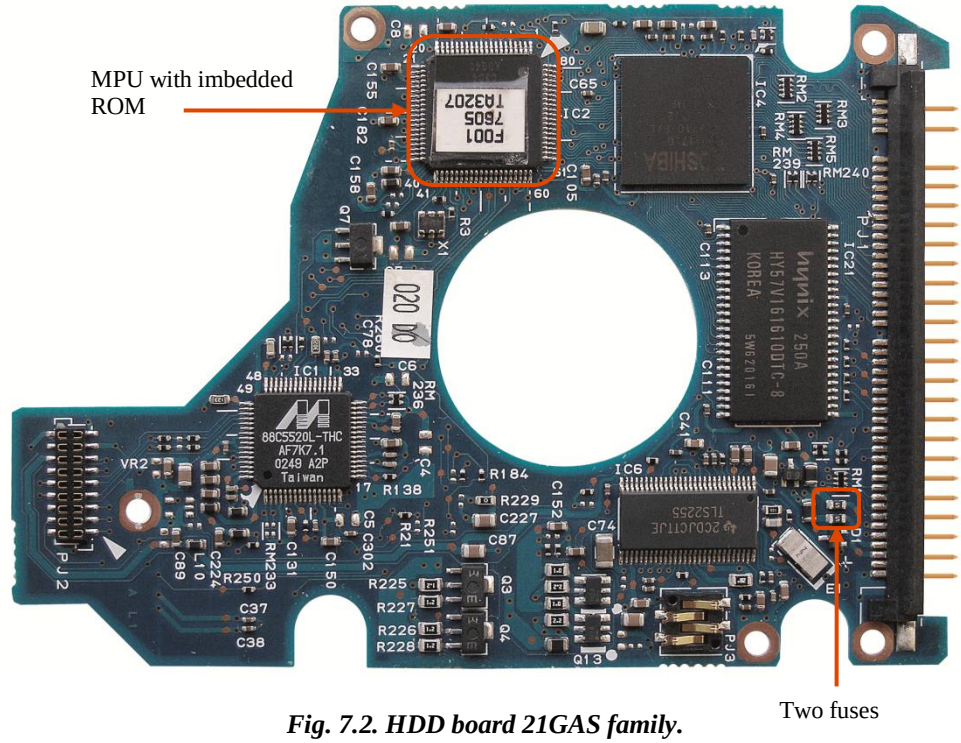


Fig. 7.2. HDD board 21GAS family.

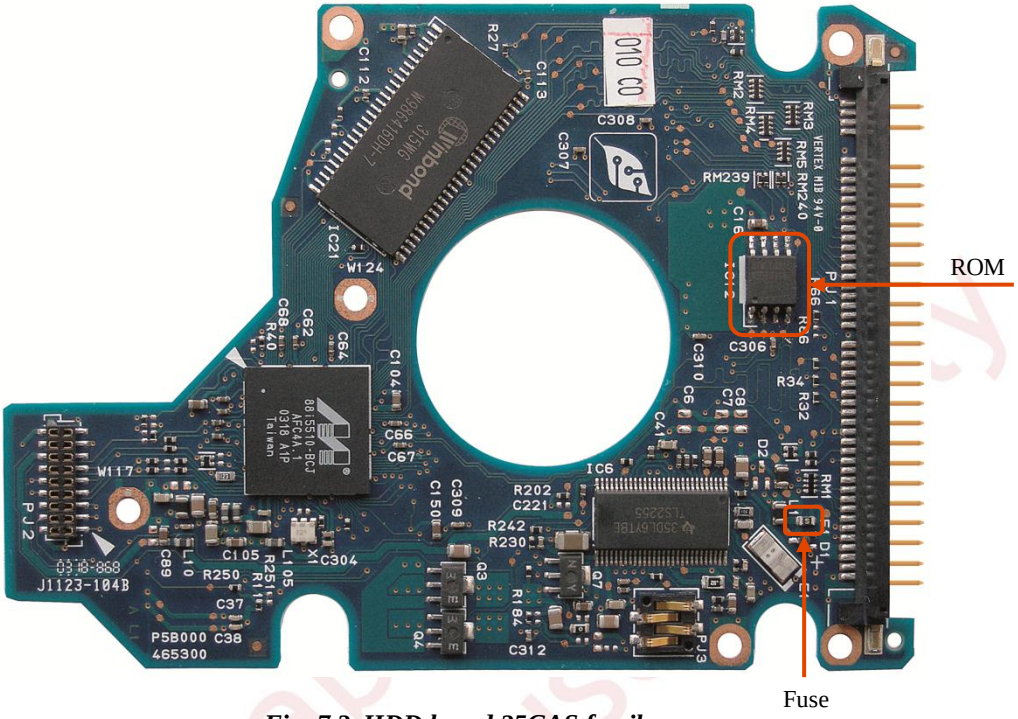


Fig. 7.3. HDD board 25GAS family.

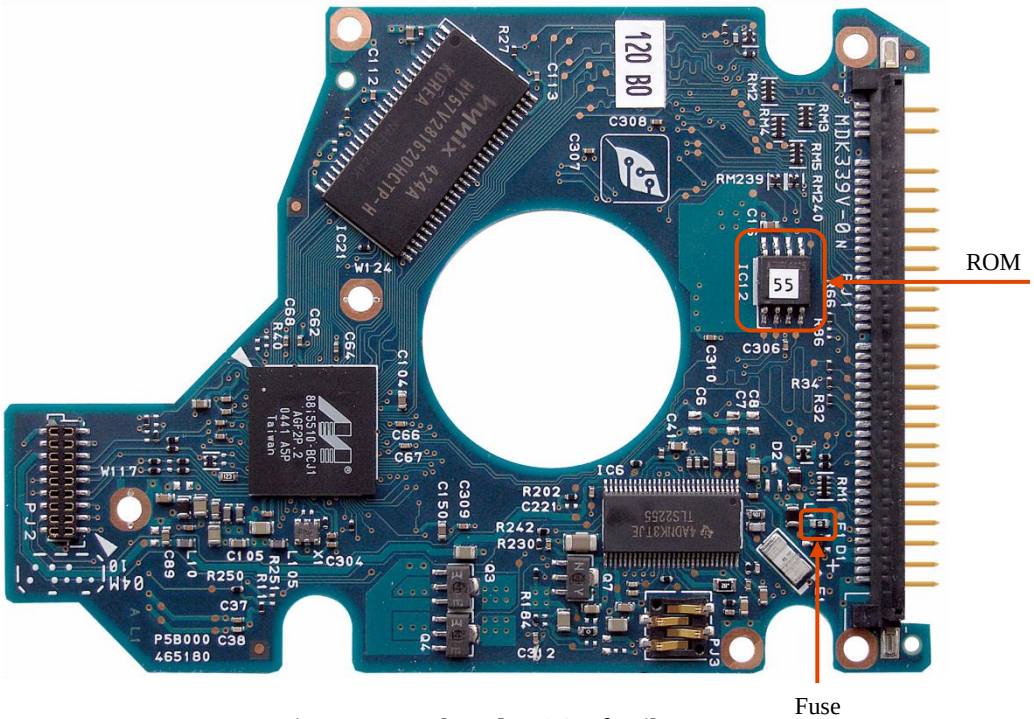


Fig. 7.4. HDD board 26GAX family.

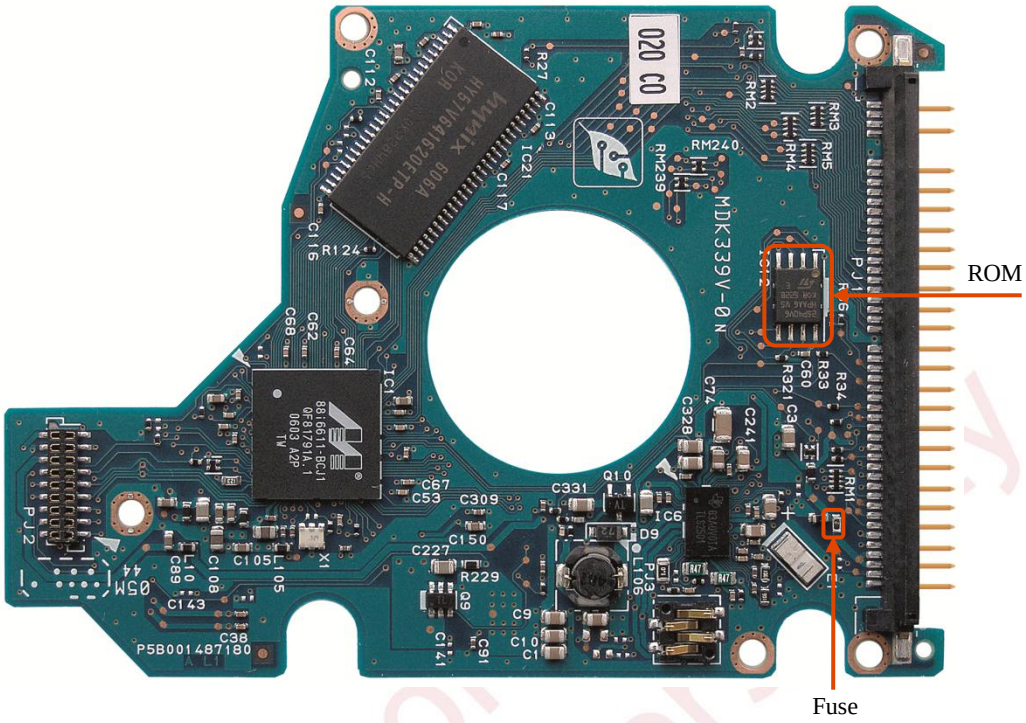


Fig. 7.5. HDD board 32GAX family.

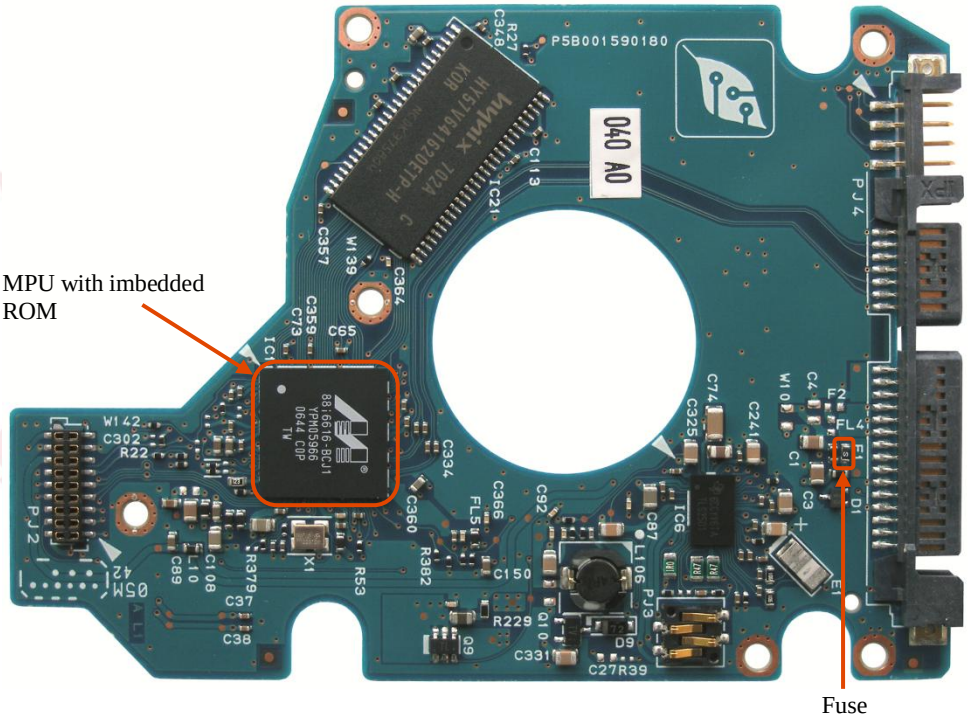


Fig. 7.6. HDD board 34GSX family.

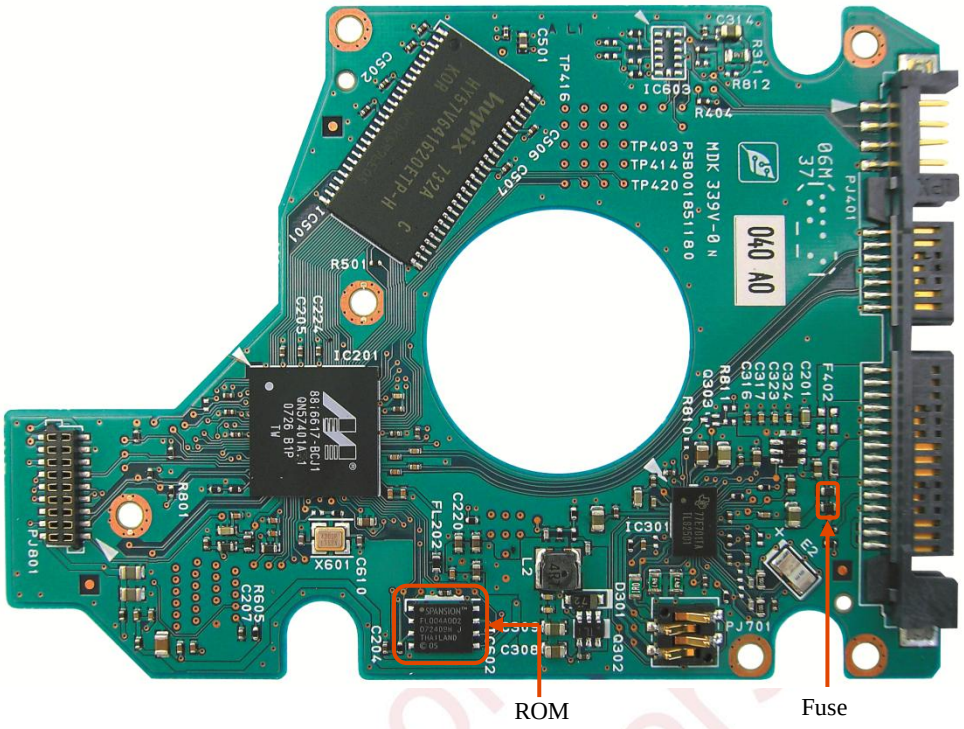


Fig. 7.7. HDD board 37GSX family.

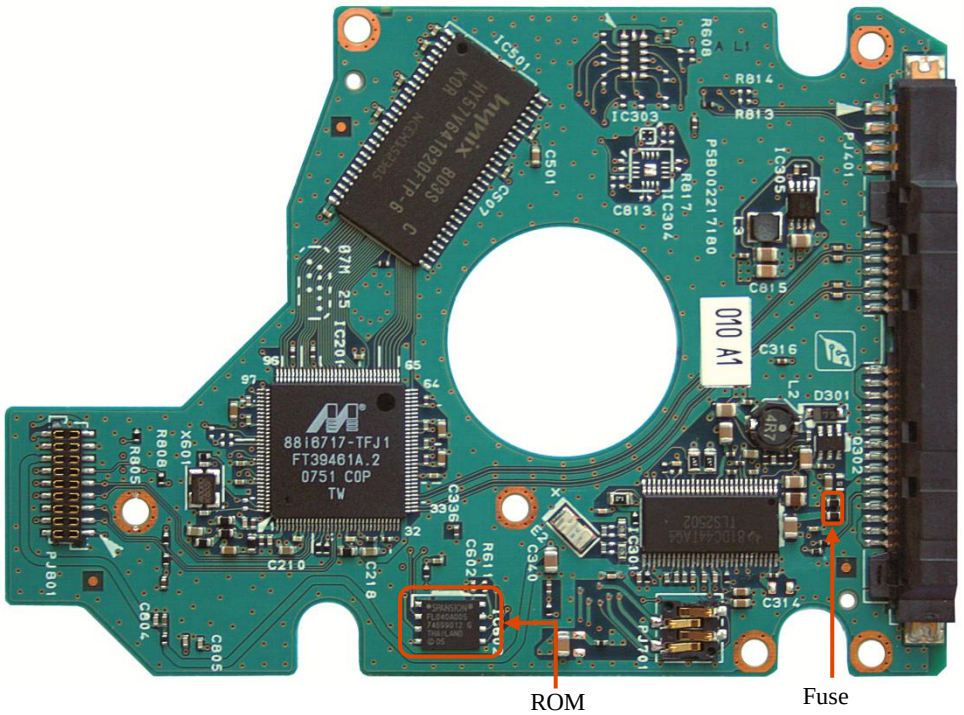


Fig. 7.8. HDD board 46GSX family.

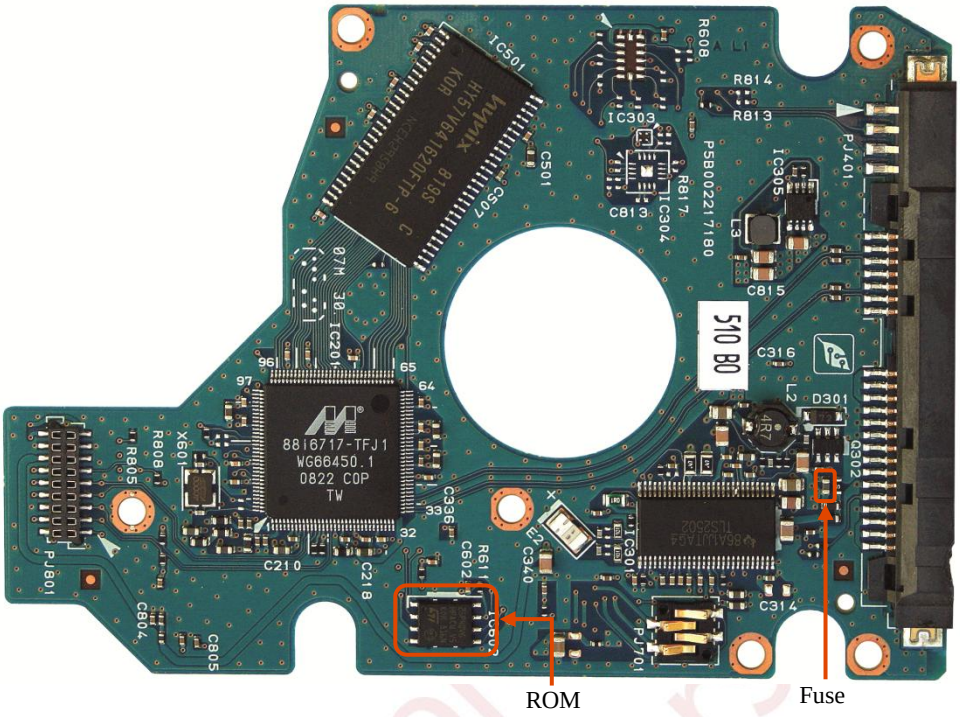


Fig. 7.9. HDD board 52GSX family.

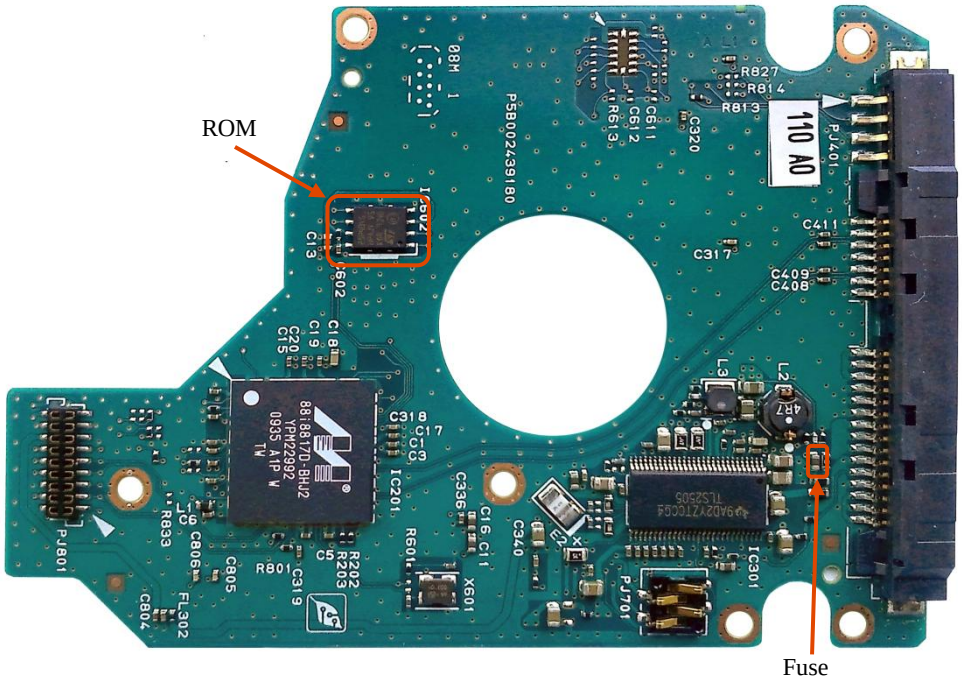


Fig. 7.10. HDD board 55GSX family.

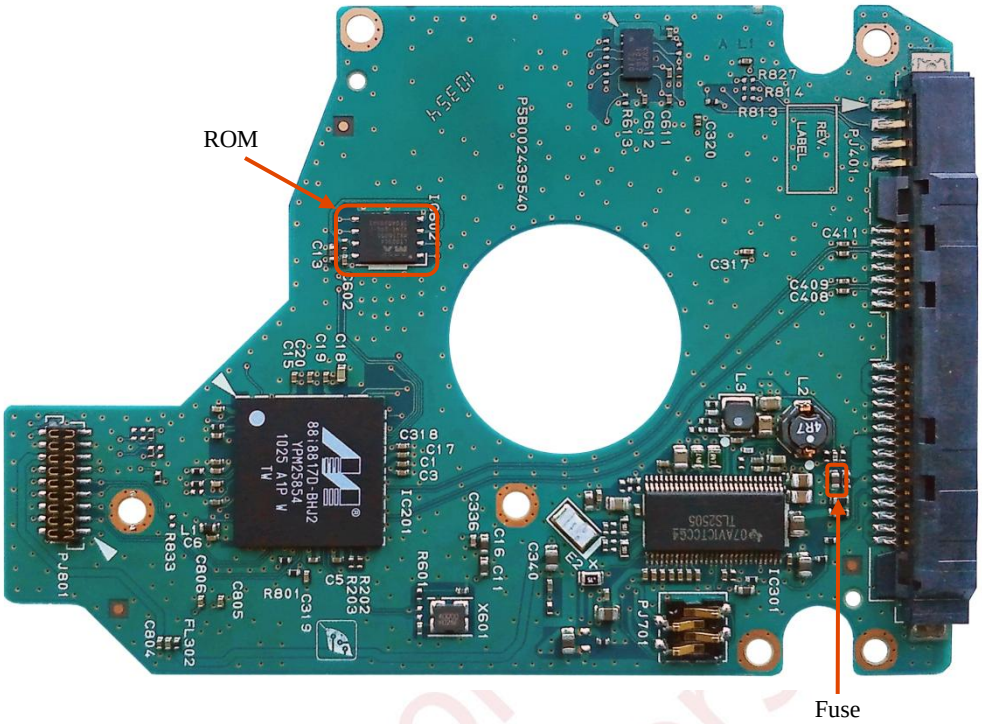


Fig. 7.11. HDD board 55GSXF family.

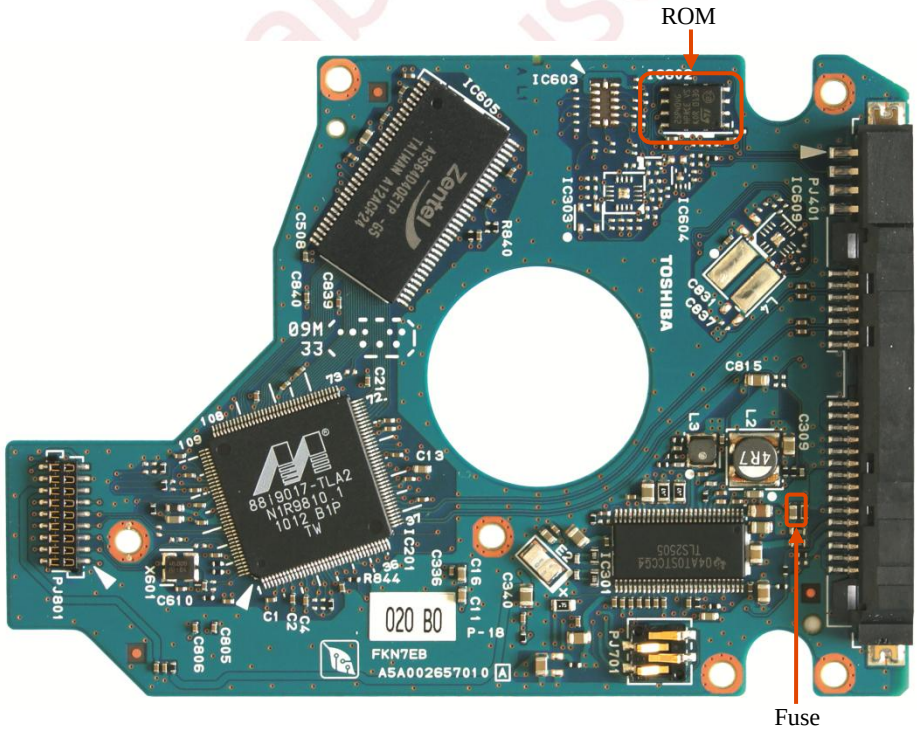


Fig. 7.12. HDD board 55GSXN family.

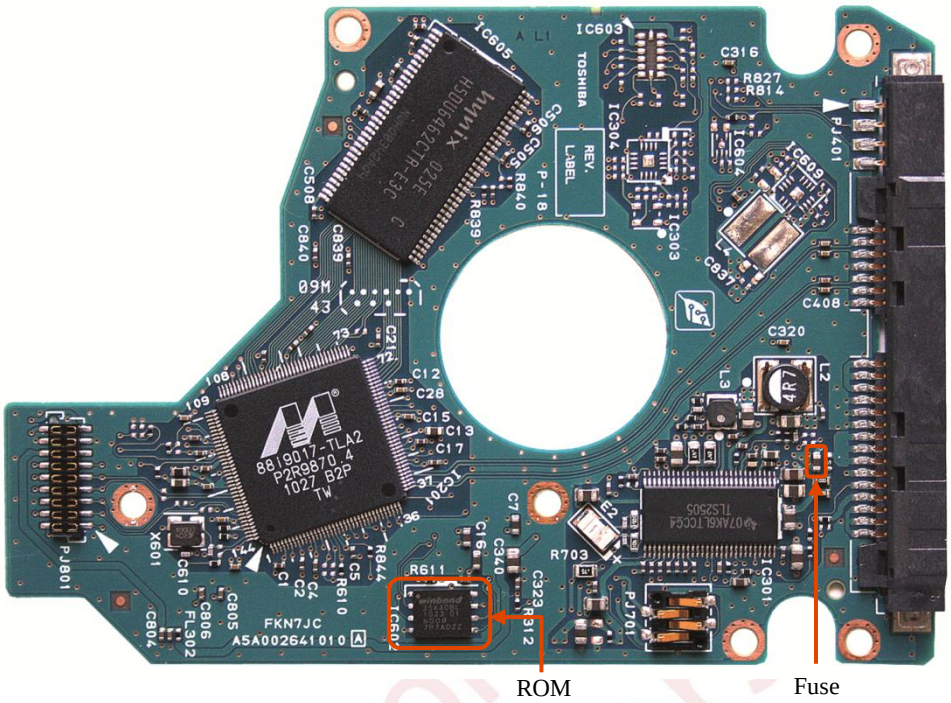


Fig. 7.13. HDD board 59GSX family.

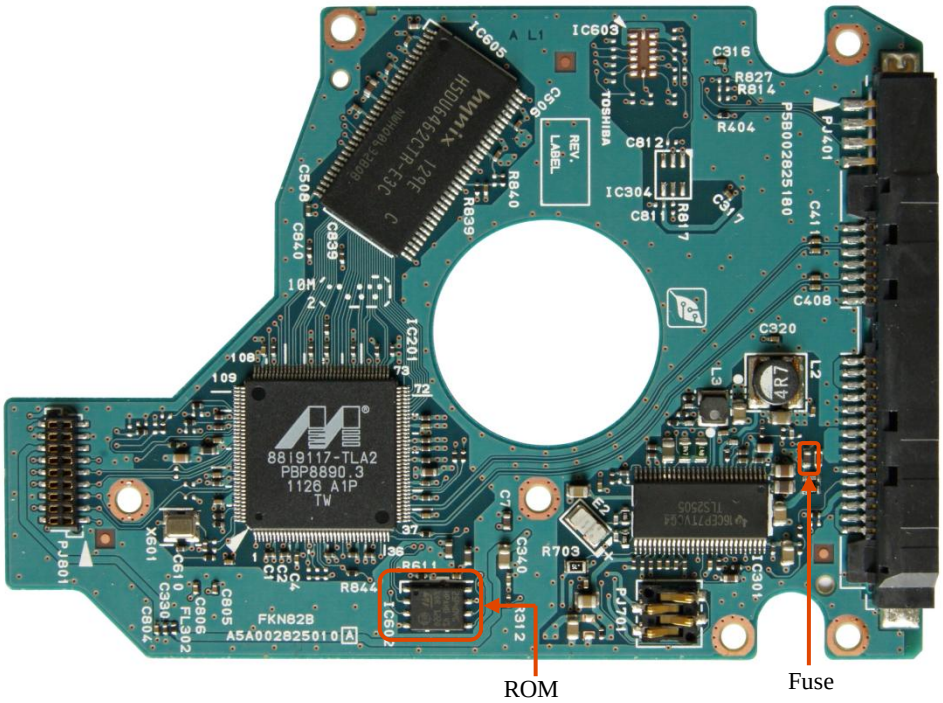


Fig. 7.14. HDD board 59GSXP family.

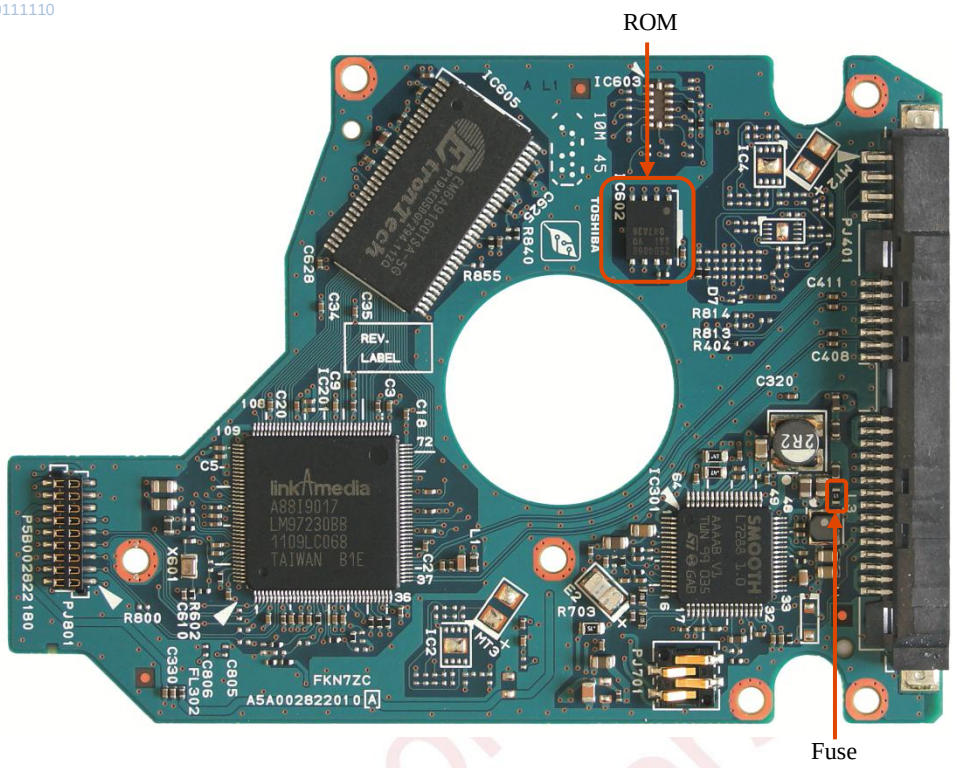


Fig. 7.15. HDD board 61GSY family.

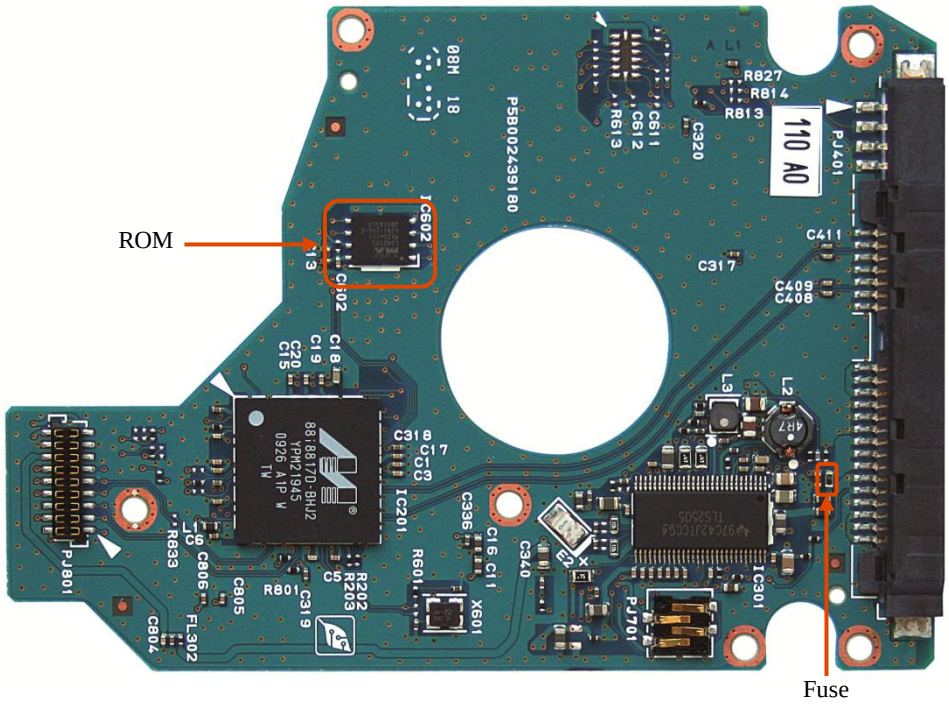


Fig. 7.16. HDD board 63GSX family.

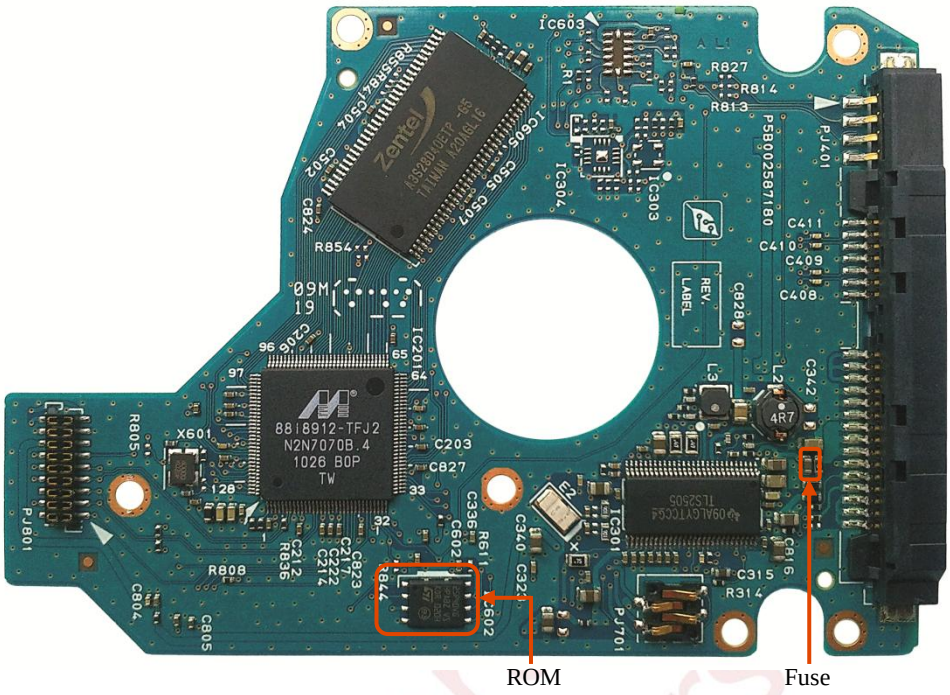


Fig. 7.17. HDD board 64GSY family.

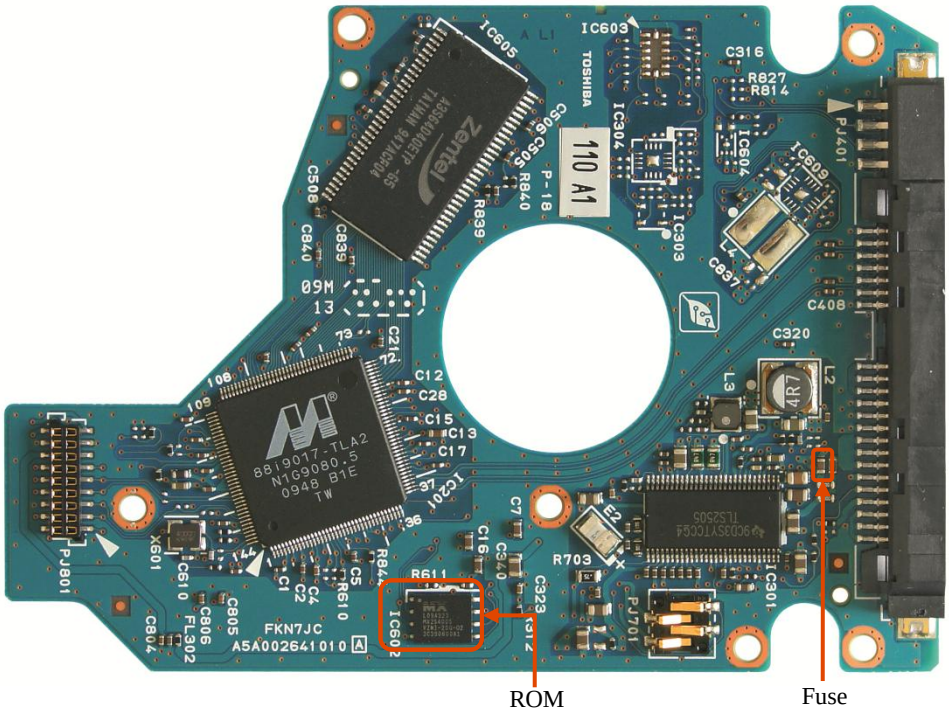


Fig. 7.18. HDD board 65GSX family.

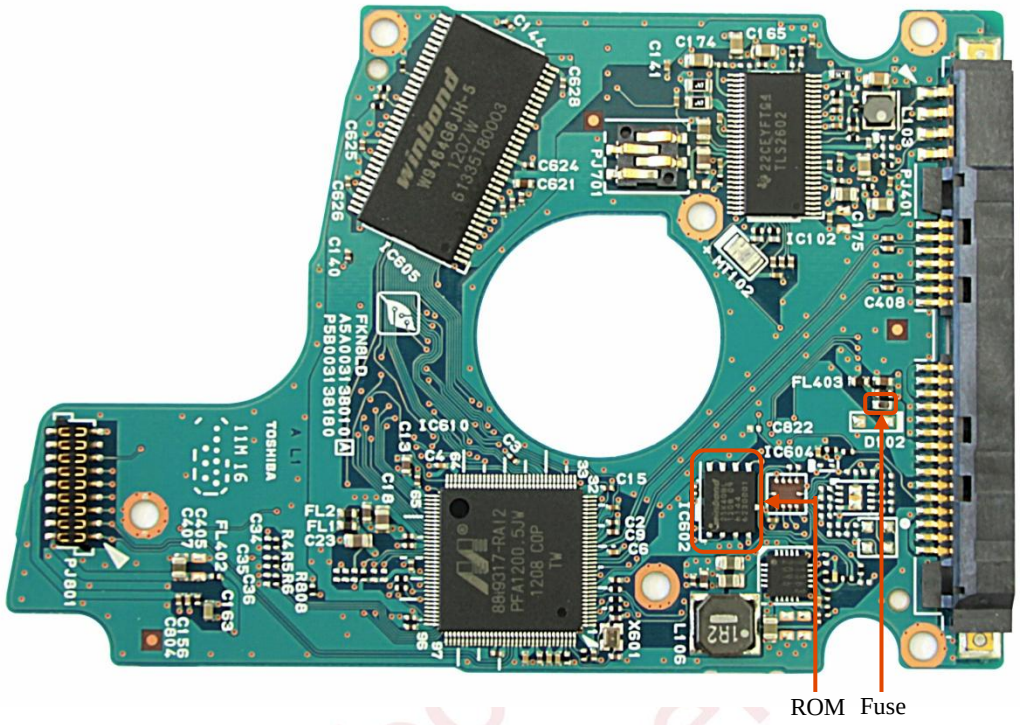


Fig. 7.19. HDD board MQ01ABD family.

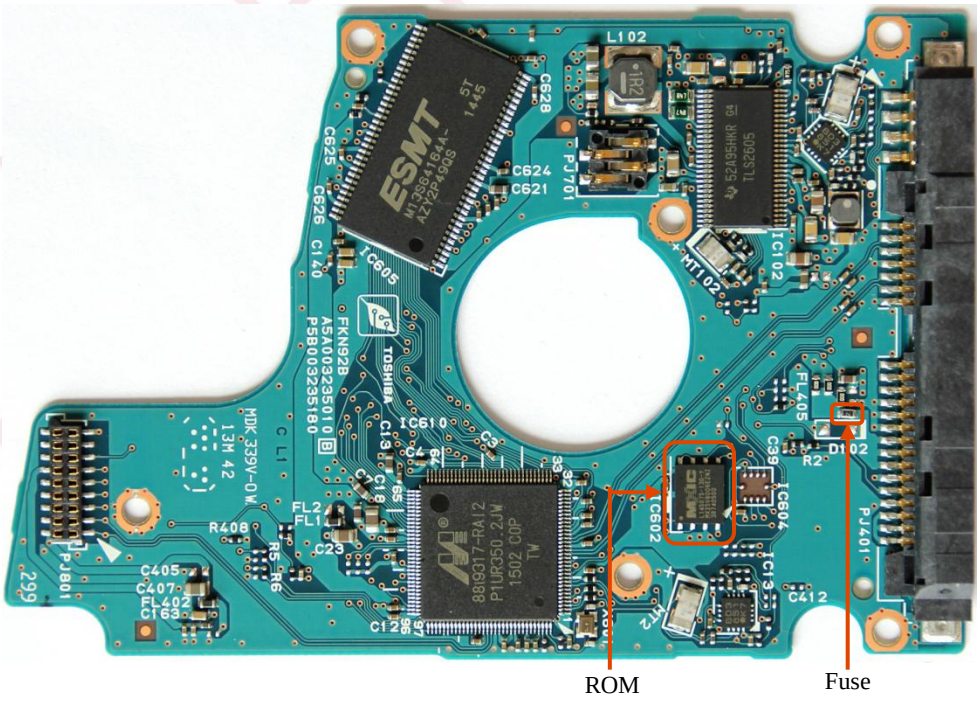


Fig. 7.20. HDD board MQ01ABF family.

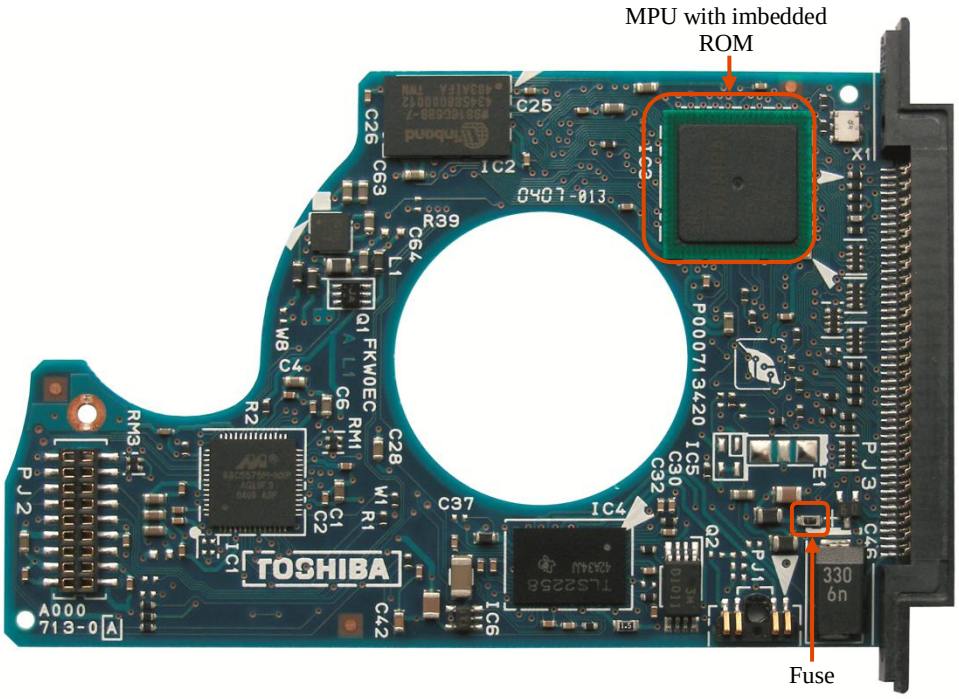


Fig. 7.21. HDD board 1.8" 04GAH family.

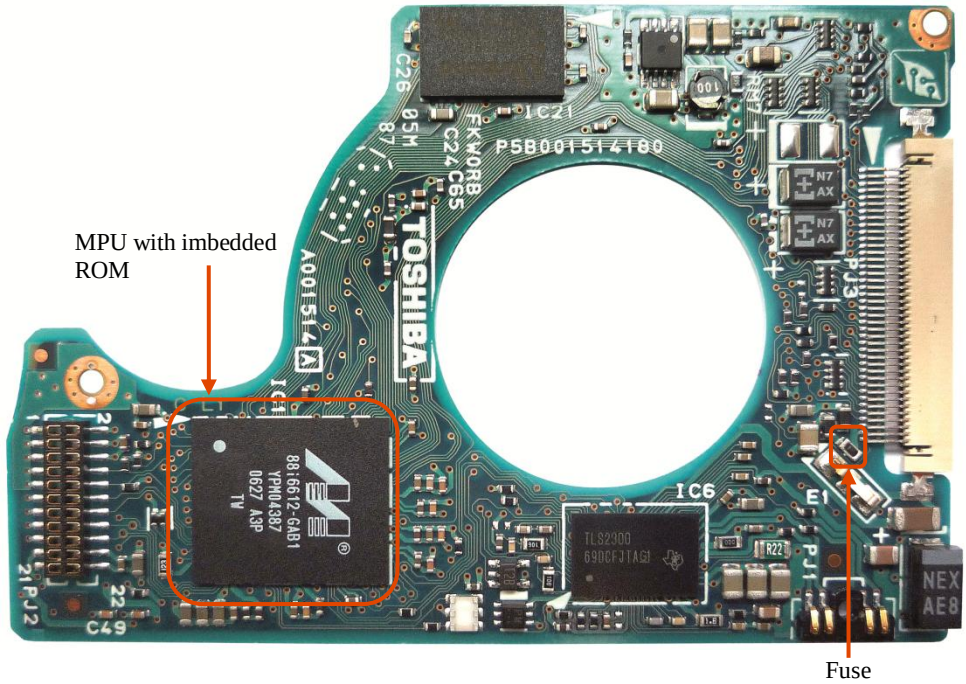


Fig. 7.22. HDD board 1.8" 08GAL family.

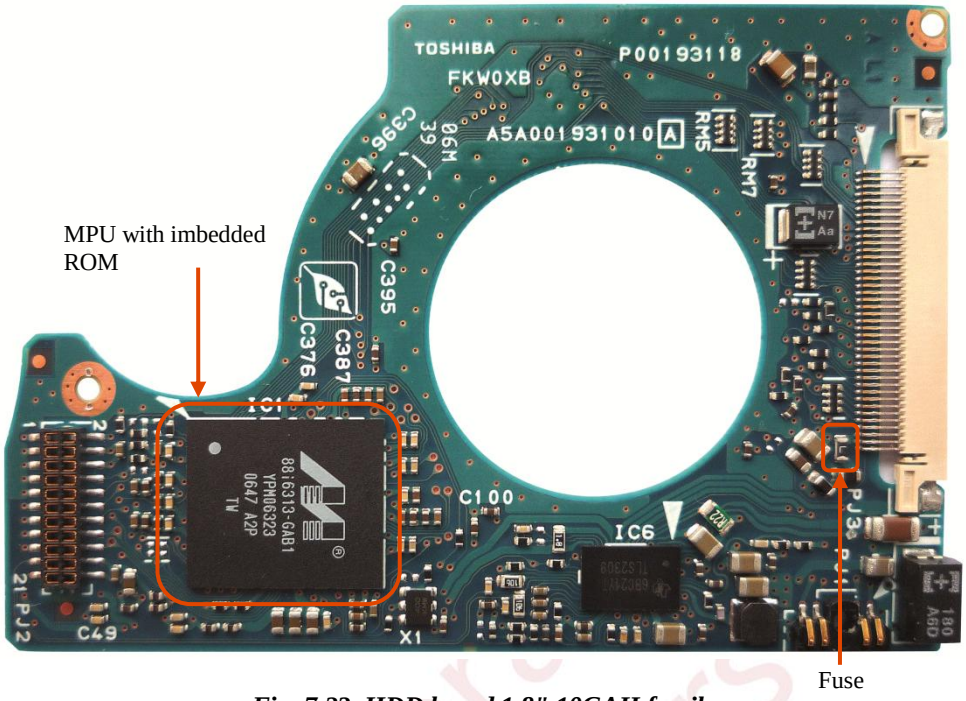


Fig. 7.23. HDD board 1.8" 10GAH family.

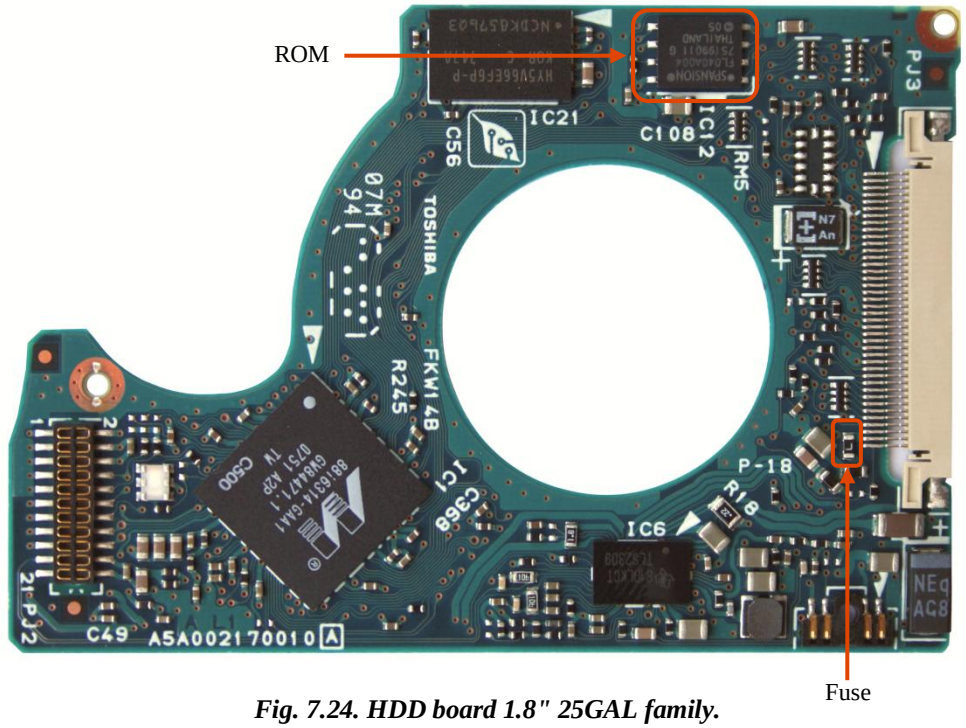


Fig. 7.24. HDD board 1.8" 25GAL family.

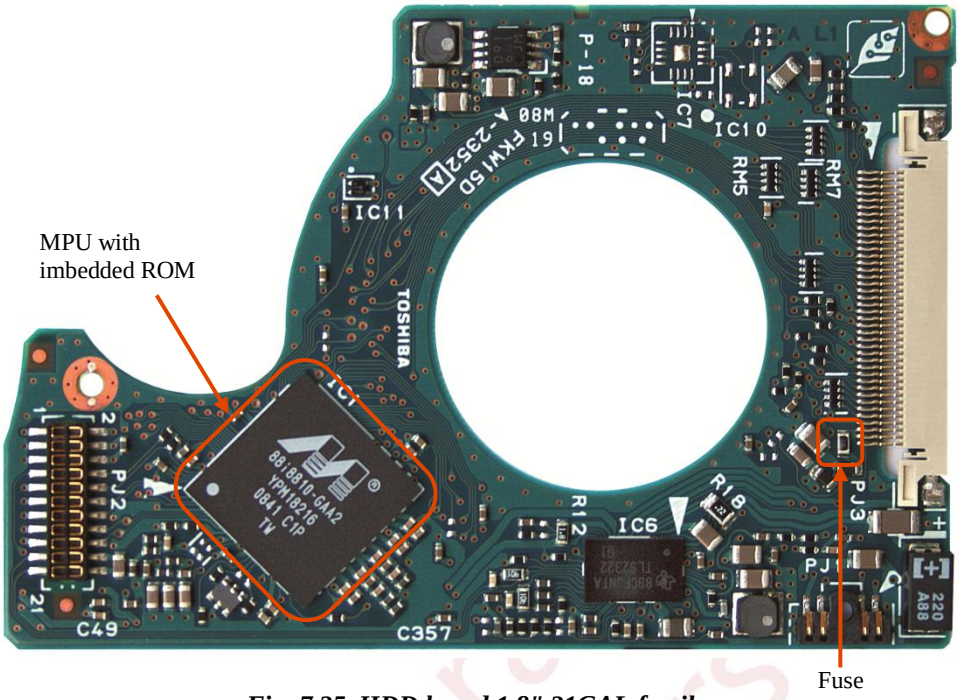


Fig. 7.25. HDD board 1.8" 31GAL family.

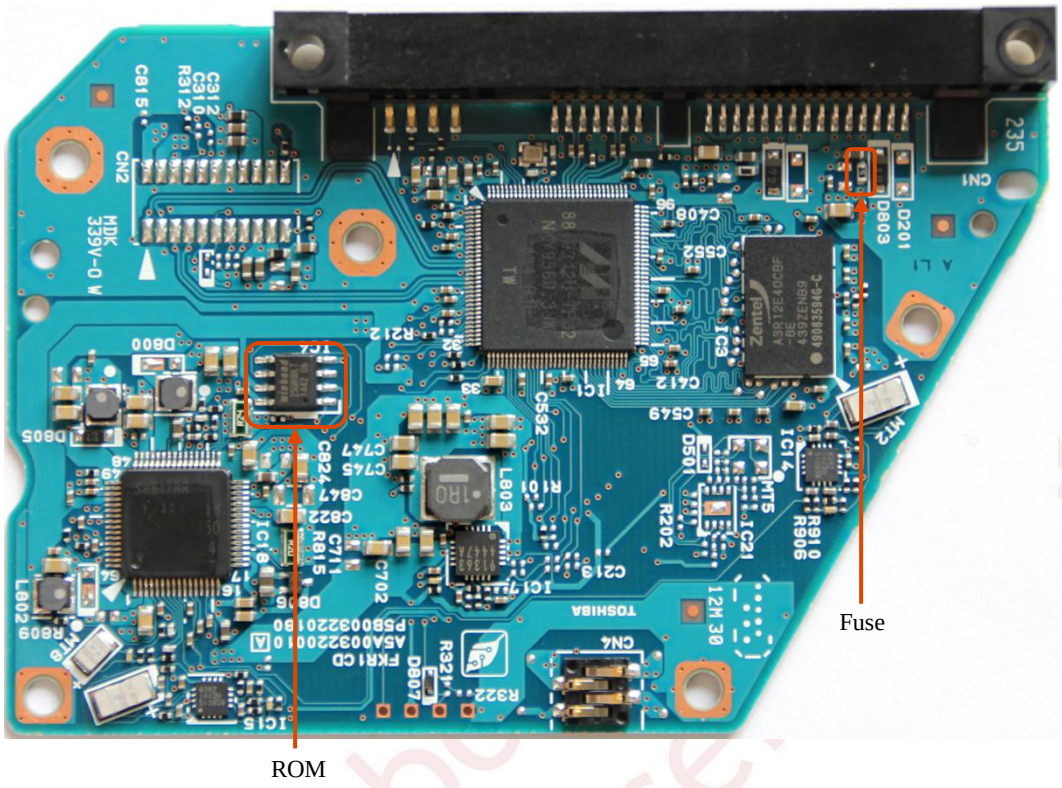


Fig. 7.26. HDD board 3.5" MG03ACA family.

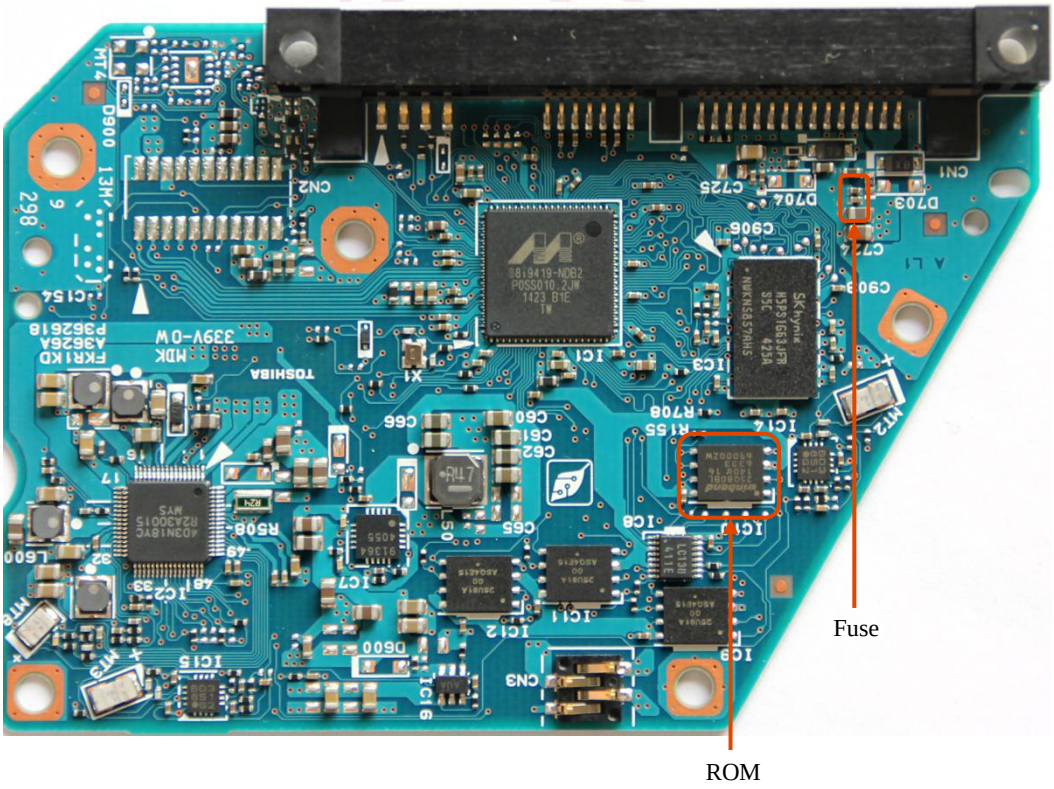


Fig. 7.27. HDD board 3.5" MG04ACA family.