No.	Catalog	Description	Rev. Date
HD:001	26-4150	Switch and jumper positions for interface board.	11/29/82
HD:002	26-4150	Wrong value pot, R3, on controller board.	11/29/82
HD:003	26-4150	Correct shipping procedure.	11/29/82
HD:004	26-4150	Prevent erratic operation - schmitt trigger.	11/29/82
HD:005	26-4150	How to install secondary drive.	03/06/84
HD:006	26-4150	Prevent stepper motor from getting lost.	11/29/82
HD:007	26-4150	Mislabeled connector causing drive not ready.	11/29/82
HD:008	26-4150	Write protected drive after service.	11/19/82
HD:009	26-4150	Random and intermittent hard drive problems.	02/04/83
HD:010	26-1130	RS-232 problems with hard drive connected.	04/25/84
HD:011	26-1130	Jumper differences between 12 and 5 MEG drives.	06/01/83
HD:012	26-4152	Insure proper level of interface signals.	01/02/86
HD:013	26-4150	8/12 MEG - How to decode XENIX hard disk errors.	09/09/83
HD:014	26-4150	Hard Drives - Arrangement of tracks and cylinders.	03/19/84
HD:015	26-4152	Reduce temperature drift of VCO.	11/30/83
HD:016	26-6006	15 MEG internal controller board alignment.	12/05/83
HD:017	26-4150	Shielded cables for random problems.	12/28/83
HD:018	26-4152	False triggering of CTC chip modification.	12/19/83
HD:019	26-6006	Modification to improve interface signal integrity.	01/26/84
HD:020	26-4152	Mandatory modification to correct VCO failures.	02/07/84
HD:021	26-4152	Acceptable WD1010 and WD1100 combinations.	07/09/85
HD:022	26-5104	Model 2000 Hard Drive alignment procedure.	03/22/84
HD:023	26-4152	Modification for write data pulse.	04/19/84
HD:024	26-1130	Power supply going into current limiting mode.	03/11/85
HD:025	26-1130	Motor speed alignment & wire connection points.	08/07/85
HD:026	26-1130	Specifications for brake assembly.	04/18/84
HD:027	26-6006	Correct drive select problem with external drives.	04/19/84
HD:028	26-4152	Reduce occurrence of "Active Drive Not Ready".	05/21/84
HD:029	26-4152	Identify hard disk bubble types.	04/30/85
HD:030	26-4155	Ready lamp connection on WD1010 controller boards.	06/27/84
HD:031	26-4155	Proper connection of INDEX J5 on 10 and 15 MEGS.	07/16/84
HD:032	26-4155	Conversion of oxide media PCB to plated media PCB.	08/03/84
HD:033	26-4155	XFERRQ* signal going to wrong pin on bus.	08/22/84
HD:034	26-4155	Eliminate WAIT* from WD1010 being pulled down.	09/07/84
HD:035	26-4155	Ext. WD1010 PCB not allowing secondary to power up.	10/15/84
HD:036	26-4155	PAL change for WD1010 controller board.	11/14/84
HD:037	26-4171	Grounding differences with Tandy & Astec supplies.	03/01/85
HD:038	26-4171	Connecting wire harness to 35 MEG drive logic PCB.	06/22/85
HD:039	26-4152	Effects on HD Controller with cables upside down.	08/21/85
HD:040	26-1138	Describe the external hard drive ctlr for Model 4.	03/21/86
HD:041	26-4173	70 MEG hard drive.	07/15/86

DATE: November 5, 1981

REVISION DATE: November 29,1982

BULLETIN NO.:   HD:1

PRODUCT: 26-4150

SUBASSEMBLY: 8 Meg. Hard Disk Interface Board.

PURPOSE: To show and explain the proper switch settings and jumpers for the interface board.

DISCUSSION: Each half of S1 and S2 represent one hard drive in the system. Switches 5 through 8 on S1 are used to tell the operating system that drive 4 is a 8 Meg hard drive. 1 through 4 show that drive 5 is also an 8 Meg hard drive and so on for S2 for drives 6 and 7. If the switch is set improperly the system may ignore that hard drive. S3 is used to map the port addresses of the board at CxH (between C0H and CFH).

Jumpers A-B and W-V are 5 volt pull ups for the memory section of the interface board. If these are missing the memory on the board may operate erratically. These jumpers have the same function as the 1-2 and 5-6 jumpers do on the 64K Z80 ram board.

The AP jumper maps the memory onto page 15 of the memory map, however due to a data line that was left unused (D0), the 16K of ram also shows up on page 14 of the memory map. This can be shown be using MEMII to display the ram map of a hard disk system. This also explains why a computer that has 80K (64K plus 16K) seems to have 96K according to MEMII. This does not cause any problems with operation.

PROCEDURE: The correct switch setting for the 8 meg hard drive interface board are as follows.

```
          S1 - 1, 3, 5, & 7  ON   : 2, 4, 6, & 8        OFF
          S2 - 1, 3, 5, & 7  ON   : 2, 4, 6, & 8        OFF
          S3 - 3 & 4 ON           : 1, 2, 5, 6, 7, & 8 OFF
```

TANDY COMPUTER PRODUCTS

When using the DID register test in HDIFAC, the values returned for both S1 and S2 should be 55 Hex.

There should be jumpers installed on the A-B terminals and the W-V terminals.

Finally, a jumper should be installed in the AK to AP position on the memory bank select (see below).

```
AC o o o o AF
AG o o o o AK
AL o o o o AP
```

TANDY COMPUTER PRODUCTS

DATE: November 5, 1981

REVISION DATE: November 29, 1982

BULLETIN NO.:   HD:2

PRODUCT: 26-4150

SUBASSEMBLY: 8 Meg. hard disk controller board.

PURPOSE: To correct a wrong value potentiometer used on some early production boards.

DISCUSSION: Some early boards were shipped with the 200 ohm pot installed. This makes adjustment of the 115ns VCO frequency difficult or impossible. Replacing R3 with the 2K ohm pot should correct the problem. All current production uses the 2K ohm pot.

PROCEDURE: Check the value of R3 on the controller board. If it is found to be 200 ohms, replace it with a 2K ohm potentiometer.

DATE: December 18, 1981

REVISION DATE: November 29, 1982

BULLETIN NO.:   HD:3

PRODUCT: 26-4150/1

SUBASSEMBLY: Hard drive bubble

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PURPOSE: To show correct shipping procedure for 8 Meg hard drives.

───

DISCUSSION: While the head should not be able to damage the disk during shipping when it is locked down, there is still a slight possibility that it might. To keep the damage to a minimum the head should be as far away from track 0 as possible since that is the only track that MUST be flawless for the system to work properly. The directory can be moved to other tracks, but the boot track cannot.

PROCEDURE: The head of the hard disk drive should be positioned over the innermost track before shipping. This can be done using the HDDIAG or HDVER programs by seeking track 1024 and then shutting off the drive. Once this has been do not forget to install the spindle lock before shipping.

───

DATE: February 2, 1982

REVISION DATE: November 29, 1982

BULLETIN NO.:   HD:4

PRODUCT: 26-4150

SUBASSEMBLY: Hard disk controller board

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PURPOSE: To prevent erratic operation of early production hard drives by installation of a schmitt trigger/buffer in the clock circuit.

───

DISCUSSION: When interfacing an analog output (the output of the oscillator) and a digital input (U12), problems related to reliable triggering may occur. Gates with schmitt trigger inputs were designed to help eliminate this type of problems by helping to convert an analog signal to a digital signal. By wiring U35 into the circuit to interface the two sections more reliable operation of the board should result. All new units should already have this modification done at the factory.

PROCEDURE:

1. Verify that there are no jumper wires connected to U35 on either side of the logic board. If there are none continue to step 2 else the modification has already been done and is not required.

2. Find the trace from U12 pin 3 to TP3 (the end of R31 closest to the center of the board). Notice that it feeds thru the board to the back side near TP5 and makes a short run (about 1/4 inch) to connect to U12 pin 3. Cut the short trace between the feedthru and U12 pin 3.

3. Run a jumper wire from U12 pin 3 to U35 pin 8. This is the output of the schmitt trigger.

4. Run a jumper wire from U35 pin 9 (the input of the schmitt trigger) to the feedthru where the cut was made.

5. Reassemble, realign, and test the hard drive unit.

DATE: February 16, 1982

REVISION DATE: March Ø6, 1984

BULLETIN NO.:   HD:5

PRODUCT: 26-415Ø/1

SUBASSEMBLY: Hard disk drive logic board/Hard disk controller board

_____

PURPOSE: To explain how to install a secondary hard drive and what
modifications may be applied.

_____

DISCUSSION: Pin 6 of J5 (and pin 6 of 8C) is connected to the write
gate line. This line when low causes the selected hard drive to write on
the disk. In order to keep this from happening the power to this line must
be turned on first. Since the primary drive is turned on first, it will be
the drive to have the resistor (by installing the 15Ø ohm resistor on pin
6 of J5) and it will have to be removed from the slave (by pulling pin 6
of 8C).

PROCEDURE: To install a secondary hard drive unit, open up the primary
unit and remove the resistor pack in position 8C on the drive logic board.
Note that it should have pin 6 lifted out of the socket. If it does not,
the modification list later in this bulletin should be done. When the
resistor pack is removed the label on the back of the drive stating that
the drive is terminated should also be removed.

The 5Ø pin cable is a daisy chain, that is it goes from one drive to next.
The resistor pack should be installed in the last drive in the chain (the
one furthest from drive 4) and it should also have pin 6 lifted out of the
socket.

Once this has been done, make sure the drive select jumpers have been set
properly.

DRIVE	JUMPER
4	DS1
5	DS2
6	DS3
7	DS4

MODIFICATION: The controler board should have a 15Ø ohm resistor
installed from pin 6 of J5 to the end of R5Ø nearest TP22. Once this has
been done pin 6 of the resistor pack can be removed from the socket.

DATE: March 30, 1982

REVISION DATE: November 29, 1982

BULLETIN NO.:   HD:6

PRODUCT: 26-4150/1

SUBASSEMBLY: Hard disk drive logic board

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PURPOSE: To prevent the stepper motor from becoming intermittently lost.
Errors caused by this will not be reported by TRSDOS. It will only cause
intermittent slow restores of the drive affected.

_____

DISCUSSION: Noise on the 5 volt power supply can cause either the
stepper control board or ROM to intermittently lose which track the head
is on. When this happens the read is aborted because the head is on the
wrong track and a retry occurs. Usually the read is successful after one
retry, however this does slow down operation of the system because the
restore is done at a much slower rate.

PROCEDURE: This applies to all drive logic boards that do not already
have this modification. A 100 uf capacitor rated at 10vdc or more should
be installed across the +5 volt power supply near location 3C.

The + lead of the cap to the trace coming from pin 18 of location 3C.
Then connect the - lead of the cap to the nearby trace connecting C56,
C74, & R46 (these are in the group of components in front of location 3C
and the trace is between them and J3).

DATE: May 6, 1982

REVISION DATE: November 29, 1982

BULLETIN NO.:   HD:7

PRODUCT: 26-4150/1

SUBASSEMBLY: Hard disk drive logic board

PURPOSE: Due to a mislabeled connector, the index connector could be attached incorrectly and produce drive not ready errors.

DISCUSSION: The connector on some index assemblies (P6) is labeled incorrectly so that pin 1 on the connector does not correspond to pin 1 on the PCB. To avoid this problem make sure that pin 1 on the drive PCB (the one closest to J1) has a wire connected to it by P6. Pin 3 has no wires connected to it. See the drawing below.
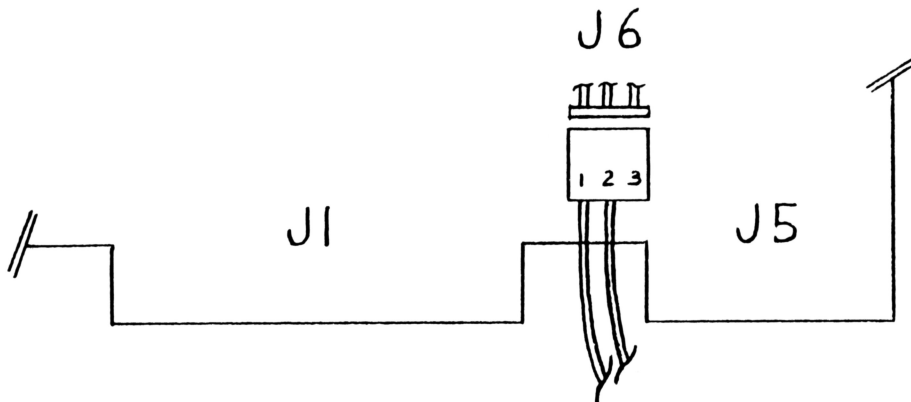
DATE: MAY 6, 1982

REVISION DATE: NOVEMBER 19, 1982

BULLETIN NO.:   HD:08

PRODUCT: 8 MEG. HARD DISK   26-4150

SUBASSEMBLY: CABLE ASSEMBLIES

PURPOSE: To correct problem of drive being write protected after the drive
         has been serviced.

PROCEDURE/DISCUSSION

Problem: Hard disk drive comes up disk drive not ready or drive write
          protected after servicing.

Solution: There have been three causes for the disk being write protected:

   1. A short piece of wire wrap wire coming from pin 5 of J2
   on the drive logic board breaks. This wire is about 1/2 inch
   long and goes to a feed through on the PCB to a blue wire going
   to the lamp driver board. Either through shipping or during
   manufacturing this wire breaks and the controller thinks
   the drive is write protected even though the button is not
   pushed and the lamp is not on.

   2. The 20 pin data cable connected between the master and
   the slave has been reversed. The quickest way to find out
   if this is the problem is to slide the 20 pin connector off
   the slave drive logic board and put it on upside down. If
   this corrects the problem then the cable has been reversed.

   3. The 20 pin data cable connected between the drive logic
   PCB and the controller PCB is not properly connected. To
   correct this problem connect the 20 pin data cable to J1 of
   the disk controller PCB.

DATE: February 4, 1983

REVISION DATE: February 4, 1983

BULLETIN NO.:   HD:9

PRODUCT: 26-113Ø/1 and 26-4152/3   5 and 12 Meg Hard Drives

SUBASSEMBLY: Bubble units AXX-5Ø38 (5 MEG), AXX-5Ø39 (12 MEG)

_____

PURPOSE: To correct random and intermittent hard drive problems.

_____

DISCUSSION: Random failures in some Hard Drives (5 meg and 12 meg)
have been traced to loose or intermittent edge-card connectors on the
bubble unit. These connectors are designated J1 and J2. New production
hard drive units will have these connectors 'tie-wrapped' to the PC board
to insure that they do not vibrate off.

It is suggested that when tracing intermittent failures, these connectors
be checked first, as they have a history of causing this type of problem.

Tie wrap the connectors J1 and J2 on units not already tied to insure
future reliability.

DATE: April 27, 1983

REVISION DATE: April 25, 1984

BULLETIN NO.:   HD:10

PRODUCT: All 5" Primary hard drives (26-1130,26-4152,&26-4155)

SUBASSEMBLY: Controller PCB with 8X300 controller chip (AX-9282)

PURPOSE: To correct improper installation of resistor packs on controller PCB.

DISCUSSION: During manufacture, resistor packs R43, R44, and R45 may have been installed backwards. With the resistor packs installed backwards the open collector inputs and outputs are not tied to a pullup voltage.

PROCEDURE: Remove the cover of the primary hard drive and remove the controller board. Locate resistor packs R43, R44, and R45 adjacent to connector J7. If the packs are backwards (refer to fig. 1), remove them and replace them with part# ARX-0331 noting correct orientation (see fig. 1).

    After remounting the controller board, verify proper operation of the hard drive and reinstall the cover.

CONTROLLER PCB
FIG. 1
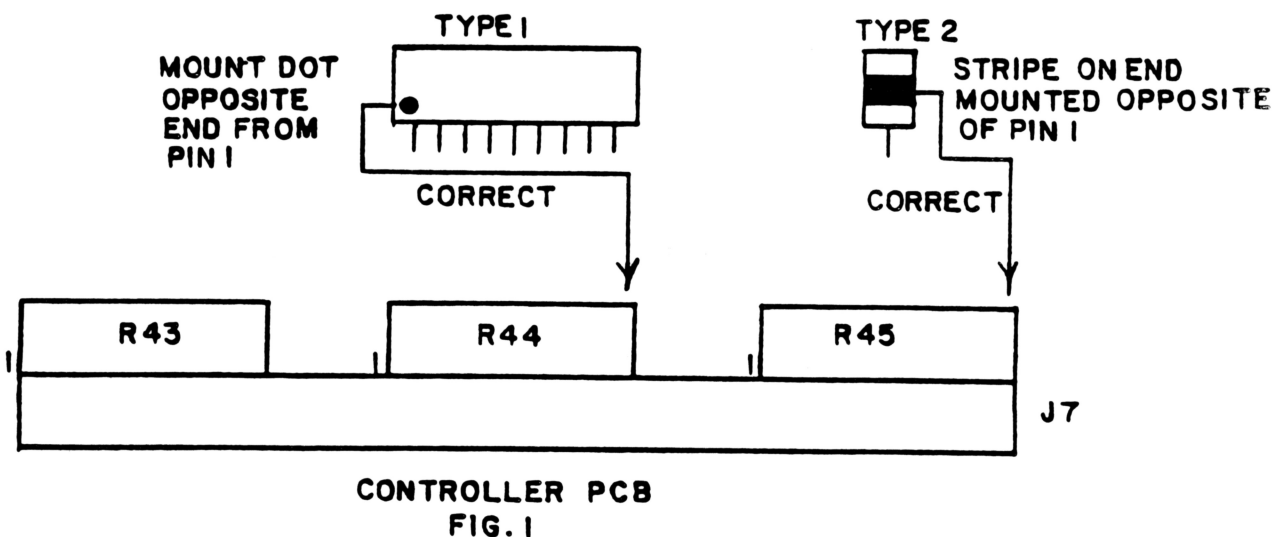
DATE: June 1, 1983

REVISION DATE: June 1, 1983

BULLETIN NO.:   HD:11

PRODUCT: 5" hard drive (26-1130/1 & 26-4152/3)

SUBASSEMBLY: Drive logic board

PURPOSE: To explain the differences between a drive logic board for a
           5 meg hard drive and a 12 meg hard drive.

DISCUSSION: There are two jumpers that make the difference between a
drive logic board for a 5 meg hard drive and a logic board for a twelve
meg hard drive. They are the W5 jumper (tracks) and the W13 jumper
(heads).

The 5 meg hard drive has only 153 cylinders while the 12 meg hard drive
has 230. If W5 is installed the hard drive can only access 153 cylinders.
If it is removed the drive can access more than 153 cylinders. It should
be installed in a 5 meg hard drive and removed in a 12 meg hard drive.

The 12 meg hard drive has 6 heads while the 5 meg hard drive has less than
5 heads. If W13 is installed the hard drive can access 5 or more heads.
If it is removed the drive can only access 4 or less heads. It should be
installed in a 12 meg hard drive and removed in a 5 meg hard drive.

	W13	W5
12 meg	installed	open
5 meg	open	installed

DATE: July 20, 1983

REVISION DATE: January 2, 1986

BULLETIN NO.:   HD:12

PRODUCT: 26-4152 12 Meg Hard Drive
                    26-4155 15 Meg Hard Drive
                    26-4171 35 Meg Hard Drive
                    26-4173 70 Meg Hard Drive

SUBASSEMBLY: AX-9282 Controller PCB
                    AX-9367 Interface PCB
                    AX-9454 Western Digital Controller PCB

PURPOSE: To insure proper termination and level of hard drive interface
signals.

DISCUSSION: All Hard Disk Interface boards to be used with an **EXTERNAL** hard
disk and installed in an eight inch business system (Model's II, 12, 16, 16B,
and Tandy 6000) must be modified according to this bulletin regardless of the
computer type.

If the system consists of a Hard Disk with an 8X300 controller board
(AX-9282) do part "A" to the controller board and part "B" to the Interface
Board (AX-9367).

If the Hard Disk is used on a Model III/4/4P system and contains an 8X300
controller board (AX-9282) do part "A" to the controller board. This is
especially important if the Hard Drive is to be used in a Network 4 system.

Should the system consist of a Hard Disk with a Western Digital WD1010
external controller board only part "B" should be applied to the interface
board as part "A" is incorporated in the silkscreen of this controller board.

**   **   Compliance With This Bulletin Is Mandatory   **

<u>PROCEDURE:</u>

PART A) Modify the Hard Drive Controller PCB inside the Hard Drive.
You will need An X-acto™ knife, some wire wrap wire, wire cutters, and
soldering equipment.

Make the following cut on the <u>FOIL</u> side of the PCB.

    Cut the trace going from J7 pin 41 to U73 pin 5.

Make the following cut on the <u>COMPONENT</u> side of the PCB.

    Cut the trace going from J7 pin 43 to U73 pin 7.

Make the following jumpers on the <u>COMPONENT</u> side of the PCB.

    1) Jumper U38 pin 11 to U72 pin 1

    2) Jumper U72 pin 2 to J7 pin 41

    3) Jumper U58 pin 10 to U72 pin 3

    4) Jumper U72 pin 4 to J7 pin 43

While this modification would not normally cause alignment problems, the
alignment should be checked and 'tweaked' as a part of the normal repair
procedures.

PART B) Modify the Hard Drive Interface Card if available. You will
need two 470 ohm 1/4 watt 5% resistor (N-0169EEE 26-9999R), wire cutters,
and soldering tools.

Install the resistor on the <u>FOIL</u> side of the Interface card.

    1) Cut the resistor leads to 3/8-inch in length.

    2) Solder one end of the resistor to U12 pin 11. Solder the free
       end of the resistor to +5 volts (see diagram).

    3) Remove R11 and replace it with a 470 ohm resistor.

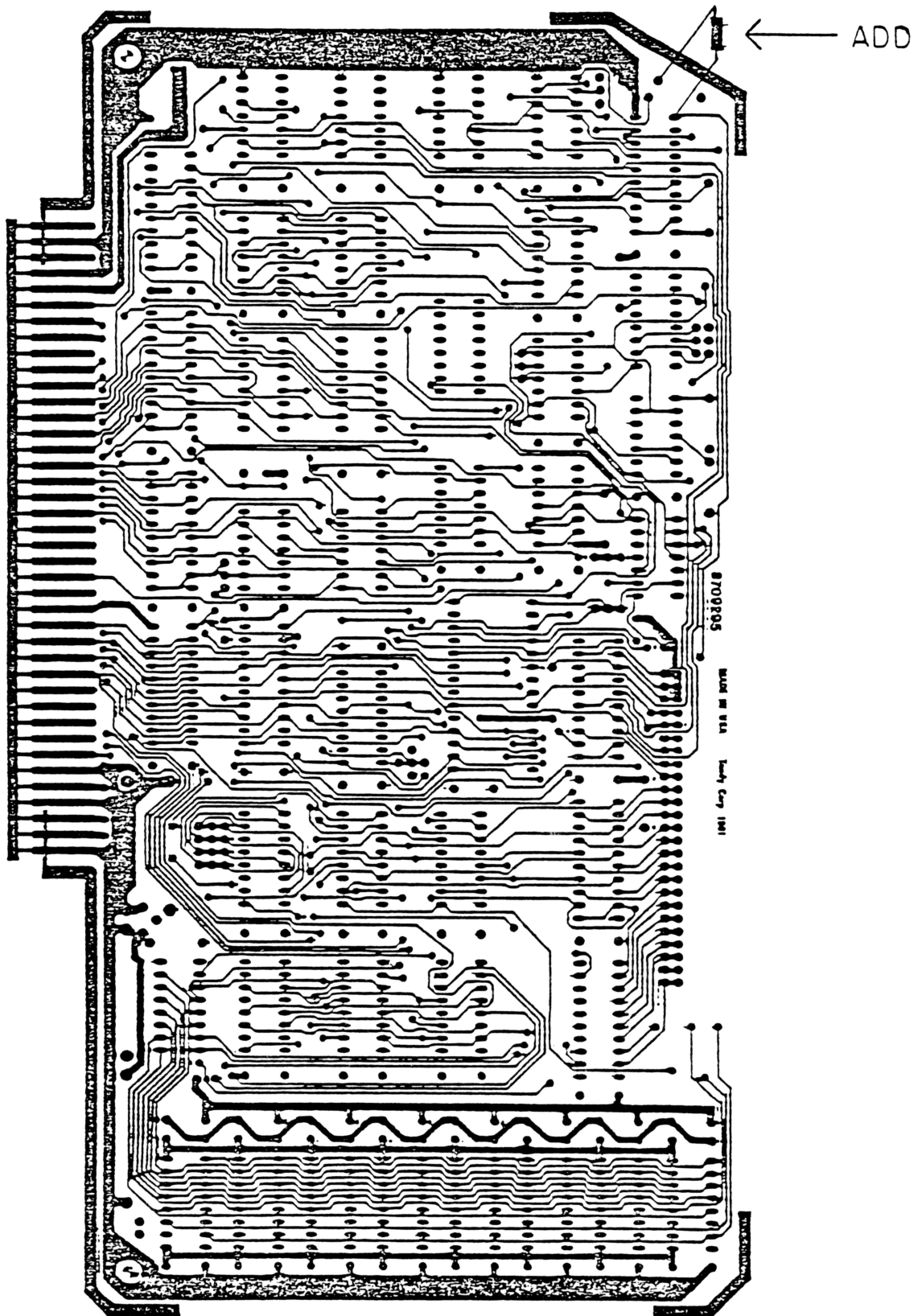The Hard Drive Interface Card requires no alignment after this
modification.

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← ADD
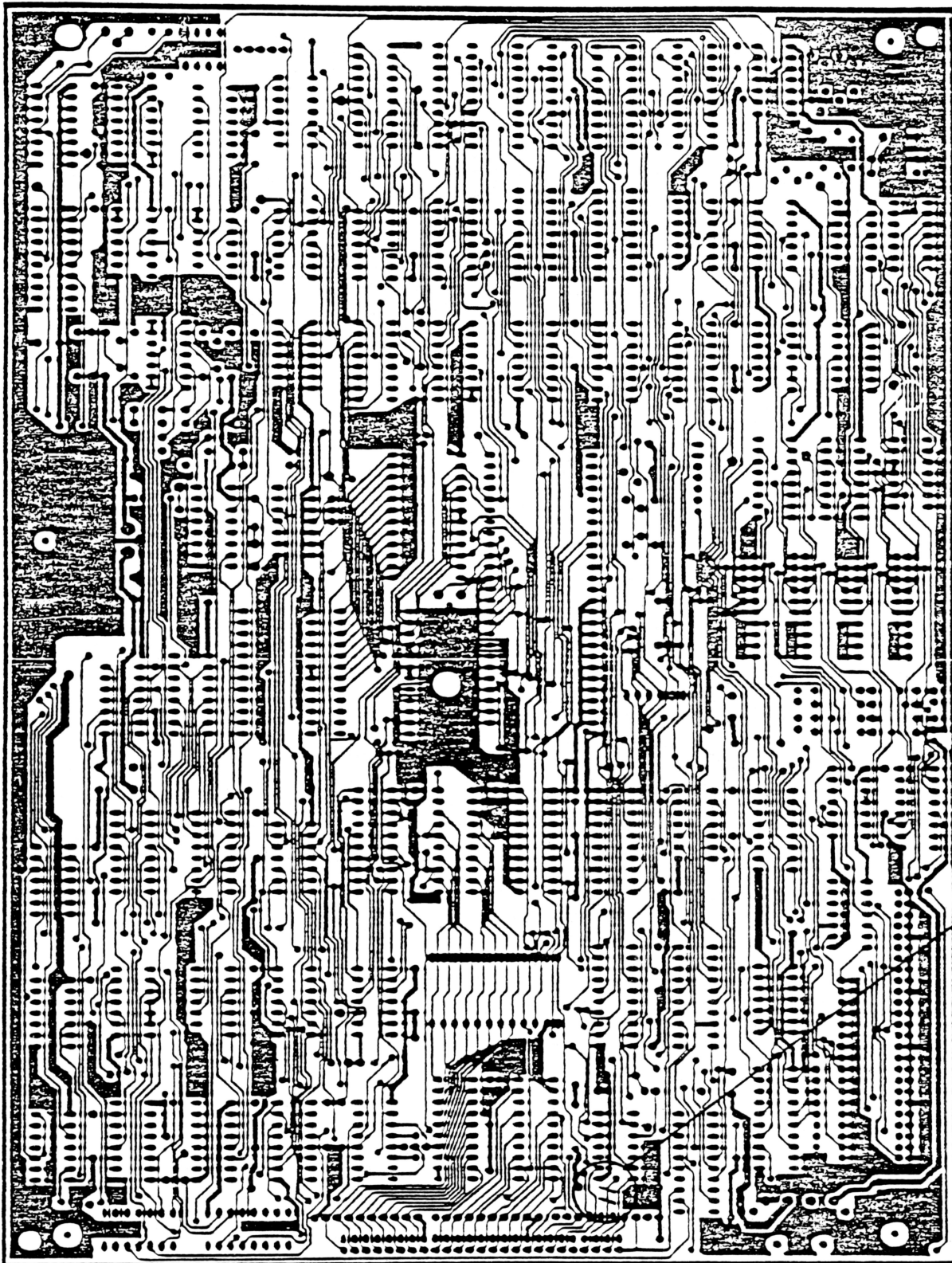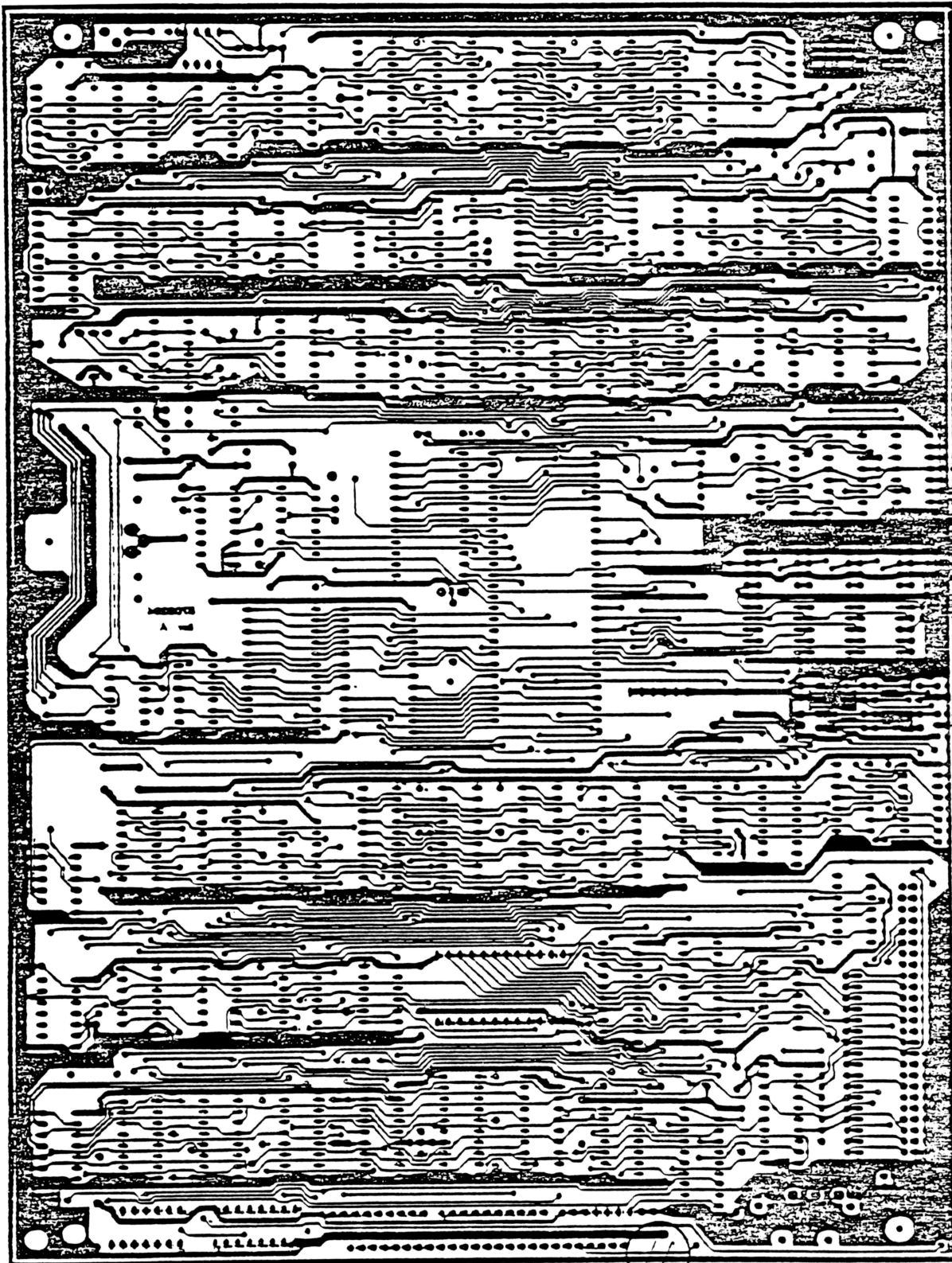
DATE: September 9, 1983

REVISION DATE: September 9, 1983

BULLETIN NO.:   HD:13

PRODUCT: 26-4150/1/2/3 8 and 12 megabyte hard drives

SUBASSEMBLY: Xenix operating system

PURPOSE: To help decode hard disk errors on the Xenix operating system.

DISCUSSION/PROCEDURE: When using the Xenix operating system it is not uncommon to run across an occasional hard disk error. When this occurs the operating system returns a message similar to this:

HARD DISK 1: hard err **4059** on rd of trk 0 head 3 sect 7

The number in bold face print is the only undefined part of this message. 4059 is really two messages in one. It is the hex number stored in the status register and the error register of the hard disk controller chip on the controller board. To analyze this number we must first know what the status and error bits represent. These bits are labeled in Table 1 and 2 on page 2.

Error Register ----------->40   59<-------------- Status Register

To find out what the error in the Error register is, convert 40 hex to binary:

40 hex = 01000000 binary

Now line this up with the error table:

```
bit 7  bit 6  bit 5  bit 4  bit 3  bit 2  bit 1  bit 0
  0      1      0      0      0      0      0      0
         ^
         |_____ bit 6 is set.  Looking at the table this tells us
                    that this is an uncorrectable error.
```
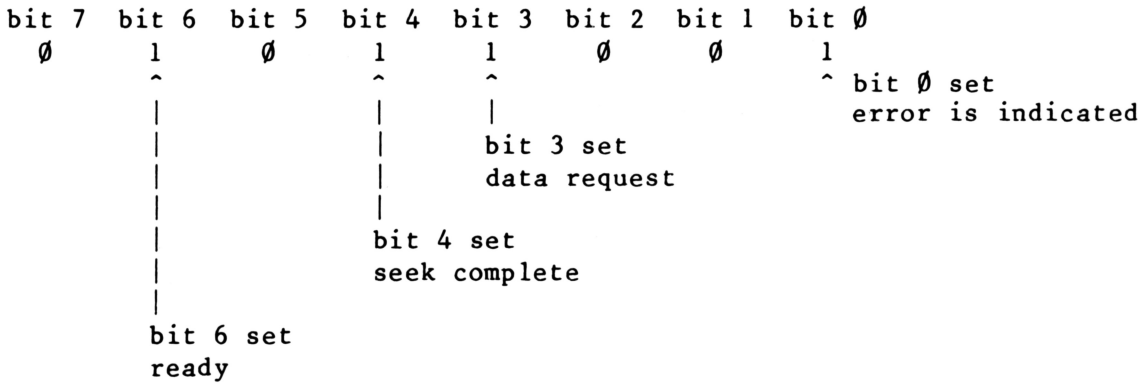
Now convert the status registers bits:

59 hex = 01011001 binary

```
bit 7  bit 6  bit 5  bit 4  bit 3  bit 2  bit 1  bit 0
  0      1      0      1      1      0      0      1
         ^             ^      ^                    ^ bit 0 set
         |             |      |                      error is indicated
         |             |      |
         |             |      bit 3 set
         |             |      data request
         |             |
         |             bit 4 set
         |             seek complete
         |
       bit 6 set
       ready
```

Knowing the contents of these registers may not tell you exactly where the problem is, but it can be helpful in troubleshooting.

Table 1
Error register bits

Bit set	Error
bit 7	Bad block detect
bit 6	Uncorrectable error
bit 5	CRC error - ID field
bit 4	ID not found
bit 3	Undefined
bit 2	Aborted command
bit 1	Track 0 error
bit 0	Data address mark not found

Table 2
Status register bits

Bit set	Status
bit 7	Busy
bit 6	Ready
bit 5	Write fault
bit 4	Seek complete
bit 3	Data Request
bit 2	Corrected
bit 1	undefined
bit 0	Error

DATE: October 18, 1983

REVISION DATE: March 19, 1984

BULLETIN NO.:   HD:14

PRODUCT: All Hard Drives

SUBASSEMBLY: N/A

PURPOSE: To explain arrangement of Tracks and Cylinders on Hard Drives
and how Operating systems refer to them.

DISCUSSION/PROCEDURE: It is easy to understand that with a
single-sided floppy the tracks are numbered consecutively along the one
side. However when we start talking about more than one Read/Write head
we need to talk about cylinders. On a Hard Drive with multiple platters
and multiple heads the tracks on the outermost edge of the all the
platters is considered cylinder 0. Figure 1 is the first 10 cylinders of
a Hard Drive with 6 Heads (12 or 15 Meg). If you can imagine the line
between Head 0 and Head 1 as the first platter, the line between Head 2
and Head 3 as the second platter, and the line between Head 4 and Head 5
as the third platter you can get a good picture of how the tracks and
cylinders are numbered. Cylinder 0 contains tracks 0 - 5, cylinder 1
contains tracks 6 - 11, and so on. Head 0, which is one side of the first
platter, contains tracks 0, 6, 12, 18, and so on.

XENIX OPERATING SYSTEM:

The Xenix system can be very confusing when it comes to tracks and
cylinders. For example, during diskutil when you are asked to enter the
Media Error Map from the Hard Drive, you are prompted for the Track Number
and the Head Number. However, even though the Map is labeled Track, Head,
and Sector, it actually is giving the cylinder number and not the track
number. Even though diskutil is prompting for the track number it also is
asking for the cylinder number. Another example is when Xenix gives an
error message; HARD DISK 0: hard err 4059 on rd of trk 0 head 3 sect 7.
It is not refering to Track 0 but actually to Cylinder 0 Head 3 which is
Track 3. You could confirm this by looking at Figure 1. Track 0 is on
head 0 not head 3, whereas cylinder 0 head 3 gives a specific location.

TRSDOS 4.3:

TRSDOS 4.3 is currently the only TRSDOS that allows you to lock out tracks
before formatting. Here again it asks for the track and head number and
again, just like Xenix, you enter the CYLINDER number not the track.
REMEMBER, the media error map gives you the Cylinder number not the
track number.

LDOS FOR MODEL III AND 4:

LDOS configures the Hard Disk(s) in such a way that you always have four
logical Hard Drives no matter how many physical drives you have. For
example; a 5 Meg has 2 platters and 4 heads. With one hard drive in the
system LDOS will format it so each head is one logical drive. This means
that the Head Ø side of one platter is one logical drive with 153 **TRACKS**
numbered consecutively, just like a single-sided floppy. The Head 1 side
of the same platter becomes another drive with 153 tracks and so on for
Head 2 and 3. If, however, you have two Hard Drives in the system then
LDOS makes Head Ø and Head 1 of the first physical drive one logical
drive. Head 2 and Head 3 become another logical drive giving you two
logical drives for each physical drive. This format basically gives you
two drives to each Hard Disk (double-sided, 153 **CYLINDERS** or 3Ø6
tracks).

After all of this it is easy to see where confusion can settle in. The
best way to avoid any confusion when talking about Hard Drives is to avoid
the term "TRACK". Any location on the hard drives media can be identified
by the CYLINDER number and the HEAD number. Below are three formulas for
computing track, cylinder, or head number:

$$T = \text{Track number} \qquad H = \text{Head number}$$
$$C = \text{Cylinder number} \qquad N = \text{Number of heads}$$

To find T given C and H : $T = (C * N) + H$
To find C given T and H : $C = (T - H)/N$
To find H given T and C : $H = T - (C * N)$

CYLINDER #	Ø	1	2	3	4	5	6	7	8	9
HEAD Ø	Ø	6	12	18	24	3Ø	36	42	48	54
HEAD 1	1	7	13	19	25	31	37	43	49	55
HEAD 2	2	8	14	2Ø	26	32	38	44	5Ø	56
HEAD 3	3	9	15	21	27	33	39	45	51	57
HEAD 4	4	1Ø	16	22	28	34	4Ø	46	52	58
HEAD 5	5	11	17	23	29	35	41	47	53	59

Figure 1

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DATE: November 30, 1983

REVISION DATE: November 30, 1983

BULLETIN NO.:   HD:15

PRODUCT: 26-1130/1 5 MEG Hard Drive
                     26-4152/3 12 MEG Hard Drive
                     26-4155/6 15 MEG Hard Drive

SUBASSEMBLY: AX-9282 Controller Board

PURPOSE: To reduce temperature drift and increase VCO stability.

DISCUSSION:

Due to thermal characteristics of the trimmer capacitor C33 the VCO
alignment may drift as the controller board warms up. This can cause
intermittent errors depending on whether the hard drive is warm or cold.

PROCECURE:

Whenever a Hard Drive comes in for repair check C33. If it is not a
negative coefficient capacitor, replace it with a negative coefficient
type. The negative coefficient capacitors have a ceramic type case
whereas the standard types have a dark plastic case. The Hard Drive must
be aligned after this modification is done.

The capacitor can be ordered from National Parts under part number
ACF-7364 and catalog number 26-4004.

DATE: December 5, 1983

REVISION DATE: December 5, 1983

BULLETIN NO.:   HD:16

PRODUCT: 26-6006   16B with Built-in 15 MEG Hard Drive

SUBASSEMBLY: AX-9432   Controller Board

PURPOSE: 15 MEG internal controller board alignment procedures.


DISCUSSION:

The 16B with built-in Hard Drive has a controller board which fits into
the motherboard of the 16B computer, unlike the 5, 8, and 12 MEG Hard
Drives. This controller board eliminates the need for an interface board;
however to insure proper interrupt chaining it must be installed in the
bottom card slot as the 8 or 12 MEG interface board would have been.

PROCEDURE:

1. Connect the hard drive power cables. Connect the control cables from
    the hard drive to J4 and J5 (the connectors with the pins pointing up
    not the ones with the cable release) on the controller board.

2. Move the Video PCB up to the highest available slot to allow easy
    access to the controller board.

3. Jumper E7-E8 on the hard drive controller board and install the board
    in the bottom slot of the card cage.

4. Power on the computer and wait for the **INSERT DISKETTE** message.
    Attach the scope probe to U26 pin 37, or (if the board is Rev. A) at
    TP8. Adjust R3 for a 75-80 nanosecond high pulse width. Refer to
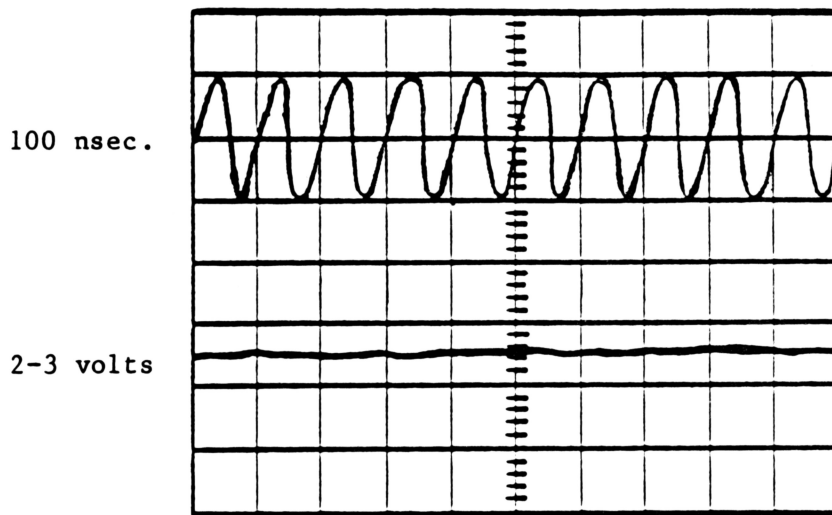   Figure 1.

    NOTE: Revision PP2 boards will not have a test point 8.
            Therefore it is advisable to attach a jumper wire
            from U26 pin 37 to an empty pin on the unused IC
            position next to J3. This will allow easy access
            for this adjustment while the board is installed.

5. Attach scope probe to TP7. If **the board is Rev. A** <u>DO NOT</u> **use TP7 instead use U27 pin 15.** Adjust R2 for a waveform with as little jitter as possible. At this point the exact waveform is not important only that the signal is pulsing and not a steady high or low.

6. Move jumper E7-E8 back to E6-E7. Set channel A of the scope to 2 volts/division. Set channel B to 1 volt/division and set the timebase to 100 nanoseconds/division. Attach channel A to TP6 and channel B to TP3. Adjust C11 for a 100 nanosecond waveform on channel A and 2.0-3.0 volts on channel B. Refer to Figure 2.

7. Set the scope for 2 milliseconds/division. Attach channel A to U19 pin 6 (INDEX), trigger positive on channel A. Attach channel B to TP7 (if the PCB is Rev. A use U27 pin 15).

8. Using HDDIAG or HDREL diagnostics, format track 1 then do a continuous read. Adjust R2 until you can distinguish 17 distinct pulses on channel B between the index pulses. Refer to Figure 3. The pass counter on the diagnostic screen should be incrementing with no errors. While reading the track repeat step 6.
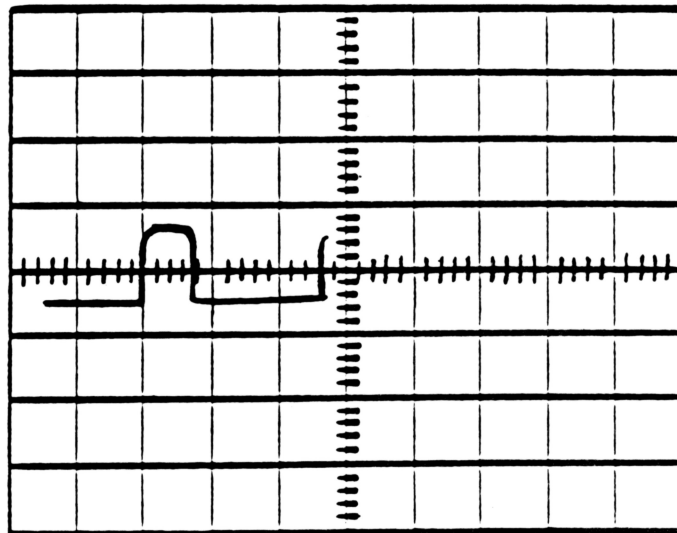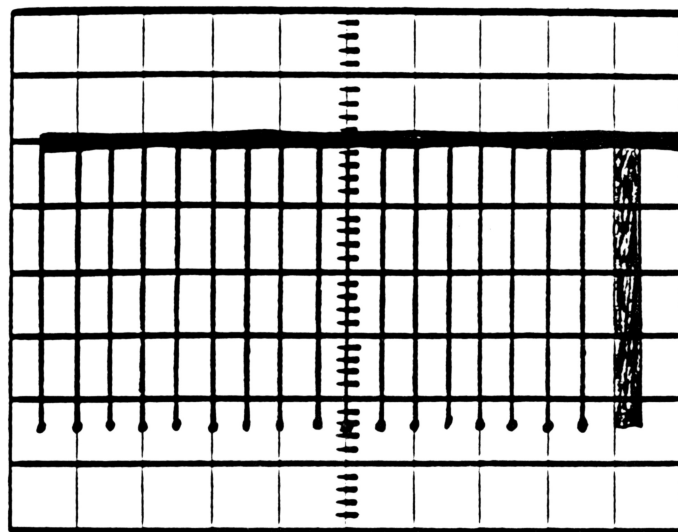

TP8 or U26 pin 37
75 nanosecond high pulse

Figure 1

100 nsec.

2-3 volts

Channel A - 2 volts/division at TP6
Channel B - 1 volt/division   at TP3
Timebase - 100 nanoseconds/division

Figure 2

Channel A - 2 volts/division at U19 pin 6 (INDEX)
Channel B - 1 volt/division   at TP7 or U27 pin 15
Timebase - 2 milliseconds/division

Figure 3

DATE: December 28, 1983

REVISION DATE: December 28, 1983

BULLETIN NO.:   HD:17

PRODUCT: 26-4150

SUBASSEMBLY: 8 Meg Cable Assemblies

PURPOSE: To prevent random lockups, lost data, intermittent CRC errors and provide part numbers for the shielded cables.

DISCUSSION/PROCEDURE: Extraneous electrical noise may cause random lockups, lost data, or intermittent CRC errors. The major induction points for this interference consists of two cables. The internal cable runs from the eight meg interface board to the Model II/16 external connector on the rear of the computer. The external cable runs from the external connector on the rear of the computer to the hard drive. To prevent noise from interfering, shielded cables are available from National Parts. Replace these two cables with the new shielded cables. Use HDDIAG for the 8 Meg to verify proper connection of the two cables.

The part number for the Internal Cable is AW-3160.
The part number for the External Cable is AW-3159.

Please note that the Internal Cable is not needed for Model 12/16B.

DATE: December 19, 1983

REVISION DATE: December 19, 1983

BULLETIN NO.:   HD:18

PRODUCT: 26-4152   12 Meg Hard Drive

SUBASSEMBLY: AX-9367   Interface PCB

PURPOSE: Modification to prevent false triggering of the CTC chip on the 12 Meg Interface board.

DISCUSSION: Unused CLK/TRG inputs on the CTC chip, when left floating, may cause false triggering of the CTC chip, resulting in system lockup. To prevent this from occuring these inputs need to be grounded. All units in for service **MUST** be checked for this modification.

PROCEDURE: On the foil side of the PCB jumper U22 pins 2∅ and 21 to U15 pin 1∅ (Refer to Figure 1).
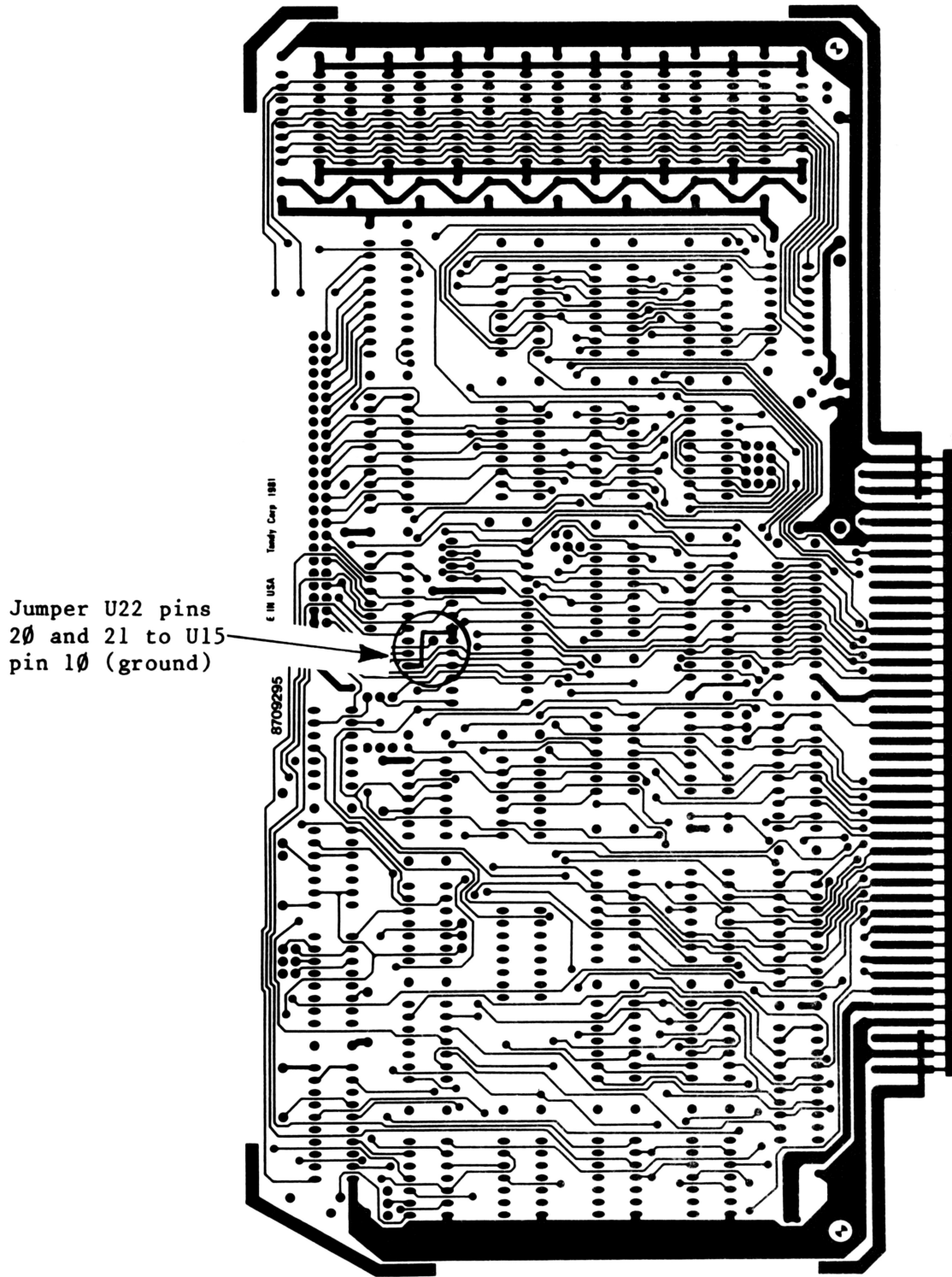
— TANDY COMPUTER PRODUCTS —

Jumper U22 pins
2∅ and 21 to U15
pin 1∅ (ground)

Figure 1

DATE: January 26, 1984

REVISION DATE: January 26, 1984

BULLETIN NO.:   HD:19

PRODUCT: 26-6006   Model 16B +HD

SUBASSEMBLY: AX-9432   Controller Board

PURPOSE: To improve interface signal integrity.

DISCUSSION:

Interface signals from the Hard Drive Controller to the Hard Drive are
active low. To increase the reliability of these signals, pullup
resistors should be added.

PRODECURE:

Seven 4.7K 1/4 watt resistors are required to complete this modification.
These resistors are available under National Parts number N-0247EEC and
catalog 26-9999R.

Add a 4.7K 1/4 watt resistor from:

```
          U10 pin 3  to  +5v  (+5 can be found at U10 pin 14)
          U10 pin 6  to  +5v
          U10 pin 8  to  +5v
          U10 pin 11 to  +5v

          U13 pin 6  to  +5v  (+5v can be found at U13 pin 14)
          U13 pin 8  to  +5v
          U13 pin 10 to  +5v
```

DATE: December 13, 1983

REVISION DATE: February 7, 1984

BULLETIN NO.:   HD:20

PRODUCT: 26-1130 5 MB Hard Drive
                     26-4152 12 MB Hard Drive

SUBASSEMBLY: Controller PCB Revision A only (AX-9282)

_____

PURPOSE: Mandatory modification to correct VCO failures.

_____

DISCUSSION: During power-up and idle conditions, the VCO attempts to
lock onto a 10 MHZ signal. In early hard drive controllers, only a 5 MHZ
signal is available during this period causing the VCO to try to lock on
to a harmonic. This results in unreliable operation. This modification
will provide the VCO with a 10 MHZ clock during idle periods.

This modification is mandatory on all Revision A controller boards, part
number AX-9282. Later units will have the jumpering performed at the
factory. Please check all hard drives for this modification.

PROCEDURE: This procedure is comprised of one trace cut, and nine
jumpers. All jumpering is to be done on the solder side of the controller
PCB. Please refer to the second page of this bulletin for the proper
position of the trace cut, as this is very important. Below is a summery
of the modification.

Cut 1   Cut trace between U4 pin 10 and feedthrough under U14. This
             cut is to be done on the component side of the board, as
             illustrated in the accompanying diagram.

                              JUMPERS

J1   U29-5 to U15-5
J2   U15-5 to U4-4
J3   U10-5 to U4-5
J4   U15-6 to U4-3
J5   U15-1 to U15-4
J6   U4-2 to Feedthrough under U-14 (solder side)
J7   U4-6 to U15-9
J8   U15-1 to U15-10
J9   U15-8 to U4-10

Upon completion of the modification, a complete controller board alignment
must be performed. Please refer to the hard drive diagnostics for the
procedure.

_____
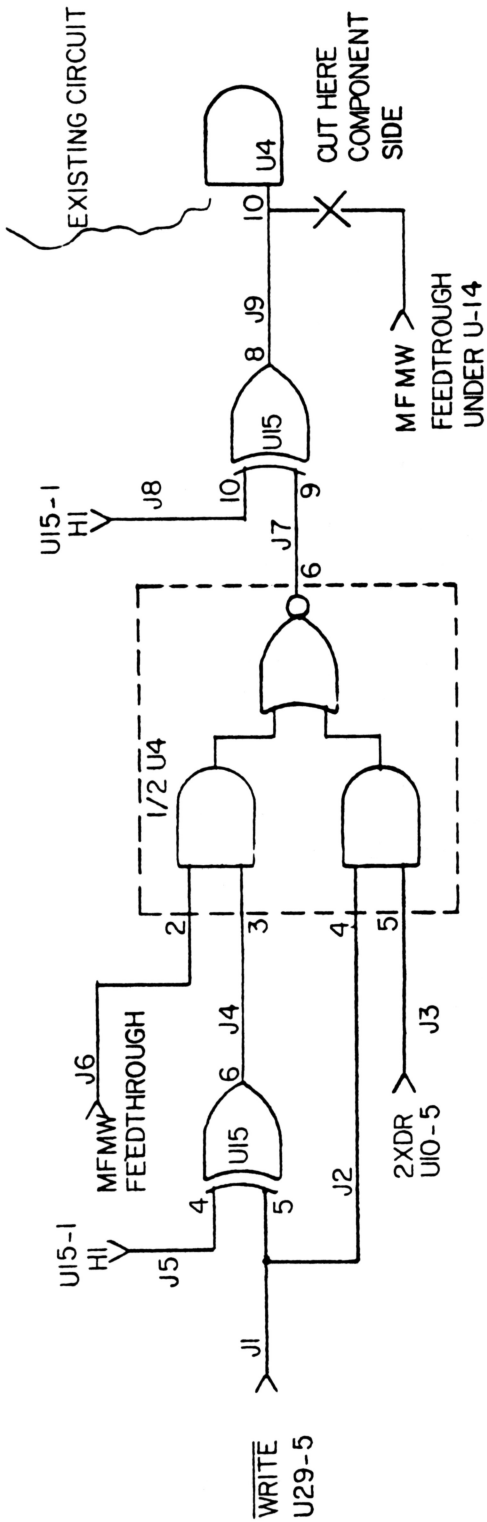
CIRCUIT DIAGRAM
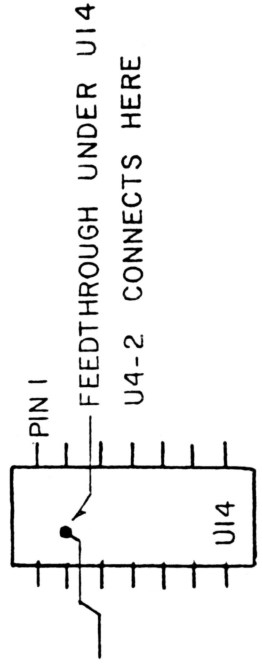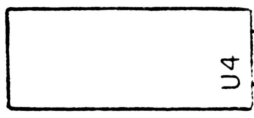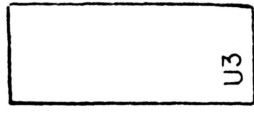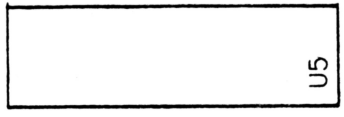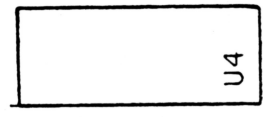
SOLDER SIDE

COMPONENT SIDE OF BOARD

— TANDY COMPUTER PRODUCTS —

DATE: March 8, 1984

REVISION DATE: July 9, 1985

BULLETIN NO.:   HD:21

PRODUCT: HD controllers with WD1010's

SUBASSEMBLY: WD1010 and WD1100

PURPOSE: Acceptable WD1010 and WD1100 combinations.

DISCUSSION:

Beginning in March 1984, all hard disk controllers containing the WD1010 series will begin using two new chips. These two chips, the WD1010-05 and the WD1100-21, are direct replacements for the WD1010-00 and the WD1100-11. Although most combinations are compatible, one combination is not acceptable on certain boards.

In addition, if the controller is to be used with the Quantum 35 meg bubble assembly, only the permitted combinations involving the WD1100-21 chip should be used. The reason for this is that the Quantum read window is 24 ns wide, versus the 50 ns of the Tandon and Micropolis bubble assemblies, and there is a minor timing difference between the WD1100-11 and the WD1100-21 causing data to be latched on a different edge. To prevent read errors, the WD1100-21 should be used on controller boards used with the 35 meg drive.

The following is a list of acceptable combinations that may be used on the same controller board. This list applies to both internal and external controller boards.

WD1010-00 with the WD1100-11 -----> use with Tandon and Micropolis drives.
WD1010-00 with the WD1100-21 -----> use with all drives.
WD1010-05 with the WD1100-21 -----> use with all drives.

The remaining combination (WD1010-05 with the WD1100-11) is compatible with the external Western Digital controller board **provided** that the board is a **WD1000-TB1** board. This type of external Western Digital

board should be the only type in the field; the designation is stamped on
the board and should be checked for certainty. This combination should
only be used with Tandon and Micropolis drives.

The WD1010-05 and WD1100-11 combination **is not** acceptable on Model 2000
and Model 16B+ internal controllers, or on any Western Digital external
controller which is not a WD1000-TB1 board. This is summarized in the
table below:

Board	Part #	OK with 1010-05 & 1100-11
16B+ int. board	AX 9432	no
2000 int. board	AX 9451	no
ext. W. D. bd.(WD1000-TB1)	AX 9454	**yes**
any other W. D. ext. controller	AX 9454	no

After replacement of these parts, an alignment will be necessary.

Replacement parts may be ordered under the following part numbers:

WD1100-11:   part # MP-0042, cat. # 26-4155W
WD1100-21:   part # MX-2131, cat. # 26-6022
WD1010-05:   part # MP-0043, cat. # 26-4155W

DATE: March 6, 1984

REVISION DATE: March 22, 1984

BULLETIN NO.:   HD:22

PRODUCT: 26-5104 Model 2000 with Hard Drive

SUBASSEMBLY: AX-9451 Hard Drive controller board

———

PURPOSE: Alignment procedures.

———

DISCUSSION:

The Model 2000 Hard Drive controller board uses the WD1010 controller chip like the 16B+. Because of this, the alignment procedure of the 2000 HD controller is identical to the 16B+ except for test point locations.

To insure proper operation of the Hard Drive the controller board **MUST** be installed in the top slot of the card cage.

PROCEDURE:

1.   Remove the main units top case cover. This will allow easy access to the controller board.

2.   On the controller board, move the jumper plug from E2-E3 to E1-E2.

3.   Power up the computer. Attach a scope probe to TP8. Adjust R4 for a 75-80 nanosecond high pulse width. Refer to Figure 1.

4.   Attach scope probe to TP3. Adjust R3 until the signal just begins to toggle. This is a preliminary 'DRUN' adjustment and will be made more exact later.

5.   Replace the jumper plug to position E2-E3. Set channel A of the scope to 2 volts/division. Set channel B to 1 volt/division and set the timebase to 100 nanoseconds/division. Attach channel A to TP5 and channel B to TP7. Set scope to display both channel A and B.

6.   Adjust C8 for a 100 nanosecond wave on channel A (TP5) and 2.0-3.0 volts DC on channel B (TP7). Refer to Figure 2.

———

7. Set the scope for 2 milliseconds/divisions. Attach channel A to U18
    pin 29 (INDEX), trigger positive on channel A. Attach channel B to
    TP3.

```
**********************************************************
*                                                        *
*                  W A R N I N G                         *
*                                                        *
*     MS-DOS DOES NOT PROVIDE FOR A DIAGNOSTIC TRACK.    *
*   Writing to ANY track may cause loss of data.  The Hard *
*   Drive is filled from cylinder ØØ up leaving cylinder *
*   3Ø5 as the least likely to have any data.           *
*                                                        *
*     CHECK WITH CUSTOMER AND MAKE BACKUPS IF POSSIBLE   *
*                                                        *
**********************************************************
```

8. Using HDDIAG diagnostics, format cylinder 3Ø5 then do a continuous
    read.

9. Display channel A. There should be two index pulses 16.66
    milliseconds apart.

    NOTE: U18 pin 29 (INDEX) is also the point to check for the bubble
           motor speed.

1Ø. Triggering on channel A adjust R3 until you can distinguish 17
     distinct pulses on channel B between the two index pulses on channel
     A. Refer to Figure 3. The pass counter on the diagnostics screen
     should be incrementing with no errors. While reading the track
     repeat step 6.
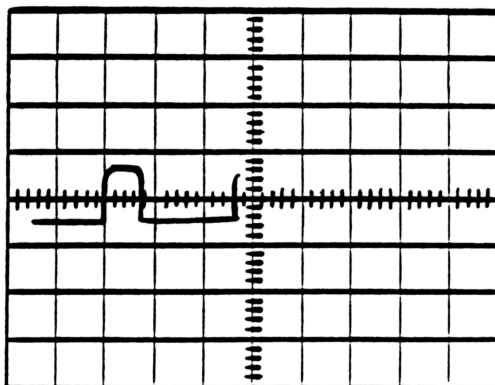
75 - 8Ø nanoseconds high pulse (TP8)

Figure 1

100 nsec.

2-3 volts.
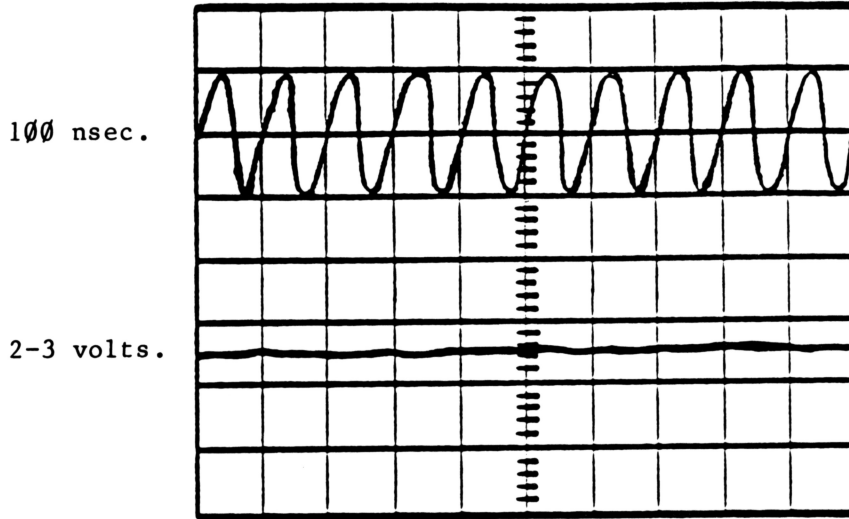
Channel A - 2 volts/division at TP5
Channel B - 1 volt/division at TP7
Timebase - 100 nanoseconds/division
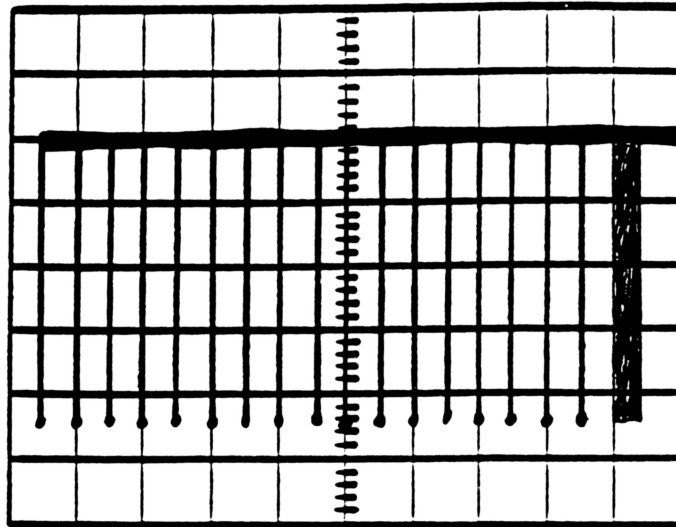
Figure 2

Channel A - 2 volts/division at U18 pin 29 (INDEX)
Channel B - 1 volt/division at TP3 (DRUN)
Timebase - 2 milliseconds/division

Figure 3

DATE: March 14, 1984

REVISION DATE: April 19, 1984

BULLETIN NO.:   HD:23

PRODUCT: 26-4155 15 Meg
                    26-4152 12 Meg
                    26-1130   5 Meg

SUBASSEMBLY: 8X300 Controller Part Number AX-9282

———

PURPOSE: Write data pulse is not in the center of the timing window, reducing data reliability.

———

DISCUSSION: As the hard drive writes data to the bubble, it produces "windows", which are nothing more than a timed space for one bit of data to be to be stored. This bit of data is supposed to be in the center of this window to be read accurately. Due to a timing problem, it has been found that this data bit is not always being recorded in the proper place. Therefore the data bit is not in the center of the "window". If this occurs, during a read when a particular window should contain a logic 1, it will be too much to one side or the other, and interpreted as a logic 0, causing data reliability problems. Bypassing the gate in the following procedure, eliminates the timing problem, increasing data reliability.

PROCEDURE:

1.) On the **COMPONENT** side of the PCB, cut pin 8 of U30 <u>right at the chip</u>. Cut the pin from the chip, and bend it up.

2.) On the **SOLDER** side of the PCB, run a jumper from pin 8, to pin 9 of U30.
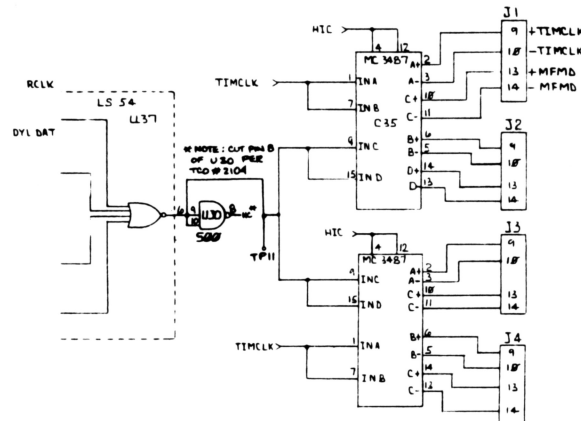
DATE: March 22, 1984

REVISION DATE: March 11, 1985

BULLETIN NO.:   HD:24

PRODUCT: 26-1130, 26-4152, 26-4155, 26-4171
                     5 Meg, HD, 12 Meg HD, 15 Meg HD, 35 Meg HD

SUBASSEMBLY: ATA-1015 Tandy 65 watt Power Supply

PURPOSE: To correct problem of power supply going into current
             limiting and the hard drive appearing dead.

DISCUSSION:

The Tandy 65 watt power supply incorporates a current limiting mode. This
current limiting mode shuts down the supply in the event that the unit
draws too much current. The 65 watt power supply is overly sensitive to
current load and may shut down without there being a problem with the
hard drive. To correct this, values of two resistors need to be changed.
This will increase the amount of current the 65 watt power supply may
draw. Additionally, R-15 (Variable Pot) may not be making proper contact
or may be defective. To correct this problem, the pot needs to be changed
to a network of resistors.

**   Compliance With This Bulletin Is Mandatory   **

PROCEDURE:

R-21 must remain a 220 ohm resistor.

Change R7 from 4.7k ohm to 1k ohm and change R35 from 47 ohm to 68 ohm.

Remove R-15 and install two (2) 510 ohm resistors, joining them where the
center tap on the trim pot was. Check the 5 volt line (V1) for a
tolerance of 4.95 to 5.25 volts. To trim the power supply, an additional
1k resistor may be used. To raise the output, locate R14 and install the
1k resistor across the 510 ohm resistor closest to R14. To lower the
output, locate R16 and install the 1k resistor across the 510 ohm resistor
closest to R16.

The fix kit needed for this modification may be ordered as:

Catalog # 26-1080   Part # AXX-7098

All units should be checked for these modifications.
Please note that only the power harness modification and not the resistor modifications apply to Astec power supplies.

DATE: April 11, 1984

REVISION DATE: August 7, 1985

BULLETIN NO.:   HD:25

PRODUCT: 26-1130/1   5 MEG Hard Drive   26-5104   Tandy 2000 HD
                   26-4152/3   12 MEG Hard Drive   25-3000   Tandy 1200 HD
                   26-4155/6   15 MEG Hard Drive

SUBASSEMBLY: AX-9287   5/12 MEG PCB   AXX-5039 12 MEG Bubble
                   AX-9456   10/15 MEG PCB   AXX-5040 15 MEG Bubble
                   AXX-5038   5 MEG Bubble   AXX-5044 10 MEG Bubble

---

PURPOSE: Motor speed alignment and Drive Logic PCB differences.

DISCUSSION:

The 5, 10 (Tandy 1200/2000), 12, and 15 MEG bubbles all use the same
drive logic board. **HOWEVER**, the 10 and 15 MEG bubbles must have a
different ROM code in the processor chip. The main difference of this ROM
coding is to allow the use of 306 cylinders. The chip can be indentified
by the version number on the IC package. The 10 MEG and 15 MEG bubbles
use a Version 3.x ROM code whereas the 5MEG and 12 MEG use a Version 2.x.

There are two types of bubbles for the 10 and 15 MEG hard drives. One has
plated media and the other oxide media. The drive logic boards have a
modification to allow use of the plated media which causes them not to be
interchangable between plated and oxide bubbles. Refer to Technical
Bulletins HD:29 and HD:32 for identifing and converting board types.

The drive logic board must also have the proper jumpering to match the
type of Hard Drive it's used with. Below is a list of those jumpers
corresponding to the type of Hard Drive:

5 MEG	12/15 MEG	10 MEG
W7 Termination	W7 Termination	W7 Termination
W8 Termination	W8 Termination	W8 Termination
W5 Max. 153 Cyl.	W13 Allows 6 heads	Sx Drive Select
Sx Drive Select	Sx Drive Select	

The external hard drives have two wiring harnesses for the front panel
write protect and activity lights. This wiring is the same for 5, 12, or
15 MEG hard drives. Below is a list of the wires and their locations:

```
                  PRIMARY                      SECONDARY
-----------------------------------------------------------------------
Yellow Wire -- U21 Pin 8 Drive Select    TP19 +12 Vdc to relay
White Wire --- U7 Pin 5   Drive Ready    Not Used
Orange Wire -- TP18   Write Protect       U21 Pin 8   Drive Select
Brown Wire --- Not Used                   U7 Pin 5    Drive Ready
Blue Wire ---- Not Used                   TP18   Write Protect
```

NOTE: The Drive Select wire may be attached to J7 pin 3. This is
        logically the same as U21 pin 8.

The secondary hard drives have a small satellite PCB which contains the
lamp driver chip for the active and write protect lamps. Below are the
pin-outs for the plugs on this board and their connection points:

```
     Pin #              Connection Point        Wire Color
-----------------------------------------------------------------------
```

FOUR PIN CONNECTOR

Pin #	Connection Point	Wire Color
1	Test Point 18 on Drive Logic	Blue
2	NC	
3	J7 pin 3 on Drive Logic	Orange
4	U7 pin 5 on Drive Logic PCB	Brown

SIX PIN CONNECTOR

Pin #	Connection Point	Wire Color
1	Pin 3 of Write Protect Switch	Black
2	Pin 4 of Write Protect Switch	Yellow
3	Pin A of Active Lamp	Violet
4	Pin B of Write Protect Switch	White
5	NC	
6	Pin B of Write Protect Switch and Pin B of Active Lamp	Red

Motor speed alignment is very important for proper operation of the hard
drive as it has a direct relation to the Index pulse. Each Hard Drive in
the system should be checked for proper motor speed. The procedures below
detail the motor speed alignment for each type of hard drive:

5, 12, and External 15 MEG

Select the first Hard Drive with the diagnostics and place the frequency
counter probe to test point 12 on the controller board. The counter
should display a count of 16.58ms to 16.74ms. If the count is not within
this range, motor speed alignment is required and you should proceed to
step one. If the count is in this range DO NOT attempt to adjust it.

NOTE: If more than one Hard Drive is in the system, you will need to
       select each Hard Drive individually and check motor speed as
       above.

1. With power off, remove the four screws that hold the metal frame the
    controller board and power supply are mounted on. Disconnect the
    cables, from the bubble assembly to the controller board, and tilt the
    controller board and frame to the right up on its end. This way the
    power supply can still be connected to the bubble assembly.

2. Remove the four screws that hold the bubble assembly brackets to the
    base of the hard disk and turn the bubble assembly on its left side so
    the drive logic board is facing the power supply.

3. Remove the right bubble mounting bracket (which should now be on the
    top of the bubble) to expose the holes which allow access to the motor
    speed adjustment pots.

4. Be sure the drive logic or any other boards are not shorting to the
    frame and turn on the power. The bubble can be operated on its side
    but **IT SHOULD <u>NEVER</u> BE OPERATED UPSIDE DOWN.**

5. Attach the Frequency Counter probe to Test Point 3 of the drive logic
    board. Adjust R5 (pot closest to stepper motor) for a 16.66ms count.

6. Power down and reassemble.

15 MEG Internal

Select the Hard Drive with the diagnostics and place the frequency counter
probe on U19 pin 6 on the controller/interface board. The counter should
display a count of 16.58ms to 16.74ms. If the count is not within this
range motor speed alignment is required and you should proceed to step
one. If the count is in this range <u>DO NOT</u> attempt to adjust it.

NOTE: If more than one Hard Drive is in the system, you will need to
       select each Hard Drive individually and check motor speed as above.

1. With power off, disconnect all cables going to the bubble assembly and
    remove it from the drive cage. Remove the mounting bracket from the
    bubble assembly. This will expose two holes which will allow access
    to the motor speed adjustment pot.

2. With the bubble assembly on its side (**THE BUBBLE SHOULD <u>NEVER</u> BE
    OPERATED UPSIDE DOWN**) so that the stepper motor is on top, place it
    on top of the drive cage and attach the power cable.

3. Attach the frequency counter probe to test point 3 of the drive logic
   board. Adjust R5 (pot closest to stepper motor) for a 16.66ms count.

4. Power down and reassemble.

1Ø MEG (Tandy 12ØØ/2ØØØ)

With power applied attach the frequency counter probe to the controller
board at U18 pin 29 for the Tandy 2ØØØ and U1Ø pin 29 for the Tandy 12ØØ.
The counter should display a count of 16.58ms to 16.74ms. If the count is
not within this range, motor speed alignment is required and you should
proceed to step one. If the count is in this range <u>DO NOT</u> attempt to
adjust it.

1. With power off, disconnect all cables going to the bubble assembly and
   remove it from the unit. Remove the mounting bracket from the bubble
   assembly. This will expose two holes which will allow access to the
   motor speed adjustment pot.

2. Remove the hard drive power supply from the main unit power supply
   leaving the AC cable attached.

3. With the bubble assembly on its side (**THE BUBBLE SHOULD <u>NEVER</u> BE
   OPERATED UPSIDE DOWN**) so that the stepper motor is on top, place it
   to the side of the power supply. Make sure the DC power supply cable
   can reach the bubble assembly.

4. Attach the power supply cable to the bubble assembly and turn the unit
   on.

3. Attach the frequency counter probe to test point 3 of the drive logic
   board. Adjust R5 (pot closest to stepper motor) for a 16.66ms count.

4. Power down and reassemble.

DATE: April 18, 1984

REVISION DATE: April 18, 1984

BULLETIN NO.:   HD:26

PRODUCT: 26-1130/4152/3/4/5/6 5¼" Hard Drive

SUBASSEMBLY: ART-4886 Linear Brake Assembly

PURPOSE: Specifications for brake assembly

PROCEDURE/DISCUSSION: The brake for any 5¼" Hard Drive should stop
spindle rotation within 15 seconds after power has been removed. If this
specification is not made, replace the brake (DO NOT attempt to adjust
it). If the brake is not functioning due to wear, adjusting the brake may
cause spindle bearing damage.

TANDY COMPUTER PRODUCTS

DATE: April 19, 1984

REVISION DATE: April 19, 1984

BULLETIN NO.:   HD:27

PRODUCT: 26-6006 Model 16B+ Internal Hard Drive

SUBASSEMBLY: AX-9432 Internal WD-1010 Controller PCB

PURPOSE: To correct drive select problem with external secondary on
            early revision PP2 boards.

DISCUSSION: Some early production revision PP2 internal WD-1010
controller boards will not properly select the external secondary hard
drive. This is due to an artwork error on these boards.

PROCEDURE:

1)   Locate U27 on the AX-9432 internal controller board PCB.
2)   On the component side of the board, cut U27 pins 5 and 6 free
      from the PCB.
3)   Add a jumper wire from pin 5 of U27 to the trace on the circuit
      board that was connected to pin 6 of U27.
4)   Add a jumper wire from pin 6 of U27 to the trace on the circuit
      board that was connected to pin 5 of U27.
5)   Reassemble and test to insure that the secondary hard drive will
      select properly.

DATE: May 21, 1984

REVISION DATE: May 21, 1984

BULLETIN NO.:   HD:28

PRODUCT: 26-4152 12 Meg Primary
                   26-4155 15 Meg Primary

SUBASSEMBLY: AX-9367 Hard Drive Interface PCB.

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PURPOSE: Reduce occurrence of "Active Drive Not Ready" error in the
Xenix operating system.

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DISCUSSION: RESETIB* signal on the hard drive interface board
resets the hard drive and associated circuits. This signal can drift to a
logic low, resetting the hard drive, and causing hard drive not ready.
Since RESETIB* is only required on power on reset, we can tie the line
high and eliminate the drifting reset problem. By complying with the below
procedure, you are isolating the the RESETIB* line, and tying its inputs
high.

PROCEDURE:

    1.) On the **SOLDER** side of the interface PCB, cut
       the trace going to U35, pin 1 right at the pin.
    2.) On the **COMPONENT** side, cut two traces going to
       U15, pin 4 also right at the pin.
    3.) Follow the two traces cut in step two of this procedure
       to their respective feed throughs and run a jumper from
       one feed through to the other.
    4.) Finally run a three way jumper from Test Point F (pull up
       R10), to U35 pin 1, and U15, pin 4.

DATE: May 21, 1984

REVISION DATE: April 3Ø, 1985

BULLETIN NO.:   HD:29

PRODUCT: 26-4154/55/56, 5125 1Ø & 15 Meg Hard Drives

SUBASSEMBLY: AX-9456/P Drive Logic PCB
                    AXX-5Ø4Ø & AXX-5Ø44 Bubbles

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PURPOSE: To help identify hard disk bubbles with the new style plated
media, and new style drive logic boards.

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DISCUSSION: Tandon is converting over to Hard Coat Plated Media on
all new bubble assemblies. This will not apply to the TM6Ø2 or TM6Ø3 (5 &
12 MEG) bubble assemblies. All TM5ØØ series bubbles (1Ø & 15 MEG) with
the new style media will be identified with a top bill number on the
drive. This bill number is a computer printed label affixed to the side
of the casing in plain sight.

There are also two types of drive logic boards. Each must be matched with
the correct bubble type.

PCB Assemblies:

To identify the PCB type, locate the capacitor at location R84 on revision
C and G boards or C54 on revision P boards. This capacitor is located
near pin 1 of U3Ø.

              If the capacitor **IS** there the PCB is for use with
              Oxide media only and is part number AX-9456.

              If the capacitor **IS NOT** there the PCB is for use
              with Plated media only and is part number AX-9456P.

Bubble Assemblies:

Oxide Type

TM-5Ø2 1Ø Meg	TM-5Ø3 15 Meg
AXX-5Ø44 (Use AX-9456 PCB)	AXX-5Ø4Ø (Use AX-9456 PCB)
Top Bill # 187500-22Ø,-224,-225	Top Bill # 187500-321,-322,-326

Plated Type

TM-5Ø2 1Ø Meg	TM-5Ø3 15 Meg
AXX-5Ø44 (Use AX-9456P PCB)	AXX-5Ø4Ø (Use AX-9456P PCB)
Top Bill # 187500-52Ø,-525,-825	Top Bill # 187500-921,-926

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DATE: June 27,1984

REVISION DATE: June 27,1984

BULLETIN NO.:   HD:3Ø

PRODUCT: 26-4155W 15Meg Western Digital Hard Drive Controller

SUBASSEMBLY: Drive Logic Control Board AX-9456

PURPOSE: Modification of the connection point of the White wire in the
             lamp circuit.

DISCUSSION:

The Western Digital Controller board has changed to a positive logic on
the Seek complete circuit to drive the Ready Lamp. This was accomplished
by using an inverter on the WD1Ø1Ø Controller board. By using this logic,
the output from Pin 5 of U7 is now not compatible. By attaching the White
lamp lead to TP8 SC (Seek Complete) on the bubble drive Logic board, the
required positive logic pulse on Seek complete is obtained.

PROCEDURE:

1. If the 15Meg Master has a WD1Ø1Ø Drive Controller board the the White
Lamp lead must be soldered to TP8 SC (Seek Complete) which is between U12
and U13.

2. If the Drive Controller is an 8X3ØØ then the White Lamp lead must be
soldered to Pin 5 of U7.

DATE: June 21, 1984

REVISION DATE: July 16, 1984

BULLETIN NO.:   HD:31

PRODUCT: 26-4155/6 External 15 MEG Hard Drives
                   26-5104   Tandy 2000 with 10 MEG Hard Drive
                   26-6006   Model 16B with 15 MEG internal Hard Drive

SUBASSEMBLY: AX-9456P 10/15 MEG Drive logic board for plated media

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PURPOSE: To explain proper connection of Index connector J5.

DISCUSSION/PROCEDURE:

The drive logic board for the plated bubble media has a four pin connector
at J5. However the plug that attaches to the connector is three pins, two
with wires and one empty. For proper operation the plug should be
attached to J5 such that the two wires from the plug connect to the two
center pins on the board. If the plug is not attached correctly the board
will not receive the Index pulse. This will cause a drive not ready error
with diagnostics and on external drives the active light will not come on.

DATE: August 3, 1984

REVISION DATE: August 3, 1984

BULLETIN NO.:   HD:32

PRODUCT: 10 & 15 Meg Oxide Media Drive Logic Boards

SUBASSEMBLY: AXX-5040/5044

PURPOSE: Conversion of oxide media board to plated media.

DISCUSSION: This is to help you convert drive logic boards for oxide media bubbles over to plated media. Do this mod only **WHEN NECESSARY** to permit use of the new style plated bubbles. It involves changing two resistors and the removal of a capacitor.

PROCEDURE: Observe the version number that is screened on the drive logic PCB. It should be 187345, this is the only board which you may convert.

Replace R55 with a 510 ohm 1/4 watt

Replace R87 with a 180 ohm 1/4 watt

Remove capacitor at position R84 on revision C and G boards or at C54 on revision P.

	Stock #	Part #
R55	26-9999R	N-0173EGB
R87	26-9999R	N-0144EEC

DATE: August 22, 1984

REVISION DATE: August 22, 1984

BULLETIN NO.:   HD:33

PRODUCT: 26-4152 12 Meg Primary
                     26-4155 15 Meg Primary

SUBASSEMBLY: AX-9367 Hard Drive Interface PCB.

PURPOSE: To correct an error in the artwork.

DISCUSSION: There was an error in the artwork on the "No Revision" boards which caused the trace for the signal XFERRQ* to be routed to the wrong pin on the system bus. This problem is currently being corrected in manufacturing, but if a problem exists, presence of this modification on the interface board should be checked.

PROCEDURE:

1.)   Cut the trace between J1 pin 42 and it's respective feedthru.

2.)   Run a jumper from the same feedthru to J1 pin 41.

Note: This modification applies to "No Revision" boards only.

DATE: September 7, 1984

REVISION DATE: September 7, 1984

BULLETIN NO.:   HD:34

PRODUCT: 26-4155W 15 Meg Primary Hard Drive

SUBASSEMBLY: AX-9454 Western Digital Controller

PURPOSE: To eliminate WAIT* line being pulled low when hard drive is attached, but powered off.

DISCUSSION: It has been found that in using a Model II/12/16/16B computer with a 15 Meg external hard drive and a Western Digital controller with the hard drive attached but powered off, that the WAIT* line of the interface is being held at an indeterminate level of 1.5V to 3V. This causes the computer to boot improperly or not boot at all. This may be remedied by removing the pullup resistor on the WAIT* line on the Hard Drive controller PCB.

PROCEDURE:

1.) Remove resistor R2 on the Western Digital controller.
2.) Test the machine for proper operation.

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DATE: October 15, 1984

REVISION DATE: October 15, 1984

BULLETIN NO.:   HD:35

PRODUCT: 26-4155W 15 Meg Hard Drive (Primary)
                   26-4171 35 Meg Hard Drive (Primary)

SUBASSEMBLY: AX-9454 Controller PCB.

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PURPOSE: Alleviate problem with external WD1010 controller boards not
          allowing secondary Hard drives to power up.

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INSURE COMPLIANCE WITH THIS MODIFICATION ON ALL UNITS IN FOR SERVICE.

DISCUSSION: Many **EXTERNAL** WD1010 controller boards have the wrong
value resistor at the R6 position. This resistor is a pull up in the
secondary power control circuit of the controller board. If this resistor
is the wrong value you will probably be unable to power up any secondary
hard drives in the system.

PROCEDURE: Replace R6 on the controller board with 10 ohm 1/2 watt
resistor. This part is available through National Parts under Category
number 26-9999R, Part Number N-0063BFE.

DATE: October 24, 1984

REVISION DATE: November 14, 1984

BULLETIN NO.:   HD:36

PRODUCT: 26-4155W 15 Meg Primary Hard Drive

SUBASSEMBLY: AX-9454 Western Digital Controller PCB

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PURPOSE: PAL change for Western Digital Controller.

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DISCUSSION: Due to some drive select problems occuring when using
the Western Digital Controller and more than one secondary hard drive, a
new PAL has been programed for use in IC position U21 on the controller
board. This PAL must be replaced in all units that come in for service.

**   ** Compliance With This Bulletin Is Mandatory **   **

PROCEDURE:

(1) Determine if the controller is in need of the new PAL by checking to
    see if the part number on IC U21 is 16L8ACJ. If it is it must be
    replaced with a 16L2 device.

(2) Replace the PAL if necessary with:
        Part# MX-6345   Catalog# 26-4155W

(3) Test the system with all Hard Drives attached to insure proper
    operation.

DATE: March 1, 1985

REVISION DATE: March 1, 1985

BULLETIN NO.:   HD:37

PRODUCT: 26-4171 35 MEG Hard Drive

SUBASSEMBLY: Power Supply

PURPOSE: To explain grounding differences with Tandy and Astec power supplies.

DISCUSSION/PROCEDURE:

The 35 Meg primary hard drive has a 65 watt power supply. Either a Tandy or Astec supply may be used. The grounding arrangement used will vary depending upon the type of supply.

Due to a ground loop situation caused by the Tandy supply there should NOT be a ground wire attached from the bubble assembly to the chassis. In addition, the screws which mount the controller board frame to the main chassis should have an insulating washer under each screw. If these two steps are followed there should be no problem using a Tandy power supply.

When using the Astec supply, there MUST be a ground wire attached from the bubble assembly to the chassis and the screws mounting the controller board frame to the chassis should NOT have any insulating washers.

DATE: April 12, 1985

REVISION DATE: August 17, 1987

BULLETIN NO: HD:38

PRODUCT: 26-4171/2 35 Meg Hard Drive

SUBASSEMBLY: AXX-5Ø49 Bubble Logic Board

SUBASSEMBLY REVISION: Revs. ASM2Ø-21ØØØ and ASM2Ø-21Øx

PURPOSE: To identify different 35 meg drive logic boards and the proper
           connection points for the wiring harness.

DISCUSSION:

There are two types of drive logic boards currently being used with the 35 Meg
Hard Drive. These differences are:

  1. Early drive logic PN# ASM2Ø-21ØØØ (May be REV D)

     Yellow wire (orange in secondary) lamp driver circuit connects
     to U4 pin 3 on the bubble logic board.

  2. Late drive logic PN# ASM2Ø-21Øx (May be REV A)

     The "x" in the part number for this board is a digit between
     1 and 9.

     Yellow wire (orange in secondary) lamp driver circuit connects
     to U15 pin 16 on the bubble logic board.

Summarized, the connections for wiring harnesses are as follows:

Early Drive Logic PN# ASM2Ø-21ØØØ:

Primary	Connection Point on Logic Board
Yellow	U4, pin 3
White	U1, pin 6
Orange	J2, pin 5

Secondary	Connection Point on Logic Board
Orange	U4, pin 3
Blue	J2, pin 5
Brown	U1, pin 5
Yellow	J1, pin 16

Late Drive Logic PN# ASM2Ø-21Øx:

Primary	Connection Point on Logic Board
Yellow	U15, pin 16
White	U1, pin 6
Orange	J2, pin 5

Secondary	Connection Point on Logic Board
Orange	U15, pin 16
Blue	J2, pin 5
Brown	U1, pin 5
Yellow	J1, pin 16

DATE: August 21, 1985

REVISION DATE: August 21, 1985

BULLETIN NO.:   HD:39

PRODUCT: 26-1130/1, 26-4152/3, 26-4155, 26-4155W, 26-4172/3
                 26-4173/4, 26-5104,   26-6006, 26-6022,   25-1001,
                 25-1007,   25-3000, Hard Drives

SUBASSEMBLY: AX-9282, AX-9454, AX-9432, AX-9572, AX-9009, AX-9529,
                 AX-9575, Hard Drive Controller PCB

PURPOSE: To explain the effect on Hard Drive Controller Boards when the
control and data cables have been installed upside down.

DISCUSSION: When installing the secondary hard drive control and data
cables in any hard drive system or connecting a secondary to an internal
controller board care should be taken not to install the cables upside
down. The data cable has 12 volts assigned to pin 7 which is used to turn
on the relay in the secondary drive. If reversed then pin 14 is connected
to 12 volts which results in damage to components on the controller board
or devices inside the computer.

PROCEDURE: The following list is an outline of possible components
which will be subject to failure in the event of cable reversal. Check
these components for change in value, damage from excessive current draw,
or burn out.

1. (AX-9282) 8X300 Hard Drive Controller PCB External
Problem: Blown (R36) 15ohm 1/4watt resistor replace with
Catalog Number: 26-9999R   Part Number: N-0074EEC

2. (AX-9454) WD1010 Hard Drive Controller PCB External
Problem: Blown (R6) 10ohm 1/4watt resistor replace with
Catalog Number: 26-9999R   Part Number: N-0063BFE

3. (AX-9432) WD1010 Hard Drive Controller PCB Internal
Problem: Blown (F3) 2 Amp 3AG 250 Volt Fuse on (AXX-6009) AA11082 Power
Supply, fuse may also be damaged causing reduction of voltage.
Catalog Number: 26-6002   Part Number: AHF-1213

4. (AX-9572) Zebec Hard Drive Controller PCB Internal
Problem: Blown (F1) 500MA PICO Fuse on Controller, Possible damage to (U1)
IC 3198-0058 Zebec (Fuse only available under Model 2000 Catalog Number)
Catalog Number: 26-5125   Part Number: AHF-1297

Note: The cables provided with the Zebec Controller board are keyed on
the controller board end. These cables are special and should only be used
with this controller board. Pin 7 of the data cable is connected to Pin 16
of the control cable, which is also connected to (U1) on the controller
board by a jumper on the logic board. Reversal of the data cable will send
12 volts to (U1) resulting in possible damage. The Cables connecting the
hard drive to the controller board should be installed with the cables
dressing up.

5. (AX-9009) WD1002S Western Digital Hard Drive Controller PCB Internal
Problem: Blown (R13) or (R14) 39ohm 1/4watt resistors on Controller board.
Catalog Number: 26-9999R   Part Number: N-0092EEB

6. (AX-9529) Tandon Hard Drive Controller PCB Internal
Problem: Doesn't support any secondary hard drives.

7. (AX-9575) Model 2000 Hard Drive Controller PCB Internal
Problem: Blown (R25) 125 Volt 500MA PICO Fuse (not a resistor)
Catalog Number: 26-5125   Part Number: AHF-1297

Note: (AX-9451) Controller PCB was the first controller used on the Model
2000. It was designed without any connectors for use with secondary hard
drives. The (R25) on this controller board is a 22ohm 1/4watt resistor. On
the (AX-9575) Controller PCB, secondary connectors were added and resistor
was changed to a fuse.

DATE: February 10, 1986

REVISION DATE: March 21, 1986

BULLETIN NO: HD:40

PRODUCT: 26-1138 Model 4 Hard Drive Controller

SUBASSEMBLY: AX-9454 Western Digital Hard Drive Controller

SUBASSEMBLY REVISION: All Revisions

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PURPOSE: To describe the external hard drive controller for the Model 4.

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DISCUSSION/PROCEDURE: The 26-1138 Hard Drive Controller is an external
controller board which may be used to run a secondary hard drive as the first
hard drive on a Model III/4/4P system. This unit consists of a controller
board and a power supply mounted in a case with connections for the Model
III/4/4P I/O bus and the secondary drive's control and data cables. It uses
the Western Digital WD1000-TB1 controller which is the same controller used on
our external primary hard drives. This controller has however been modified
to be used with the 25-1025 10 Meg half height drives or other secondary
drives and is not directly interchangeable with any other controller.

This controller has a cable which connects to the I/O port on the Model
III/4/4P systems in the same manner as a standard primary hard drive. There
are also control and data cables available for connection to the hard drive.
If the customer wishes to add a second hard drive to this system a cable kit
(25-1026) must be ordered. The controller has been modified to accept our
standard secondary hard drives, which means that the first drive in the system
must be jumpered as DS2 and the second as DS3.

In order to operate this controller on a III/4/4P LDOS version 5.1.4 or
greater, or TRSDOS version 6.2 or greater must be used. In order to use the
program HARDGEN to initialize a 10 meg hard drive, a line must be added to the
program which reads as follows:
    147 F%(10)=10000 '10 Meg

NOTE: Since this controller is the same controller used in our external
primary Western Digital hard drives, Business Product Parts will only be
stocking one part. This board will come set up for use on an external
primary, and will have to be modified in order to be used in this unit.

If the board is not modified the drive select signals will not be routed to
the correct drive and the 12V relay voltage will not be applied to the relay
of the first drive in the system. The modifications are listed below.

1.) Place a jumper wire from J6 pin 7 to J7 pin 7.
2.) Cut the trace at J4 pin 28.
3.) Cut the trace at J4 pin 30.
4.) Place a jumper wire from J4 pin 26 to J4 pin 28.
5.) Place a jumper wire from J4 pin 30 to U28 pin 5.

DATE: June 12, 1986

REVISION DATE: July 15, 1986

BULLETIN NO: HD:41

PRODUCT: 26-4173/4   7Ø Meg Hard Drive

SUBASSEMBLY: Entire Item

SUBASSEMBLY REVISION: N/A

PURPOSE: To provide information on the 7Ø meg hard drive.

DISCUSSION/PROCEDURE:

This bulletin is to provide information on the 7Ø meg hard drive system.
Included will be information on motor speed, number of heads and cylinders,
and wiring information.

Bubble Type: Micropolis 1325

Heads: 8

Cylinders: 1Ø24

Tracks: 8192

Motor Speed: 36ØØ rpm (+/- Ø.5%) or 16.58 - 16.75 milliseconds
              Non-adjustable

Miscellaneous: rotary voice coil head positioning
                 heads parked and locked mechanically on power down
                 only Astec supplies should be used
                 media error map as supplied from the factory printed on top
                     of bubble assembly

Wiring Harness Information:

<u>Primary:</u>

Yellow Wire -- J11, pin 2 (Drive Select)
              On the underside of the drive logic board (solder side)
              there is a resistor soldered between J11, pin 1 and J11, pin 2.
              This may not be present on all drives, but if it is, solder
              the yellow wire to the side of the resistor connected to J11,
              pin 2. If the resistor is not present, connect the yellow
              wire directly to J11, pin 2.
              J11, pin 2 may be identified by the fact that the red wire on
              the two pin plug which connects to J11 is connected to pin 2 of
              the plug. Additionally, on the component side of the board,
              J11 pin 1 is marked with a white dot.
Orange Wire -- J2, pin 5 (Write Protect)
              This wire is soldered onto the component side of the board.
White Wire -- Test Point labelled "SC" or "TP1". (Seek Complete)
              This wire is soldered onto the solder side of the board.

<u>Secondary:</u>

Orange Wire -- equivalent to primary Yellow wire (J11, pin 2).
Blue Wire   -- equivalent to primary Orange wire (J2, pin 5)
Brown Wire -- U1, pin 6 (READY*)
              This wire is soldered onto the solder side of the board.
Yellow Wire -- J2, pin 7 (+12 VDC to relay)
              Looking at the solder side of the board, with J2 in the upper
              left corner, the connection is made at the feedthrough
              immediately to the left of the feedthrough connected to
              J2, pin 6. The target feedthrough connects to J2, pin 7.