INDUS GT

Field Service Manual

Chapter 1
GENERAL DESCRIPTION

1.1 Introduction

This document provides all of the information a field service technician might need to troubleshoot end repair one of the Atari compatible disk drives manufactured by INDUS Systems, Inc. All references in this manual ere applicable only to the Atari compatible model. This document consists of the following sections:

SECTION 1.0 - General Description
SECTION 2.0 - Disassembly & Assembly
SECTION 3.0 - Diagnosing A Problem
SECTION 4.0 - Diagnosis with GTDOC
SECTION 5.0 - Troubleshooting Guidelines
SECTION 6.0 - Repair Guidelines
SECTION 7.0 - Schematics & Drawings
SECTION 8.0 - Parts Lists

plus various appendices.

1.2 PURPOSE OF EQUIPMENT

The INDUS GT Atari compatible disk drive is a compact memory device designed for use with any of the personal computers produced by Atari inc. Such computers include, but are not limited to, the following models: 400, 800, 600XL, 800XL, 1200XL, 65XE, 130XE and XEGS. The INDUS GT disk drive serves as a device for data storage and data retrieval. The data may either random access or sequential in nature. The specific data structure must be defined by the user's application program.

FIGURE 1-1 Photograph of an INDUS GT Disk Drive

1.3 PHYSICAL DESCRIPTION

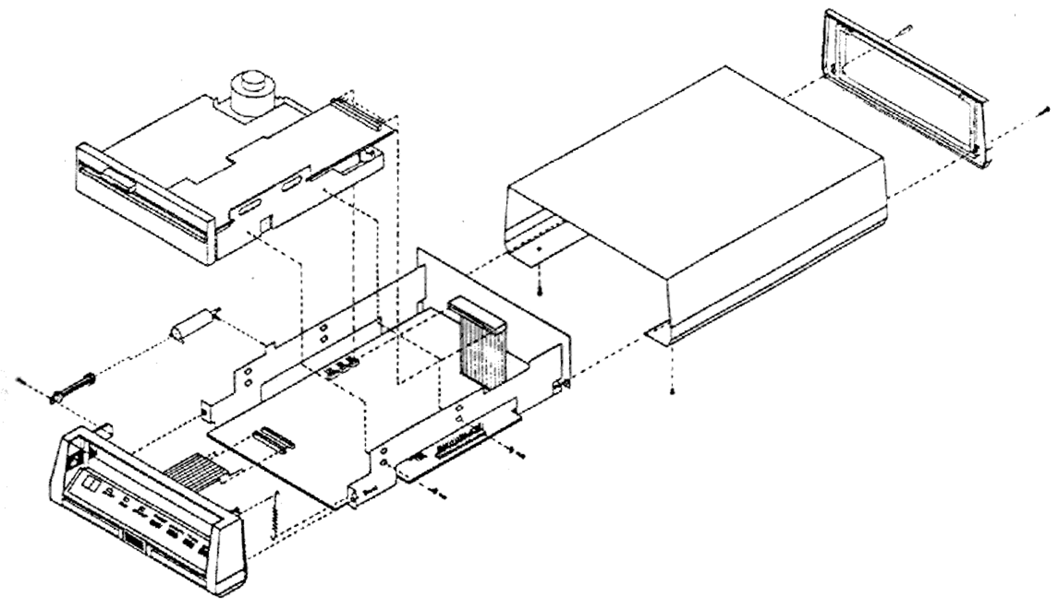
A representative INDUS GT disk drive is pictured in ***Figure 1-1***. The drive is s low profile unit, black in color, with a horizontally mounted TANDON TM50-1 half-height 5.25-inch drive mechanism. The drive has a smoke colored plexiglas dust cover that, at the touch of a front mounted button, automatically slides up revealing the disk access slot and the activity display/control panel. The back of the drive contains two standard 13-pin MOLEX plugs for interfacing to the computer (and any other daisy-chained devices). The back panel also contains the primary power connector and power ON/OFF switch for the unit, as well as a four-pole DIPswitch.

Figures 1-2 and 1-3 show two levels of an exploded view of the disk drive. These drawings are accurate to scale and illustrate the general way that the drive is put together. We will be describing each of the assemblies and how you might go about removing or re-installing them later in this manual. Right now, all you need to do is get a general picture in your mind of exactly what you will be working with.

Internally, the disk drive consists of several major sub-assemblies. There is, of course, the TM50-1 TANDON single-sided floppy disk drive mechanism and the associated wiring and connectors. The supporting electronics are laid out on two printed circuit boards (PCB's). The PCB that you see on top of the drive mechanism is the analog board. You will find such things as the read, write and motor control circuits on this board. If you remove this board and the TANDON drive mechanism, you will see a board laying flat on the bottom of the drive housing. This board is the digital board that contains the 'brains' of the disk drive

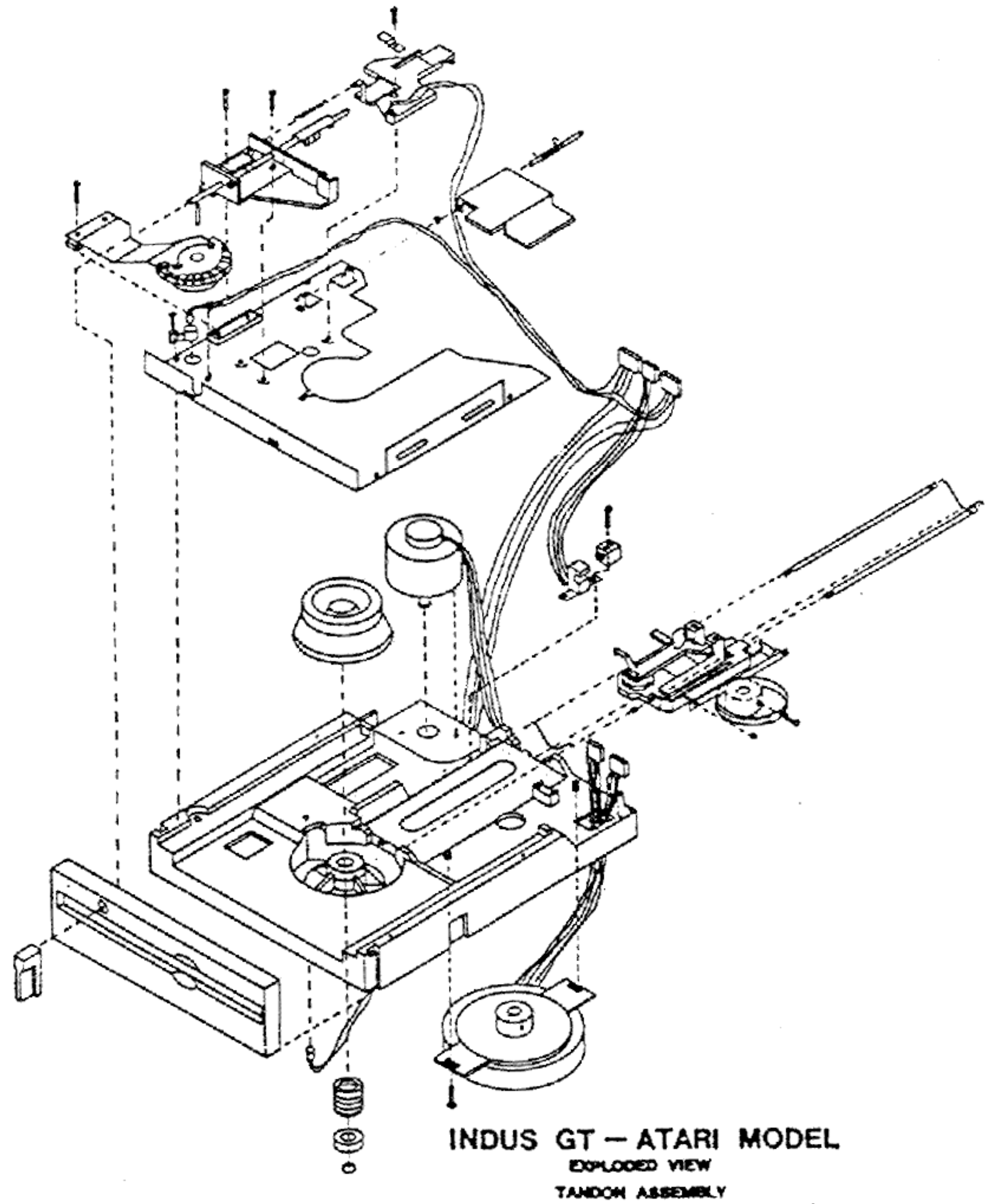
The digital board will be referred to throughout this manual as the 'WART' board. The name is derived from the original project title for the development of the disk drive. 'WART' is an acronym for 'Wonderful Atari Rotating Thing'. The WART board contains the Z80-A CPU, it's controlling ROM/EPROM, a 2K RAM buffer and a Western Digital 2797 floppy disk controller (FDC) among other things. In later sections, we will discuss each of the major components on both of the boards.

FIGURE 1-2 Exploded View of INDUS GT Disk Drive



INDUS GT-ATARI MODEL
Exploded View

FIGURE 1-3 Exploded View of the TANDON Drive Assembly



1.4 FUNCTIONAL DESCRIPTION

The INDUS GT Atari disk drive is a 5 1/4 inch floppy Disk drive that will interface with any of the various Atari 8-bit home computers. The drive is a multi-density drive and is compatible with virtually any DOS currently available for the Atari. This section will describe some of the major features of the drive and give you a better understanding of how the drive is supposed to function.

1.4.1 Power Up Self Tests

When you first apply power to an INDUS GT disk drive, the on-board Z80 computer runs a series of tests on the drive to determine if all of its major subsystems are in working order. To minimize the amount of time such testing will take, only four tests are normally made at this time. As each of these tests is running, the alphanumeric display on the activity/control panel will flash through the values C0, C1, C2, and C3. If an error occurs in any of these tests 'H' will replace the 'C' and the drive will stop testing at that point. We will be covering all of these tests and the optional series of extended tests later in this manual so we will not go into much detail here. Suffice it to say at this time that the drive runs a test on the drive's ROM/EPROM, the on-board 2K RAM, the Z80 index registers, and the western Digital floppy disk controller. Once the drive has passed all of these internal tests, the drive goes into a density select routine that we will cover in the next section.

1.4.2 Multiple Density Operation

The drive is designed to work in any o+ three density modes: single, dual, or double density. You will normally need to have a disk operating system (DOS) that 'is configured for the mode of operation that you desire. Most of the DOS currently available for the Atari operate in only single density mode. However several DOS now on the market support double density as well. As of this writing, there are only two DOS that support the 'dual', or I050, density.

There are significant differences in the three density modes. The original single density configuration consists of 40 tracks with 18 sectors on each track and 128 bytes per sector. This mode gives you maximum data storage of 92,160 bytes in a non-DOS environment. If you need to use the disk via a DOS, as most users do, then you will have only about 88K bytes of storage space available.

The so-called 'dual' density is similar to the single density configuration except that each track has 25 sectors, instead of 18. This yields a theoretical maximum storage capacity of about 133K bytes; but once you take into account the usual overhead needed for operating under a DOS environment, you end up with only 128K for actual storage. This is still an increase of roughly 45 per cent over normal single density, hence the occasional use of 'density-and-a-half' in describing this operating mode. This mode is also called 'Enhanced' density.

The double density mode of operation is true double density in the usual industry usage of the term. It consists of 40 tracks with 18 sectors on each track and 256 bytes per sector. Most of the DOS available for double density make about 179K of storage space out of the maximum 184K available on the disk.

The disk drive is configurable to any of the three density modes either from the front panel of the drive or by software commands sent across the serial I/O (SIO) bus. In addition, the drive has a default select switch located on the back panel that will cause the drive to automatically configure itself tor either single or double density when the unit is powered up. Another configuration feature is that the drive can sense when a new disk has been inserted and it will re-configure itself for the density of the new disk during the first attempt to access the disk drive.

The drive uses a relatively simple process to automatically determine which density configuration it is supposed to operate in. when power is first applied to the drive, the on-board Z80 microprocessor runs a short series of self tests and then examines the setting of the third pole on the back panel DIP switch. The normal default configuration is single density; but the DIP-switch can be set to cause this default to be double density instead. This provides drives that are not in the number one position a means of telling the DOS what density mode they are in, even if no disk is installed. Also, the disk change flag (an internal parameter monitored by the drive) is set to cause automatic disk density analysis to be performed prior to the processing of the first I/O command received over the serial bus.

At the end of the power up initialization tests, the drive attempts to read a disk in both single and double density (whether a disk is installed or not). If the read is successful in single density, then the drive is set to single density. lf the read is successful in double density, then the sector size is examined. A sector length of 256 bytes indicates that the drive is to operate in double density mode. A sector length of 128 bytes tells the drive that it should go into the dual density mode. If the drive is not able to read the disk (due possibly to the absence of a disk), then the density mode is determined by the setting on the back panel DIP-switch.

When a disk is inserted into the drive, a large portion of un-notched disk passes through the write protect sensor before the disk is inserted far enough to align the write protect notch with the sensor. This causes the drive to go from a write-enabled state due to the absence of a disk, to a write-protected state, as the disk is first being inserted into the drive. This 'rising edge' of the write protect is latched by the hardware and is used by the internal software as a signal that the disk has been changed. Whenever such a disk change is detected, the drive motor is turned ON (without turning ON the BUSY LED) to improve the centering of the disk during clamping and the disk change flag is set to indicate that a new disk must be analyzed. This flag causes the drive to analyze the new disk (as we Just discussed) as soon as a new I/O command is received from the Atari host computer and prior to actually executing the new command. However, the software cannot detect the door closing and can therefore only provide you with A fixed amount of motor spin time before it shuts the motor OFF again. This creates the requirement that you insert the new disk all the wav in and shut the door all in one smooth action. Failure to do this can result in improper centering of the disk during the clamping process.

The only exception to the automatic disk analysis following a disk change is if a format command has been sent from the computer. If a format command has been received from the computer, then the drive will not change its current density configuration. This permits disks that have already been formatted at one density configuration to be re-formatted under a new density configuration. This feature is really of interest only to those users who do not have a multi-density DOS.

The last automatic operation which can cause the density configuration to change is receipt of a SET CONFIGURATION commend. This command will cause the drive to change to the specified density regardless of any other factors. The new density mode will remain in effect until the drive is powered OFF, the disk is changed again, or until a new SET CUNFIGURATION commend is received.

There is one more way to change the density configuration. Holding down the DRIVE TYPE switch_ on the front display/control panel and then pressing the TRACK switch will cause the drive to switch from the current density to the next density in the following sequence:

SINGLE (XA) to DOUBLE (Xb) to DUAL (XC) to SINGLE (XA) . . . .

This manual switching method will shift the density mode once each time the TRACK switch is pressed. The data inside parentheses will be displayed in the alphanumeric LED on the front panel. The 'X' refers to the drive number and the ’A’, 'b’, 'C' identify which density mode is currently selected (a lower case ’b' is used Instead of the upper case to avoid confusion with -the numeric value '8’). Whenever the density mode is changed in this way, the disk _ change flag is also cleared. This permits you to insert a disk {which sets the disk change flag) and then manually select A different density mode (which will clear the disk · change flag). Note that the manual selection of s density mode must be made AFTER a disk is inserted, otherwise the drive will re-select the density mode in response to the disk change.

1.4.3 Input & Output

Input and output of date is accomplished through the standard 13-pin MOLEX plug that is found on all devices that connect to the Atari computer’s serial I/0 port. Only one such connector is required to interface to the computer, but any other peripheral devices, such as a second disk drive, must _be daisy-chained to the system. This daisy chaining is accomplished by using the second 13-pin I/0 plug on the disk drive.

1.4.4 Activity/Control Panel Displays

The drive has several LED displays on the front control panel that supply various types of information. There are the usual ’POWER' and ’BUSY’ indicators that let you know when the unit is powered up and when the I/O data bus is being accessed. There is also a ’PROTECT’ indicator that tells you whether or not the drive is allowed to write to the disk that is currently inserted.

The most important LED display on the front panel is a two-digit alpha—numeric display that can provide you with a variety of information. This display can tell you the current density, drive number, track being accessed, and I/D error status. Three push -button switches on the display/control panel determine which of the display modes will be active. The only exception to this is that the error code display will over—ride all other modes when an error occurs.

1.5 REPAIR/REPLACEMENT POLICY

This manual is intended for use by a field service technician, not an electronics engineer. Hence, the topics covered in this manual are very general and do not delve into the theory of operation of each circuit. Virtually all of the repairs detailed in this manual can be accomplished without knowledge of electronics. Repairs, as detailed in this manual, go down to the IC chip level. This means that you are not expected, or authorized, to replace such things as capacitors or resistors. At the end d4 this manual you will find an authorized parts list. 1+ an item is not on that list, then you are not supposed to replace/repair it. If you find a fault in one of the electronics boards that is not covered in this manual, you are expected to return the board to INDUS Systems for repair. A replacement board will be shipped to you upon receipt of the defective board.

Chapter 2
Disassembly and Reassembly

The INDUS GT Atari disk drive is easy to disassemble and re-assemble provided you follow a few simple guidelines. This section specifies the tools and procedures you will need. Most of the necessary steps will be obvious to you after you have gone through them once or twice.

Each disk drive can be thought of as a collection of COMPONENTS, which are put together into various ASSEMBLIES, which, in turn are mounted on a CHASSIS and then enclosed in a HOUSING. ***Figures 2-1 and 2-2*** show exploded views of the drive.

2.1 EQUIPMENT NEEDED

A medium size Phillips heed (cross-point) screwdriver is all you will need for most of the disassembly and re-assembly of one of these drives. You will also find a smell Jeweler's screwdriver useful in removing end reinstalling the few springs you will encounter. If you are going to be removing any of the IC's, you should use the proper tools to avoid damaging any of the pins. For your convenience, here is a list of suggested tools:

* Medium sized Phillips screwdriver

* Small Jeweler's screwdriver

* 24/40-pin IC extractor (EX-2 extractor tool)

* 16-pin IC extractor (EX-l extractor tool)

* 48-pin IC insertion tool (MOS-40 CMOS safe inserter)

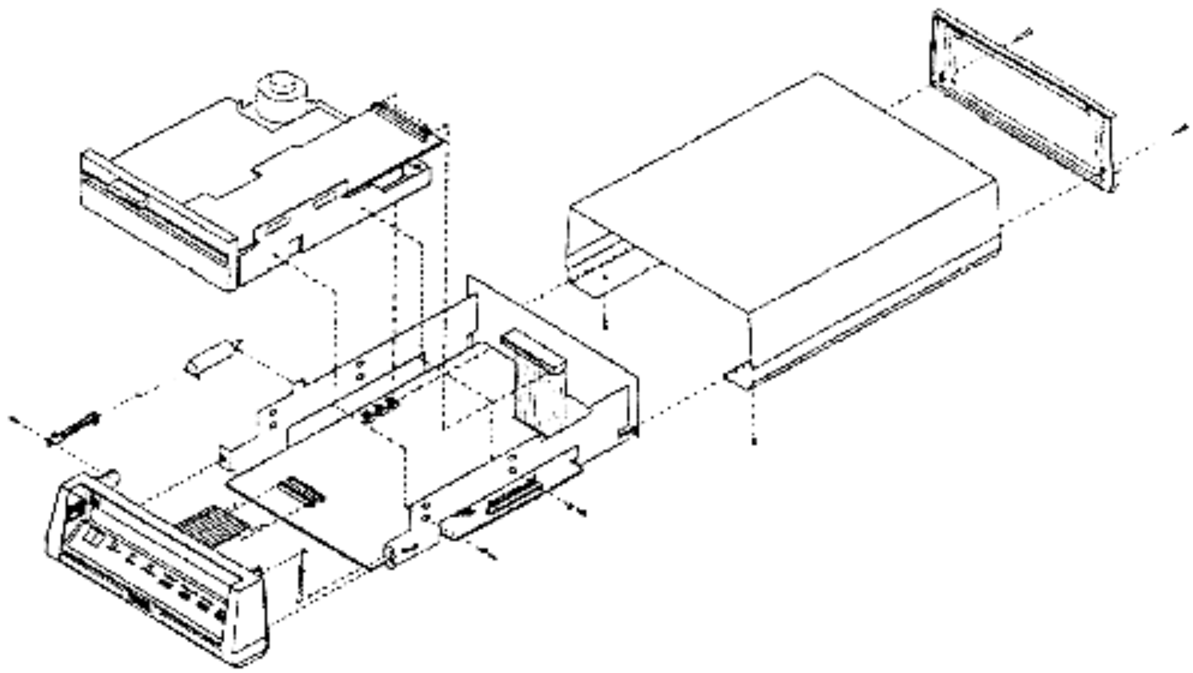
» 24-pin IC insertion tool (MOS-24/28 CMOS safe inserter)

16-pin IC insertion tool (INS-1416 DIP/IC inserter)

Anti-Static Wrist Strap connected to a good ground.

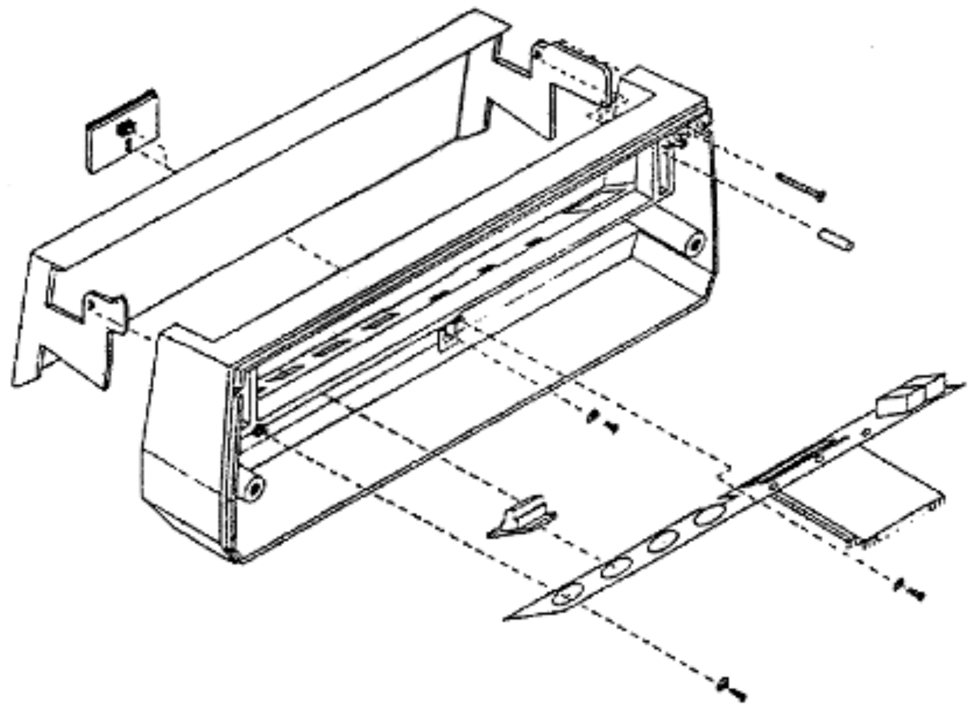
You should be able to find all of these tools or their equivalents at your local electronics supply store.

FIGURE 2-1_ Exploded View of INDUS GT Disk Drive



INDUS GT – ATARI MODEL
EXPLODED VIEW

FIGURE 2-2 Exploded View of Front Control Panel



2.2 CAUTIONARY NOTES

There ere certain common sense cautions that any technician should be aware of when working with modern solid state electronics, as well as a few special cases applicable to this disk drive in particular. Failure to follow these simple guidelines can result in destruction of sensitive electronic devices and possibly even severe electrical shock for the technician. Since these guidelines need special emphasis, we will itemize ·them. The special cautionary notes are:

NOTE I
REMOVE THE PRIMARY POWER CONNECTOR FROM THE REAR OF THE DRIVE BEFORE ATTEMPTING ANY ASSEMBLY OR DISASSEMBLY.

NOTE 2
TURN THE DRIVE'S POWER SWITCH TO THE OFF POSITION BEFORE PLUGGING IN THE POWER CONNECTOR.

NOTE 3
MAKE OR BREAK ALL ELECTRICAL CONNECTIONS BEFORE APPLYING ANY POWER TO THE CIRCUITS.

NOTE 4
PAY CAREFUL ATTENTION TO THE POLARITY OF ANY CONNECTOR BEFORE REMOVING IT. ALWAYS USE THE PROPER POLARITY WHEN RE-CONNECTING ANY CONNECTOR. PAY SPECIAL ATTENTION TO THE 20-PIN BUS CONNECTOR ON THE ANALOG BOARD.

NOTE 5
PAY CAREFUL ATTENTION TO THE ORIENTATION OF *PIN 1* ON ANY IC BEFORE YOU INSTALL IT. EACH BOARD HAS A SPECIAL STENCIL ON IT FOR EACH IC INDICATING WHICH WAY THE IC SHOULD BE INSTALLED.

NOTE 6
MANY OF THE IC'S CAN BE DAMAGED BY STATIC DISCHARGES. USE PROPERLY GROUNDED TOOLS AND WORKING SURFACES WHEN HANDLING EITHER THE IC'S OR THE BOARDS THEY ARE MOUNTED ON.

2.3 DISASSEMBLY INSTRUCTIONS

For convenience, we will assume that any disk drive brought to you for repair will be in an assembled state; we will therefore discuss the disassembly of a disk drive first.

2.3.1 Removing the Rear Panel

Place the disk drive on your workbench and position the drive so the rear is facing towards you. Using a medium sized Phillips screwdriver, remove the two screws you see (one on each side of the panel). Place the screws in a holding area and gently pull the plastic frame off of the rear surface of the drive. Do not remove the thin plastic graphics overlay unless it is already damaged. You may now proceed to the next step in the disassembly.

2.3.2 Removing the Main Housing

After completing ***section 2.3.1***, turn the drive upside down and law it flat on your workbench. You will see two small screws on each side of the bottom. Using a Phillips screwdriver. Remove each of these screws and place them in your holding area. Now, lift the rear of the drive up, with the bottom towards you, and grab the outside of the housing in both hands. Place your thumbs on the rubber {set and gently pull the housing up and off of the main disk drive assembly. You may now proceed to the next step in the disassembly.

2.3.3 Removing the Front Panel Assembly

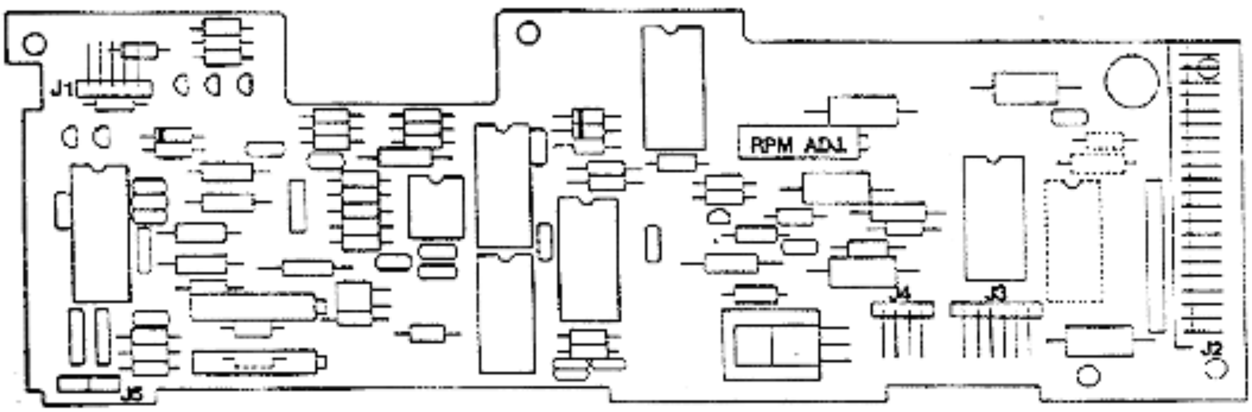
After completing ***section 2.3.2***, set the drive down with the rear of the drive towards you and you will see two small screws holding the front panel assembly to a pair of right angle flanges. Using a Phillips screwdriver, remove those two screws and place them in your holding area. Now, using either a spring tool or the Jeweler's screwdriver. Gently remove the small spring you will find attached to the left side of the front panel. Place this spring in your holding area. Next, find the small hydraulic damper on the opposite side of the drive. (It looks like a miniature shock absorber.) Slide the end closest to you off of its mounting post. DO NOT try to remove the entire front panel at this time. If you look at the exploded view drawings (see ***Figures 2-l and 2-2***) of the drive, you will be able to see that the front panel assembly is still attached to the main assembly by two small ribbon cables. This is as tar as you can go in removing the front panel assembly until the TANDON mechanism has been removed. Proceed to the next step now.

2.3.4 Removing the Top (Analog) Circuit Board

This step is necessary only if you are planning on shipping the analog board back to INDUS for a replacement. All of your repairs, except actually replacing this board can be accomplished without removing the analog board from the TANDON drive mechanism.

The analog board is held in place by two small screws and three interlocking slots/tabs. Once you have removed the two screws with the Phillips screwdriver, gently wiggle the board from side-to-side to disengage the tabs from their slots. The board should come free easily. Once you have the board free, you will need to unhook the four connectors that are attached to the board (see ***Figure 2-3***).

FXGURE 2-3 Parts Layout of the Analog Board



INDUS GT — ATARI MODEL

Connector J2 is the large 20-pin bus connector you will find on the back end of the board. Grasp the female mating connector with your thumb and forefinger. Now rock it back and forth while trying to pull the connector off of the board. The connector fits very snugly, so you will have to use more force than you have up to now. Be careful to remove the connector evenly or you will bend the pins on the analog board. Once you have removed this connector, gently remove connectors ***J1*** (a 4-pin connector) and ***J3*** (a 6-pin connector), which are located close to ***J2***. They should come off easily once you get a good firm grip on them.

Okay you are now ready to remove the last connector. Look toward the front of the board. You should see a 5-pin connector (***J0***) that is snugly mated with a right-angled plug. Remove this one in the same way you removed ***J1*** and ***J3***. On some of the older versions of the drive you may have to bend the pans of the plug up a little to be able to work the connector free. Once you have disconnected this last connector, the board can easily be lifted free of the TANDON drive mechanism.

Go back now and look at the board. Notice that the labels don the board) for the connectors don't quite match the labels on the connectors you Just removed. The table below lists the ID codes on the board and the actual code that is used on each connector. Note that the labels used on the board itself match those used in the schematics (see Section 7.0).

Board ID	Connector ID	Number of Pins
J1	J0	5
J2	NONE	20
J3	J3	6
J4	J1	4

This confusion in the connector IDs will also occur with some of the other subassemblies, so don't be surprised when we show you another table like this one elsewhere in this manual.

2.3.5 Removing the TANDON Drive Assembly

The TANDON disk drive mechanism is mounted to the main chassis with four small screws, two on each side. After you have made sure that the front panel assembly has been loosened, remove the tour mounting screws with a Phillips screwdriver. If you have not already disconnected the 20-pin bus connector to the analog board, do so at this time. The TANDON mechanism should lift easily out of the main assembly. Note that there are still three small connectors attaching the mechanism to the board below (the WART board).

Gently disconnect the three small 4-pin connectors. They should be labeled ***J7***, ***J9***, and ***J12***. Note, once again, that the labels on the connectors do not necessarily match the labels on the board. The table below shows you, which connectors go where:

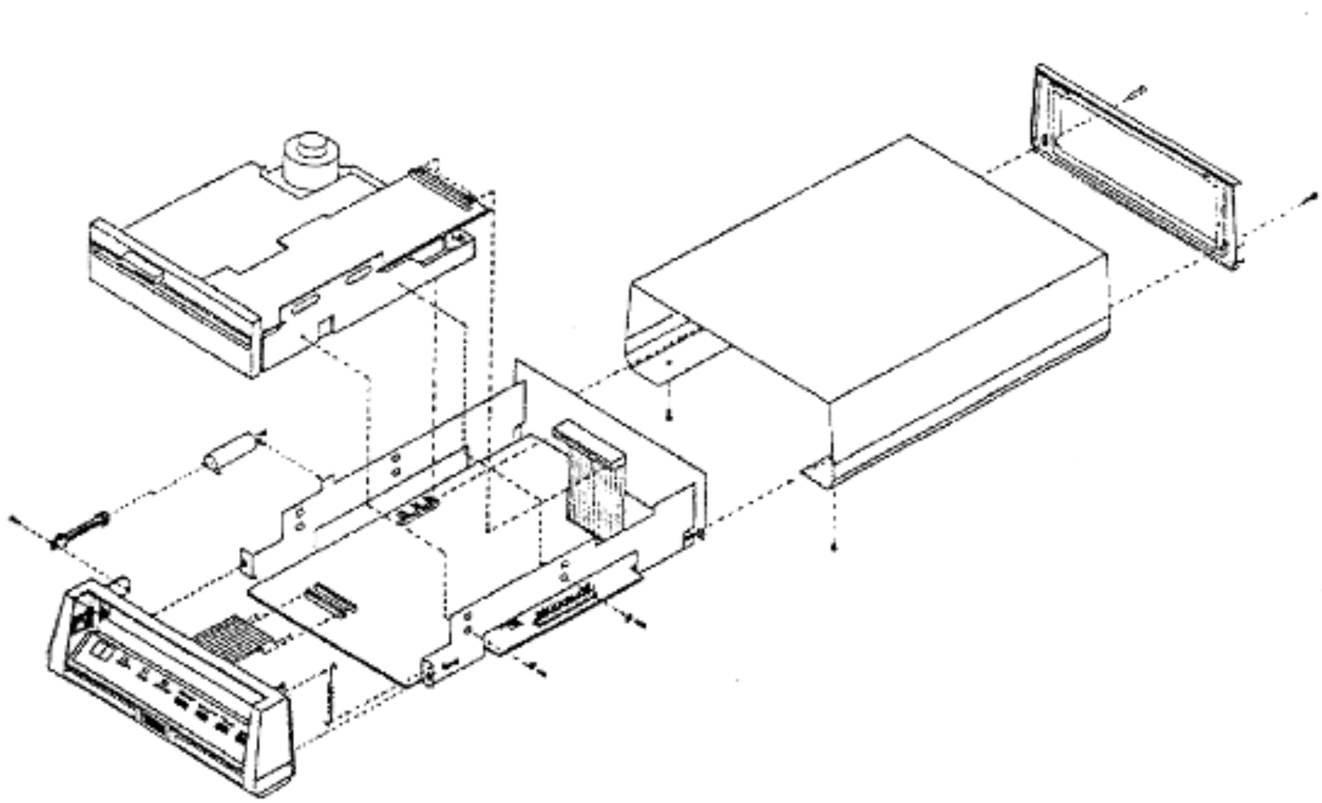
Board ID	Connector ID
J7	J7 or J11
J8	J12
J9	J9

Some versions of the drive may also be one or two small 2-pin connectors in the same bundle of wires. Ignore those connectors. See ***Figures 2-4 and 2-5*** for exploded views of the TANDON drive mechanism.

2.3.6 Removing the Plexiglas Cover

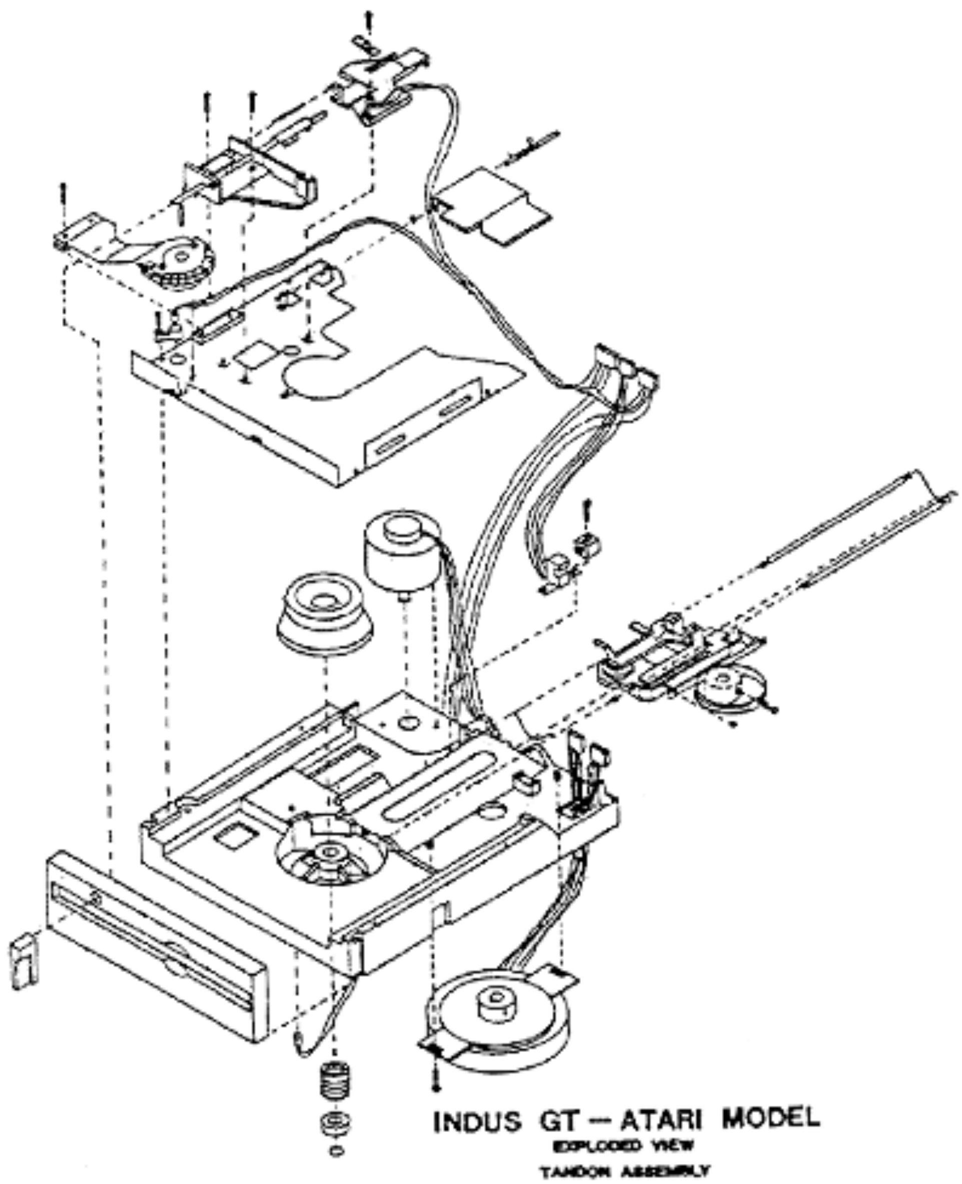
This step is needed only if you must replace the dust cover in the front panel assembly. What you should have at this stage is a main chassis with the WART board mounted in the bottom of it and a front panel assembly that is only attached by two 12-pin sections of ribbon cable.

FIGURE 2-4 Exploded View of INDUS GT Disk Drive



INDUS GT — ATARI MODEL
EXPLODED VIEW

FIGURE 2-5 Exploded View of TANDON Drive Mechanism



Take a close look at the ribbon cables. Older drives have bulky plastic connectors attaching the cables to the WART board. All of the later model drives have slim-line ribbon connectors. When you are ordering replacement parts be sure you specify which type of connector is needed.

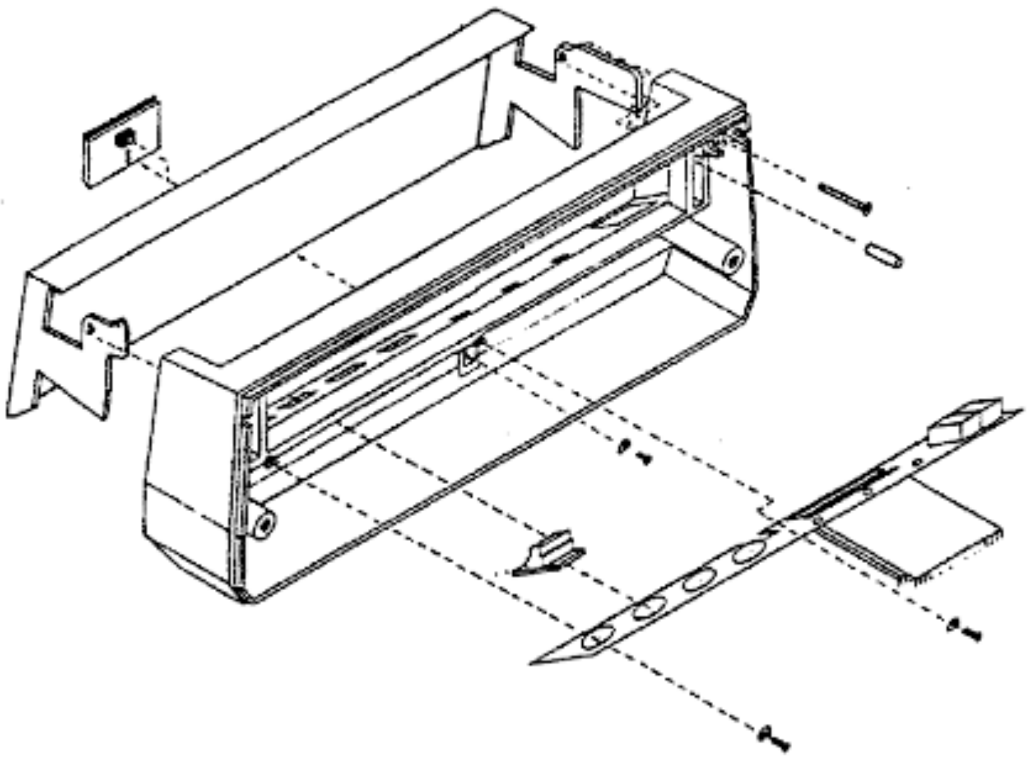
Okay, gently disconnect the ribbon cables (connectors ***J10*** and ***J11***) from the WART board. The front panel assembly should now be totally disconnected from the rest of the drive. If you look at the top inside portion of this assembly, you will see two small screws, which are holding a pair of dowel pins in place. These pins are the 'hinges' that the dust cover moves on. Loosen these two screws with a Phillips screwdriver and pull the dowel pins out. You may have to use a small pair of pliers to get the pins out. Once you get the dowel pins out, the Plexiglas dust cover will almost fall out into your hands. See **section 2.4.3** for instructions on how to re-install a new dust cover.

2.3.7 Removing the Front Display/Control Board

This step is necessary only if you are replacing either the display/control board or the front door latch. The display/control board is mounted inside the front panel assembly as shown in ***Figure 2-6***. This board has all of the LED displays as well as the PC bubble switches, which are actuated by the front panel push buttons.

First, make sure you have disconnected the ribbon cables from the WART board (***J10*** and ***J11***). The display/control board is held in place by two small Phillips screws. You do not need to actually remove these screws; loosening them should allow you to remove the display/control board. We do NOT authorize any repairs to this board. If you have a switch or LED failure, simply replace the board with a new one and ship the defective board back to INDUS for a replacement.

FIGURE 2-6 Exploded View of Front Control Panel



INDUS GT — ATARI MODEL
EXPLODED VIEW
FRONT BEZEL

2.3.8 Removing the Door Latch

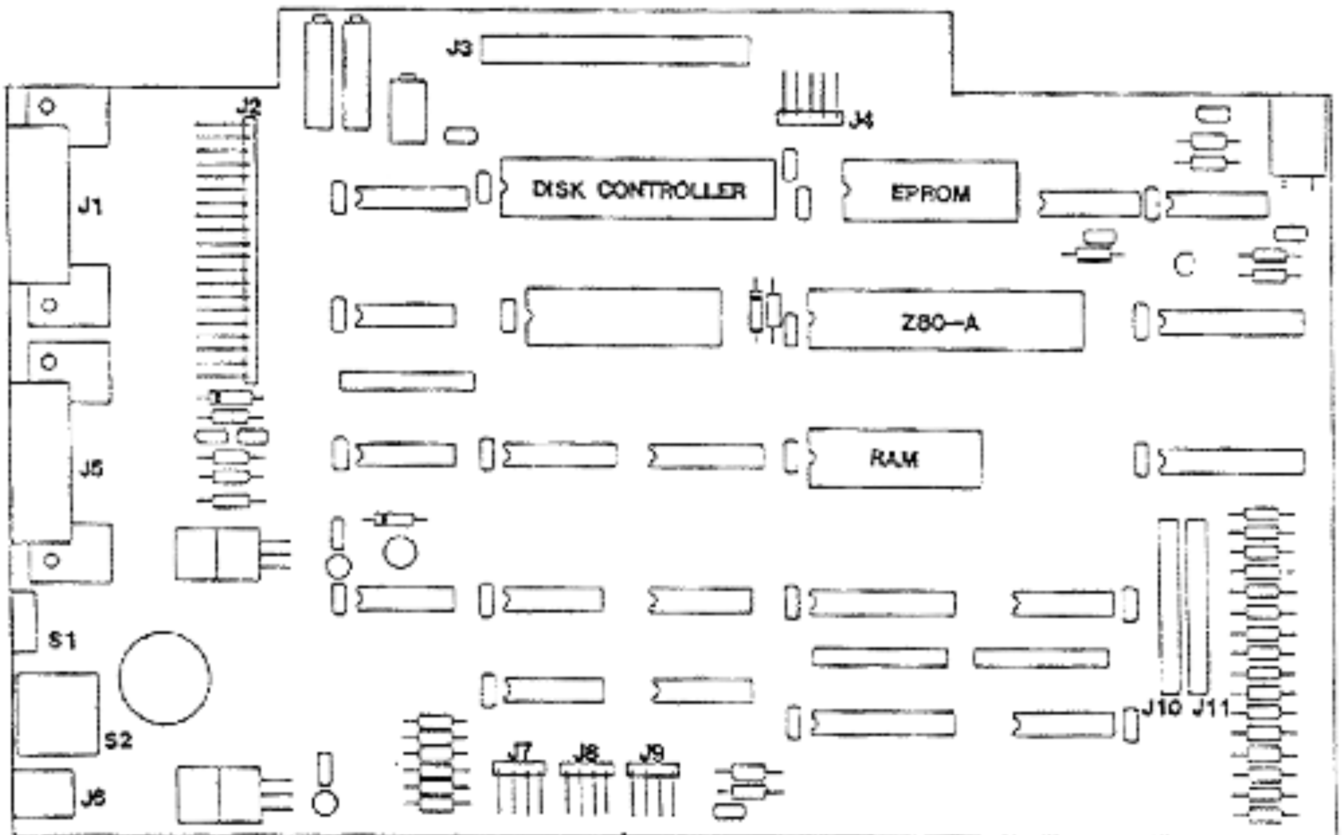
The door latch is the slide catch that secures the Plexiglas dust cover. Refer back to Figure 2-6 to see how the latch is mounted. You must remove the display/control board before you can get this latch out. Once you have the display/control board out, remove the single Phillips screw you will find in the center of the front panel assembly and the door latch will easily pull out. Be careful to catch the small spring that is under the latch.

2.3.9 Removing the WART Board

This is the last stage in the disassembly or an INDUS disk drive. You should have the main chassis with the WART board mounted in the bottom. All of the other assemblies should have been removed by now. SIX Phillips screws secure the WART board. You will find one screw in each of the four corners of the board. Go ahead and remove these four screws.

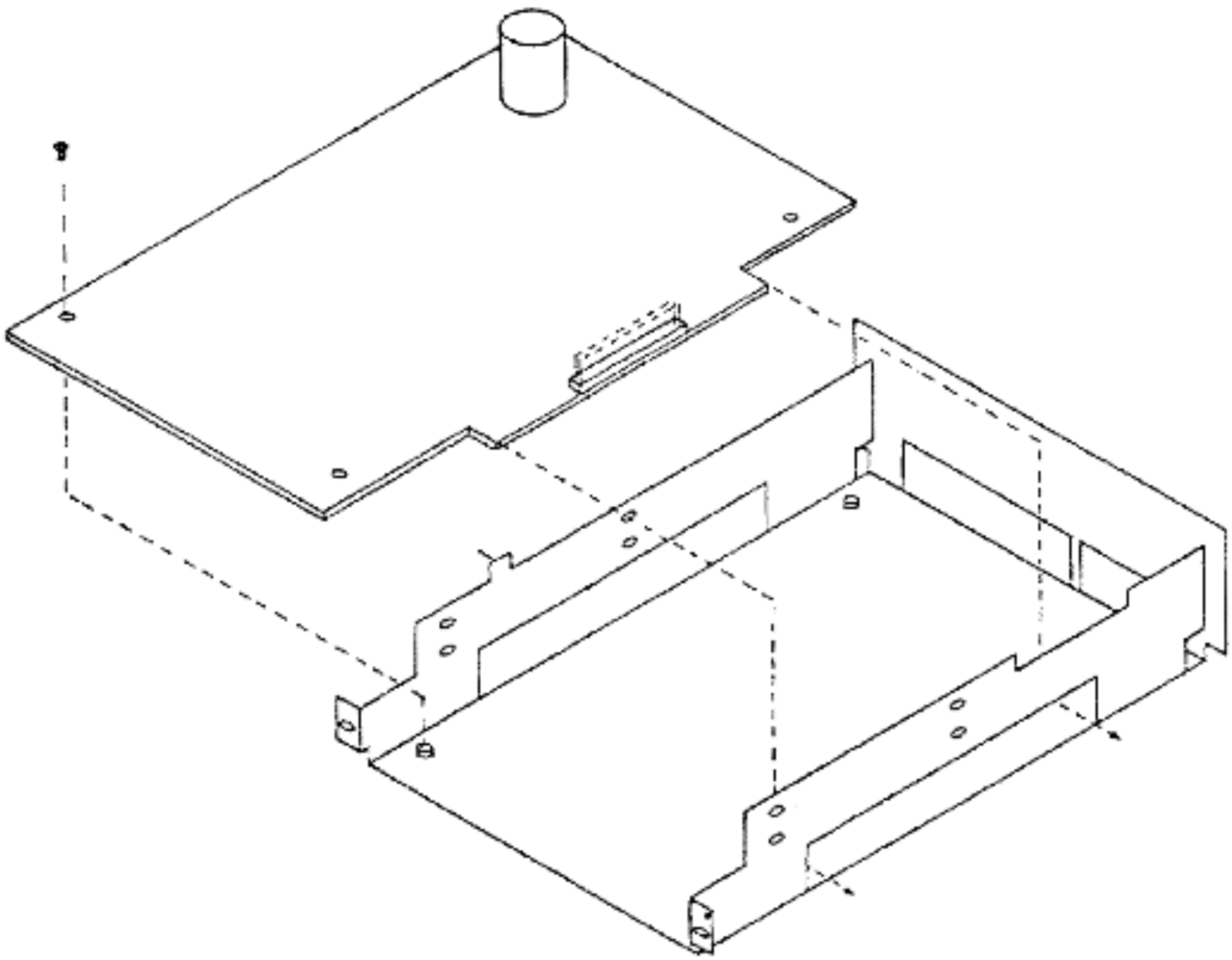
Now, look at the rear part of the board near the main power switch. Find the two voltage regulators***, VR1*** and ***VR2*** (see ***Figure 2-7***). Remove the Phillips screw from each of these components. The MART board is now disconnected from the chassis. A little physical maneuvering will enable you to work the board free from the chassis (see ***Figure 2-3***).

FIGURE 2-7 Parts Layout of the WART Board



INDUS GT — ATARI MODEL
MOTHER BOARD

FIGURE 2-8 Removal of the WART Board



2 .4 ASSEMBLY INSTRUCTIONS

The steps for re-assembling an INDUS disk drive are essentially no more than a reversal of the disassembly instructions. However, we suggest that you read through this section at least once to make sure that you don't overlook some crucial step. The instructions will start with the assumption that you have a completely disassembled disk drive.

2.4.1 Installing the WART Board

Slide the WART board into position in the bottom of the main chassis. Align the screw holes with their counter-parts on the bottom of the chassis. Using a Phillips screwdriver, install the four corner screws. Don't torque them down until you have all four loosely screwed in. Now, install the screws that go through the two voltage regulators, ***VR1*** and ***VR2***, which you will find near the main power switch.

2.4.2 Installing the Door Latch

Strangely enough, this is actually the most difficult step in re-assembling one of these drives. First, place the small latch spring in its slot on the front panel. Now, put your finger behind the assembly to hold the spring in place and compress the spring by using the bottom of the center flange on the latch itself. Make sure that the beveled part of the latch is toward the bottom of the assembly. It may take a little maneuvering to get the latch back in place with the spring properly compressed. Once you have done this, hold the latch in place with one hand and position the crew-cut washer over the hole on the backside. The flat section of the washer should be towards the top of the assembly. Now comes the hard part, while holding the latch in place, and without losing the washer, insert the holding screw back in its hole and tighten it down. Do not tighten the screw too much or the door latch will not function properly. (You may have to use a magnetized screwdriver to actually be able to accomplish this with only two hands.)

2.4.3 installing the Front Display/Control Board

Before installing the display/control board, make sure that any of the push buttons that may have fallen out are back in place. Then, position the display/control board inside the front panel assembly with the ribbon cables coming out the back of the assembly. The small slot that is cut into the side of the board should fit over the screw that holds the door latch in place. lf the board does not slide into place easily, try loosening the holding screws a little bit. Once you have the board positioned in the front panel assembly, lightly tighten the two screws until the board is snugly held in place. Do not over torque the screws or you may damage the board.

2.4.4 Installing the Plexiglas Cover

Position the Plexiglas dust cover inside the front panel assembly in approximately the place it will normally be installed. Make sure that the two retaining screws are well clear of the place where the dowels need to go. Now, push the dowels through the hinge holes in the cover and correct the cover's position as much as you can. Spread a little quick drying cement (such as airplane glue) on the outside end of each dowel pin, being very careful not to let any glue get on the plexiglas cover. If you get any glue in a hinge hole, IMMEDIATELY remove the dowel pin and clear the hinge hole. If everything is going okay so far, then tighten the retaining screws until they hold the pins in place. (Yes, the screws are supposed to be in contact with the wet glue.) Double check the proper positioning of the dust cover and then let the glue dry. If you positioned everything just right, the cover should be able to easily clear the top edge of the front panel assembly. Unfortunately, the only way to accurately check this out is by raising the dust cover when it is installed on the main chassis.

2.4.5 Installing the TANDON Drive Assembly

First, take the front panel assembly and plug the two ribbon cables back into their appropriate places (***J10*** and ***J11***) on the WART board. Next, slide the TANDON drive assembly into the top cavity of the main chassis and line up the holes in the chassis with the screw holes in the sides of the TANDON drive mechanism. Now, insert the holding screws into their respective holes and torque them down. This task will be easier if you don't tighten the screws until after you have gotten all four screws started. The next step is to re-connect the 20-pin bus connector to the analog board and the three 4-pin connectors to the WART board. You should also make sure that ***J0***, ***J1***, and ***J3*** are still properly connected to the analog board.

2.4.6 Installing the Analog Board

The first step to installing the analog board is to slip the board into position on the top of the TANDON drive mechanism. One edge of the board fits snugly into slots cut in the drive mechanism. Insert the two retaining screws and tighten them down. Next, plug the three small connectors (***J0***, ***J1***, and ***J3***) into their respective places on the board. See ***section 2.3.4*** if you have any questions about which connector goes where. Finally, re-install the 20-pin bus connector.

2.4.7 Installing the Front Panel Assembly

If you have not previously re-installed the two 12-pin ribbon cables, then go back and remove the TANDON drive mechanism so you can plug the two cables into their positions on the WART board. With the connectors plugged in, position the front panel assembly so the screw hole on each side lines up with one of the flanges, which are on the outside of the chassis. Insert the holding screws and tighten them down. Next, use a small Jeweler's screwdriver (or a spring tool) to install the small spring on the backside of the assembly. Finally, slip the loose ends of the hydraulic door damper over the screw post you will find on _the other side of the chassis. The 'log wheels' on the damper should be towards the bottom of the drive.

Chapter 3
DIAGNOSING A PROBLEM

3.1 WHAT TO DO FIRST

Before you actually try to repair a defective disk drive, you should try to get some idea as to what is wrong with it. The first thing to do is read the service report (if any) to see if you can isolate the probable cause of the defect. Next, you should give the drive a good close visual inspection. Note any obvious defects and determine whether they need repair or not. Finally, before you disassemble the disk drive, go through this inspection checklist:

1. Inspect the power and I/O connectors. Make sure that they are properly installed and that they have no broken pins. Also make sure that their mating cables plug in properly.

2. Verify that the dust cover lifts smoothly and that the front latch opens and closes easily. The head arm should lift when the front latch is open.

3. Verify that a diskette can be easily inserted and removed from the drive.

4. Take the main housing off of the drive and make sure that all of the circuit board connectors are properly seated and have no broken wires.

5. Check for any loose or missing hardware.

6. Manually rotate the drive hub. It should rotate freely.

7. Check the circuit boards for any damaged or missing components.

8. Attach an INDUS power supply to the drive and turn the power ON. The LED display should flash through a series of codes beginning with 'C', then stop on track 00 for a few seconds, and finally come to rest on track 39. The drive motor should come ON during his sequence and turn OFF at the end. Note any deviation from this sequence.

The next step is to try to determine if the defect is due to an electrical fault or a mechanical one. Electrical faults are divided into three categories: power, analog, and digital. We will discuss the potential power problems first and then the more prevalent mechanical faults. This chapter will then discuss the drive's internal diagnostics, which can help you isolate some of the more common digital problems. The next chapter extends the discussion into using a special diagnostic Atari program, GT-DOC, which can help you analyze much of what the drive is doing.

3.2 POWER SUPPLY PROBLEMS

Power problems are usually the simplest ones to diagnose and repair. Power problems fall into one of three major groupings. The external power transformer is the source of most power related problems. Occasionally, the power input connector in the drive may be the culprit. If you are lucky, the power problem won't be due to a defect in the power circuit on the UART board.

3.2.1 External Power Transformer

The INDUS GT external power transformer should have an output of somewhere between 12.2 and 13.0 volts DC. You can verify this by using any common voltmeter. ***Note that the output is DC, not AC like the Atari power transformers.*** It is possible that someone may have accidentally attached one of the AC Atari supplies to the INDUS drive. The result would be a non-operating INDUS disk drive; but there should be no actual damage to the INDUS drive electronics.

First, check the power supply that came with the drive and verify that it is a standard INDUS unit. Next, attach your voltmeter to the output connector of the power supply and plug the power supply into a normal 120 VAC wall socket. Verify that the output of the power transformer is between 12.2 and 13.0 volts DC. If the power supply checks out okay, then unplug it from the wall socket and disconnect the voltmeter.

3.2.2 Power Input Connector

The INDUS input power connector is a simple device and is unlikely to cause you any problems; but it is possible that it may be damaged by excessive physical abuse. About the only thing that could go wrong is one of the three solder connections with the WART board might get cracked or broken. You will have to almost completely disassemble the drive to check this since you will have to actually remove the WART board.

The older models or the INDUS drive have a power connector that is slightly too large in diameter and slightly too short in length (depth) for the standard power supply output connector. This results in a poor power connection and the plug tends to fall out of the socket it you look at it too hard. Unfortunately, it is hard to tell the difference between the old and the new connector except in the way the transformers output plug fits into it. One general rule of thumb is that all drives that have a version 1.2 ROM (or EPROM) should have the new power connector. Drives with an earlier ROM version probably will have the old connector.

3.2.3 Internal Power Elements

There are a number of components on the WART board that are associated with the input power. These are what we are calling {internal power elements'. None of these components are on the approved replacement list. Ii you trace a power problem down to a defect in the WART board, then simply replace the entire board unless the problem is a bad power connector.

In general terms, anytime you trace a problem to the components (other than IC's or connectors) on a PWA you are supposed to simply replace the board and send the defective board to INDUS for a new one. This case is no exception; but we suggest that you perform further diagnostics before automatically replacing the WART board.

3.3 MECHANICAL PROBLEMS

Mechanical problems can sometimes be the easiest ones to spot and the most difficult ones to fix. We will address some of the more common mechanical problems in this section. If present, most of these problems will be glaringly obvious to You during your initial visual inspection of the drive.

3.3.1 Dust Cover will Not Open

This problem is fairly common and can be caused by a couple o¥ things. The dust cover is hinged on a couple or dowel pins. lf the cover gets pressed from the top, it is possible to knock the dowel pins out of alignment. This can result in faulty operation of the dust cover. It is also possible that the drive was left in a place, such as a car, when the environment was hot enough to cause the cover to warp. Ii the problem is due only to a misalignment of the dowel pins, and then you can correct the problem by physically realigning them. 14 the cover itself+ is damaged, then you must replace lt. In either case, you will find instructions for installing a dust cover in ***section 2.4.4.***

There are a couple of other possible problems you might run into in this area. First, the cover will not open properly if the door spring has come off or if the hydraulic damper is malfunctioning. You could also have a problem if the door latch is not sliding properly.

3.3.2 Missing or Broken Springs

There are four or five different springs in an INDUS disk drive. They are highlighted in ***Figure 3-1***. Spring number five has little bearing on the operation of the drive; but the other four will have a very noticeable effect ii they are broken or missing. If a spring is broken or missing, replace it.

The spring in the door latch causes the slide switch to move back into the 'latched' position. If the door latch does not function properly, the cause may be a missing spring or the retaining screw for the latch may be too tight.

The spring on the back-side of the dust cover is what causes the cover to open when the door latch is released. If the dust cover does not open properly. This spring may be missing.

The spring near the read/write head pulls a felt padded arm down on the diskette during normal read/write operations. This pad makes sure that the read/write head is snug against the diskette. If this spring breaks, you will get unreliable operation during virtually all read and write functions.

The spring near the locking bar on the TANDON mechanism is the diskette ejector spring. If this spring is missing, there will be very little resistance when you try to insert a diskette into the drive and the diskette will not automatically eject when you open {NE locking oar.

Some drives have a fifth spring attached to a plate near the read/write head. This spring serves no useful purpose and you will find it has no effect on drive operation whether the spring is there or not. You may ignore this spring.

3.3.3 Broken wires/Connectors

The most likely connectors to have problems are the two serial I/O connectors on the rear of the drive. The most common problem is that the user will be careless when plugging an interface cable into the drive and bend one or more of the pins in the connector. You can try to simply straighten the bent pins using a smell set of needle nose pliers; but the damage may be so bad that you will have to replace the entire connector. This is a problem you should identity when you perform your initial visual inspection of the drive.

The next most likely connector problem area is with the DIPswitch in the rear of the drive. We realize that this is not exactly what you would call a connector; but it seems appropriate to discuss it at this point anyway. The switch is mechanically attached to the WART board by nothing more than the leads coming out of the package. If the user has been changing the switch settings a lot, then it is possible to break those rather fragile solder connections. Usually the only clue to this is that the drive will refuse to configure to another drive number.

The remaining connector and _wire problems are likely to occur only if the drive has been opened. You will have to be careful not to contribute to the problem while servicing the drive.

The most likely break occurs at the Junction of the 20-pin bus cable on the WART board. It is difficult not to flex this flat cable some when you are working on the drive. The result is that some of the wires in the cable will break off right at the surface of the WART board. This can result in an unpredictable collection of problems. All we can suggest here is for you to be aware of the potential for a problem with this cable and make sure you carefully inspect it before you reassemble the drive or replace a good board that Just appears to be bad.

The second most common problem is with the wires going into connectors J1 and J3 on the analog board. These wires are easy to break off when you are sliding the main housing on or off of the drive. There are a number of possible symptoms that could result from one of these wires breaking. One that is fairly common is that the drive motor runs at 700 plus RPM.

Less frequently you will have a problem with the three connectors (J7, J8, and J9) on the WART board. The center connector, in particular, is a problem occasionally. This connector runs back to the write protect sensor. If the drive motor refuses to turn DPF, the write protect sensor may be bad. You can check this by snorting the center two pins of the center connector. This bypasses the write protect sensor· altogether. In this condition, the only thing that determines the 'protect' status of a diskette is the front panel PROTECT switch. Do not leave a drive in this configuration. With those two pins shorted, the drive's automatic density selection will no longer work.

3.3.4 Door Locking Bar

There are two potential problems that you might find with the door-locking bar. The first, and most probable one, is that the handle on the front of the bar may come off. I4 it has come off or been broken, simply replace the handle. ***Figure 3-2*** shows what the bar assembly looks like in an exploded view. There is a stud screwed into the shaft (et a right angle) end the handle is installed with a simple press fit.

The second possible problem is more serious and probably will require you to replace the entire TANDON drive mechanism. The back end of the locking bar has a rather peculiar looking cam attached to it by a smell dowel pin. If that dowel pin breaks or falls out, the drive spindle will not be able to engage the diskette. Since the only replaceable sub-assembly in the TANDON mechanism is the entire TANDON mechanism, you must replace the entire drive assembly.

3.3.5 Drive Belt

The drive belt is not on the approved replacement list. It this belt breaks, you will have to replace the entire TANDON drive mechanism. The primary symptom of a broken drive belt is that the diskette drive spindle will rotate manually, but not when you power up the drive. You will have to remove the TANDON mechanism and visually inspect the bottom of it to find out if the belt is really broken.

3.3.6 Read/Write Head Guide Rails

The read/write heed slides back and forth on a pair of metal guide rails. If these rails are not lubricated properly, the drive may not function normally. Specifically, the drive may have trouble reading or writing random sectors on a diskette. A dirty read/write head could also cause performance problems of this kind.

3.4 LEVEL ONE INTERNAL DIAGNOSTICS

The WART is designed to perform one of two power-on self-tests (POST). These tests are normally referred to as the LEVEL ONE internal diagnostics and the LEVEL TWO internal diagnostics. This section will discuss the LEVEL ONE diagnostics in some detail. The LEVEL TWO diagnostics will be discussed in the next section. You will find that these two built-in diagnostic programs can save you a lot of time when it comes to finding bad ICs.

The LEVEL ONE diagnostics are always performed whenever the drive is powered up. This diagnostic performs a quick check on several of the major ICs. The specific test sequence is as follows:

1. Z80A processor flag testing and partial primary accumulator ([A]) test.
2. Z80A primary accumulator ([A]) test.
3. Z80A primary and alternate 8-bit utility registers ([B], [C], [D], [E], [H], [L]. [A'], [B'], [C'], [D'], [E'], [H'], [L']) and interrupt register ([I]) test.
4. Z80A stack pointer ([SP]) test.
5. Control ROM (EPROM) checksum test.
6. *Quick* SRAM (static RAM) test.
7. Z80A index registers ([IX], [IY]) test.
8. Floppy disk controller (FDC) test.

You should understand at this point that if one of the self tests fails, that does not necessarily mean that the component which is undergoing the test is detective. The device's supporting circuitry may be at fault. However, replacing that component is probably a quick and easy first step you could try.

All of the internal diagnostics, except for the main Z80A processor tests (items 1 through 4 above), display a special code on the drive's LED display prior to the beginning of each test. This code always starts with a capital letter 'C' and ends with a single digit number between zero and three (0, 1, 2, 3) for the LEVEL ONE diagnostics.

Since all of the LEVEL ONE tests are performed faster than the human eye can Follow, the 'C' displays are provided as a diagnostic aid Just in case the drive goes "off in the weeds' before a test is completed. Should a test be completed, but fail, the 'C' is changed to an 'H' (testing Halted at test '0, 1, 2, 3'), and the drive stops. Whenever such a halt occurs, the drive sends a tone to the host Atari computer over the audio line to alert you that a problem has occurred.

3.4.1 Z80A Processor Tests

Since the Z80A processor cannot be relied upon to perform correctly if it fails any of its self-tests, the Z80A is simply instructed to HALT (not the same as the Halt we Just discussed) whenever a failure is discovered in the initial test series. This means that the disk drive simply will not work at all if the Z80A is defective this is better than corrupting a disk). With the proper tools (logic probe or oscilloscope) you can detect a Z80A test failure by monitoring the Z80As HALT pin for a quick non-halt then halt condition. If the Z80A halts when it is powered on, then something besides the self-test probably caused the halt condition.

The chances of the self-test detecting a defective Z80A are extremely unlikely since the Z80A must be operational to some extent for the tests to run at all. About all a self-test can do is check the registers, similar to a quick RAM test. A Z80A could still function with one or more bad registers, but it would make a mess out or any data it manipulated.

3.4.2 (C0/H0) ROM Checksum Test

This test computes a 16-bit checksum of the controlling ROM (EPROM) and compares that number to the contents of the last two bytes of the ROM image. This test provides a 65535 out of 65536 chance of detecting any bad bits in the ROM image. If the ROM image is bad in any areas which the Z80A uses for the tests in ***section 3.4.1***, the Z80A will probably get lost before the drive ever gets this far. However, assuming that the internal diagnostics do get this far and this test fails, an error code HB will come up on the drive's LED display.

3.4.3 (C1/H1) Quick RAM Test.

The WART board contains a 6116 (2K SRAM) chip, which is used for internal operations and to store any data that is transmitted or received over the serial bus from the Atari computer. This test checks that RAM chip by filling the entire RAM with a 55AAH checkerboard pattern and then trying to read the pattern back. It the pattern read back matches the original pattern written to the RAM, the test is repeated using the reverse pattern AA55H. If the pattern read back on the second pass is okay, the RAM is passed as 'good'. If this test fails, an H1 code will be displayed on the disk drive's LED display.

3.4.4 (C2/H2) Z80A Index Registers Test

This test is separate from the initial Z80A tests that were performed earlier in the power up sequence. The Z80A index registers ([IX] and [IY]) are not tested until after the quick RAM test because the index registers test relies upon the RAM during the testing. Since the main Z80A registers will have had to pass their testing before you could get this far, an index register test failure will not HALT the Z80A processor. Instead, if this test fails, an H2 error code will be displayed on the drive's LED display and the drive will Halt.

3.4.5 (C3/H3) Floppy Disk Controller Test *

The floppy disk controller (FDC) is the heart of the disk drive. This test runs through a complex series of routines to checkout the FDC. The test proceeds as follows:

1. The UART issues a FORCE IMMEDIATE INTERRUPT command to the FDC.

2. The Z80A goes into a short time delay loop for 52 microseconds. This is the maximum time the WD1770 should require to respond. The WD2797 is a lot faster.

3. The FDC INTRQ line is tested to see if the FDC has interrupted. Note that the FDC INTRQ line is not tied to the Z80As IRQ line. The test fails if the FDC has not responded.

4. The FDC is issued a FORCE INTERRUPT command to clear the FORCE IMMEDIATE INTERRUPT condition.

5. The Z80A once again waits for 52 microseconds to allow plenty of time for the FDC to respond.

6. The FDC status register is read to clear the FDC interrupt condition.

7. The Z80A waits for another 52 microseconds to allow time for the FDC to respond.

8. The FDC INTRO line is again tested to make sure the FDC has cleared it. The test fails if the FDC has not responded.

9. The FDC track, sector, and data registers (in that order) are loaded with 00H, 01H, and 02H respectively. Then the data, sector, and track registers (in that order) are tested to see if the pattern has changed. The test fails if there is a mismatch. If all three patterns match, the test is repeated with 01H, 02H, and 03H respectively. This testing continues until the last pattern used is FFH, 00H, and 01H respectively.

10. The FDC track register is copied to the data register and a seek command is issued. This causes the FDC to seek to the track it is already on. This test verifies that the WD1770 is in Mode 1 and that the IP is reselected in the status register. This test isn't required with the WD2797.

11. The FDC index pulse (IP) line is set active.

12. The Z80A delays for slightly more than 20 microseconds to give the FDC time to react.

13. The FDC status register is checked to see if the index was recognized. The test fails if it was not recognized.

14. The FDC index pulse line is deactivated.

15. The Z80A delays for slightly more than 20 microseconds to give the FDC time to react.

16. The FDC status register is checked to see if the removal of the index was recognized. The test fails if it was not recognized.

If any of these tests fail, the drive will show H3 in the LED display and 'H'alt.

3.5 LEVEL TWO INTERNAL DIAGNOSTICS

Only a service technician normally uses the LEVEL TWO internal diagnostic tests since a specially configured MOLEX connector (diagnostic plug) are required to run the tests. These tests perform a more extended series of tests on the disk drive. When LEVEL TWO testing is initiated, the drive first performs all of the LEVEL ONE tests. Then the drive performs the following series of tests:

1. Peripheral bus interface test.
2. Interrupt circuitry test.
3. Extended SRAM (static RAM) test.

This section will first explain how the MOLEX connector must be configured and how to invoke the LEVEL TWO internal diagnostics. Then we will discuss each of those tests in detail.

The MOLEX Test Connector:

The MOLEX connector is the standard 13-pin serial bus connector used to interface the disk drive to an Atari computer. For this test, you will need one of these connectors without a cable attached and with certain pins shorted together as follows:

- Pins 1, 2, and 7 shorted (CLOCKIN, CLOCKDUT, and CMD signals)
- Pins 3, 5, and 10 shorted (DATAIN, DATADUT, and ROY/+5V signals)
- All remaining pins should be left open.

This special connector should be inserted into one of the WART peripheral connectors. It does not matter which connector you use; but no cable should be attached to the other connector. Without this special connector, the LEVEL TWO internal diagnostics will always fail.

3.5.0 How To Invoke The LEVEL TWO Tests.

The LEVEL TWO internal diagnostics are invoked as follows:

1. Turn the disk drive OFF.
2. Disconnect any I/O cables from the drive.
3. Plug the test connector into one of the I/O ports on the drive (it doesn't matter which port.)
4. Press and hold down the TRACK, ERROR, and DRIVE TYPE buttons on the drive's front control panel.
5. While still holding the three control buttons, turn the disk drive power ON.

If you perform this test on a 'good' drive, the drive's LED display will flash through a series of test codes (as described in the previous section) and appear to stop with a display of C6. If you wait a moment, the display will suddenly switch to displaying a lower case 'c', i.e. c6. This display will alternate between C6 and c6 for a long time. This is the normal sequence of displays for a good disk drive.

3.5.1 (C4/H4) Bus Interface Test

The WART tests the bus interface by driving these two shorted sections of the MOLEX connector with high & high, high & low, low & high, and low & low signals on the CLOCKIN and DATAIN lines. These signal labels, by the way, are taken from the 400/800 technical reference manuals, which were published by Atari, Inc®. If all six of these signals do not respond accordingly, the test fails and the drive will display H4. The table below is a quick checklist of the possible combinations.

SHORT 1,2,7	(HI,HI)	(HI,LO)	(LO,HI)	(LO,LO)
SHORT 3,5,10	(HI,HI)	(HI,LO)	(LO,HI)	(LO,LO)

3.5.2(C5/H5) interrupt Circuitry Test.

The WART tests its interrupt circuitry by driving the CLOCKIN line (labeled from the Atari computer's viewpoint) to control the CMD line during the following test sequence:

1. The interrupt vector is initialized to point to a routine, which simply loads the accumulator ([A]) with BFFH and then returns from the interrupt.
2. The stack pointer ([SP]) is initialized to the end of the static RAM so it will be possible to return from interrupts. Of course, for this to work the RAM has to be good.
3. The CMD line is set inactive (high) via the CLOCKIN line.
4. The interrupt requests (IRQs) are enabled (EI) and a no-operation (NOP) is performed to give any latched IRQs a chance to be processed. Any such IRQ will run through the special self-test interrupt service routine (ISR); but the fact that ([A]) was loaded with 0FFH will be ignored.
5. The accumulator ([A]) is cleared to 00H and another NOP is executed to give time for any stray IRQs to be trapped.
6. The IRQs are disabled (DI) and ([A]) is tested to see if an IRQ occurred. The test fails if one did.
7. The CMD line is set low and then back to high via the CLOCKIN line to cause an IRQ to be latched by the circuitry.
8. The IRQs are re-enabled and a NOP is performed to give the IRQ a chance to occur.
9. The IRQs are again disabled and ([A]) is checked to see if an IRQ did indeed occur. If one does not occur, the test fails.

If any of the tests in this sequence fail, the drive will display H5 in the LED window and the drive will Halt. If this test fails, try replacing the WART board.

3.5.3(C6/H6) Extended RAM Test

This test, the last one in the series of internal diagnostics, executes a time consuming test on the drives static 6116 - 2K SRAM. Since the test is a long one, the LED display will alternate between C6 and c6 until the test is complete. If a failure occurs, the LED display on the drive's front panel will change to H6 and the drive will Halt. The extended RAM test is performed in the following sequence:

1. The entire 2K SRAM is cleared to 00H.
2. The least significant bit (bit 0) of the first byte (01H of RAM address 0000H is set. This byte is the first 'test byte'.
3. All of the other bytes in the entire RAM are tested bit-by-bit to see if any other bits have toggled on. If any bit other than the proper one is set, the test fails.
4. The original test byte is re-examined to verify that the test bit is still set and no other bits are set. If the byte is set incorrectly, the test fails.
5. The original test byte is cleared to 00H.
6. The next byte (RAM address 0001H) is selected as the new test byte and the test sequence is repeated. This loop is repeated until every byte in the RAM has had a chance at being a test byte.
7. The test bit (the one being turned on) is changed to bit 1 and the entire test series is repeated from step number two. This exterior loop is repeated until every bit in every byte has had a chance to be the test bit.

If this test fails, replace the SRAM chip (6116 at U13) on the WART board.

When the LEVEL TWO Diagnostics are completed

When the LEVEL ONE internal diagnostics are successfully completed, the drive is initialized for normal operation; however, when the LEVEL TWO internal diagnostics are successfully completed, an E- (no error) is displayed in the LED window and the drive freezes up (goes into an infinite loop) while it produces a tone over the computer bus audio line.

The tone is to alert you that the LEVEL TWO test is complete. The drive does not initialize for operation following the LEVEL TWO internal diagnostics for two reasons. First, the special MOLEX shorting connector is still in the drive's I/O port. Second, the LEVEL ONE diagnostics must be run again to properly configure the drive for normal operation.

If you wish to set the drive up for normal operation, turn the drive OFF, remove the diagnostic connector and reconnect the standard Atari I/O cable. Once this is done, turn the drive power back ON and the drive will perform its usual LEVEL ONE internal test before it is ready for normal operation.

NOTE: Once the LEVEL TWO internal diagnostics have been completed, you can restart the entire test series again by pressing and holding down the TRACK, DRIVE TYPE, and ERROR buttons.

Chapter 4
DIAGNOSIS WITH GT-DOC

4.1 OVERVIEW OF GT-DOC

GT-DOC is a compiled BASIC program designed to exercise various functions of the INDUS GT Atari disk drive. The program assumes that the drive in question has already passed the internal diagnostics we described in section 3.8. The features of this menu driven diagnostic program can be an aid in isolating the possible cause of a problem before you open the drive casing.

The GT-DOC program should run properly on any Atari 400/800/1200XL or 600XL/800XL that has at least 40K of RAM. You do not need any special peripherals except for an INDUS GT Atari disk drive. A printer is not required. The program source code was written in Atari BASIC and compiled using the ABC Compiler, a copyrighted product of Monarch Data Systems, Cochituate, MA 01778.

We suggest that you run this program on a computer system that has a known good drive for drive number one. It does not matter whether the 'system' drive is an INDUS GT or not for the purpose of running this program. Attach the defective drive to the system as drive number two. The master diskette containing the GT·DOC program comes with the OSS disk operating system on a standard single density diskette. lf you normally run your system in double or dual density, simply transfer the file GTDDC.COM over to a diskette formatted in the desired density.

The program is independent of DOS in most of its functions. Exceptions to this rule will be noted in the write up on the appropriate commands. Although it is possible that some of the routines in the GT-DOC program may work on a non-INDUS drive, we do not support any operations on other types of drives.

Before you go any further, turn ON the drive to be tested. If it passes the initial internal diagnostics, then GT-DOC will function properly on the drive.

To run GT-DOC, boot your computer system and perform a binary load of the file GTDOC.COM. The master program diskette contains the OSS DOS and the OSS DOS menu. If you are booting from this diskette, the following steps will get you going:

1. Turn drive number one ON.
2. Insert the GT-DOC master diskette (label side up).
3. Turn the computer ON.

NOTE: Hold down the OPTION key on a 600XL or 800XL.

4. Wait for the DOS menu to appear on the screen.
5. Now perform a binary load of GTDOC.COM.

NOTE: Do NOT use the Xtended Command menu option.

4.2 THE COMMAND MENU

The first thing that the program will ask for is the drive number to be tested. You may specify any number from 1 to 8; but remember that the computer can address only four drives under normal operation due to hardware limitations in the Atari computer itself. Assuming that you are using the recommended two drive set up, you should enter the number '2' at this time. The GT-DOC main menu will then appear on the screen showing you the following options:

A. Disk Directory	H. Track Zero Adj.
B. Motor Speed	I. Format Disk
C. Config Set/Inq	J. LED Test
D. Drive Select	K. Drive Status
E. Exit To Dos	L. ROM Version
F. FDC Type	M. Position Head
G. Write Data	N. Check Disk

The following sections will describe each of the menu options in some detail and give you a reasonable idea of what kind of diagnostic information you can derive from them.

4.3 DISK DIRECTORY

NOTE: *This function is DOS dependent*.

This function tries to read the directory on a standard DOS formatted diskette. The directory function will operate in any of the standard density modes provided you have a DOS formatted disk in the specified drive. If the DOS is configured for two drives and you attempt to get a directory on drive three, an error message will appear. The easiest thing to do is configure your DOS diskette for four drives, and then you will not have to worry about drive NAK errors. The OSS DOS supplied on the GT-DOC master diskette has been configured for four drives for you.

If there are no errors, then a standard DOS-type directory will be displayed, twelve entries at a time. You will be prompted to press the RETURN key to progress through the directory, if there are more than eleven entries. Once the complete directory has been displayed, you can exit back to the main menu by pressing the ESC (escape) key. In general, the ESC key will be a valid exit from any of the menu functions.

4.4 MOTOR SPEED

The ’SPEED’ of a disk drive motor is normally measured in revolutions per minute (RPM). There are two ways to measure the apparent RPM of an INDUS GT disk drive. The first method consists of disassembling the drive and adjusting the RPM while observing the radial tachometer (strobe) located on the bottom of the TANDON drive mechanism. The other method is to measure the RPM via software while you adjust the speed.

There are two ways in which software can measure the speed of an INDUS GT disk drive. The first method, also the most familiar to Atari owners, uses what is known as the ’Address Mark'. The second method, which will be more familiar to IBM and TRS-80 owners, uses the timing hole to measure the ’Index Mark.’

The ADDRESS MARK speed check works on any Atari compatible disk drive. The only restriction is that the drive must be configured for the same density as the diskette you are trying to read. This method works in the following fashion:
First, it positions the head to track zero, sector one. When the drive finds this 'mark,' it tries to read the mark 100 times. The system clock in the Atari computer is polled before and after the reading process to derive the total elapsed time for the reading. The average speed of the diskette rotation is then calculated for the 100 reads and the average RPM is displayed on your monitor screen. This measurement is accurate to about two tenths of an RPM. Although it would have been possible to use a sample smaller than 100 reads, the accuracy falls way off when you go as low as 50 reads. Press the ESC key to exit this routine. lf you press the ESC during a read process, the routine will complete the current cycle of 100 reads before exiting.

The INDEX MARK speed check will work only on the INDUS GT Atari disk drive. Density configuration will not affect this speed check. This routine looks at the timing hole, which is standard to all soft sectored diskettes. It counts two revolutions of the diskette. The first time around, the routine finds the timing hole and sets the system clock on the WART board. The second reading is made one revolution later and the system clock is polled again to derive the elapsed time. The RPM number displayed on the monitor screen is the instantaneous translation of how long it takes the timing hole to make one complete revolution. This method is accurate to within one tenth of an RPM and should be close to the Address Mark results. Pressing the ESC key will immediately return you to the main menu.

When you enter this menu function, you will be prompted to select either the Address mark method or the Index mark method. Enter either an 'A' or an 'I' to begin the test.
Pressing ESC at this point will return you to the main menu. Once the test starts, two scales will be displayed on the screen and the particular option you selected will be displayed in the top center of the screen. The first scale ranges from 8 to 576 RPM with a scale factor of 15 RPM per division. The second scale ranges from 278 to 386 RPM with a scale factor of one RPM per division. The RPM test, in both cases, is continuous so you can leave the test running while you are adjusting the drive speed.

Theoretically the RPM reading should be 288 RPM plus or minus four RPM. lf the speed check shows that the drive speed is too fast, too slow, or varies more that five RPM between each read then you should open the drive and adjust the RPM to within the acceptable range. we recommend that you adjust the speed to 288 plus or minus one RPM. A variation in the RPM of more than one half of an RPM on consecutive reads is not normal and further service may be required.

4.5 DRIVE CONFIGURATION INQUIRY

This routine polls the drive for its current density configuration and allows you to verify that all three densities, single, dual, and double are functioning.

Start by pressing the DRIVE TYPE button on the front panel of the drive to cause the drive to display its current density setting. Next, press either A, B, or C on the computer keyboard to select another density. The computer will send an inquiry code along with configuration instructions to the drive. The results are displayed on the screen as follows:

```
Number of Tracks : 40
Step Rate: 26 ms
Sectors per Track : 18
Density : Single
Sector Size : 128
Drive Present : YES
```

The Number of Tracks should show 40 in all cases for an Atari disk drive regardless of the brand name.

The Step Rate for all INDUS GT Atari disk drives is 20 ms. The Sectors per Track number will be one of two values. For single and double density this number should be 18. Dual density uses 26 sectors per track.

The Density figure shows what the current density setting is for the drive: single, double, or dual. You can change the density setting by pressing A, B, or C on the computer keyboard. This function is independent of whether a diskette is in the drive or not.

The Sector Size shown in the display should be 128 for single or dual density and 256 for double density. This number corresponds to the maximum number of bytes that can be stored in a single sector.

The Drive Present status has a entire bit allocated for it in the status byte received from the drive, so it must mean something important. Anyway, you will probably always see a
YES here, since, if the drive is not present, you will get A device error that returns you to the main menu.

If any of the above displays deviate significantly from what we just described, the drive probably has a defective EPROM or a bad I/O connection.

4.6 DRIVE SELECT

This routine selects a new drive for testing. You will be prompted to enter a number from one to eight similar to when you first began program execution. The same restrictions we described there are still in effect.

4.7 EXIT T0 DOS

This routine does not return to DOS in the manner you are probably used to. What actually happens in this case is that a Jump is made to the SYSTEM RESET vector and the computer reboots. Because the Jump is a system reboot, you will be prompted with a yea or nay question before the program actually executes this command.

4.8 FDC TYPE

This routine sends a forced interrupt to the floppy disk controller and measures the response time of the FDC. Based on this timing, the program can tell whether the drive has a WD177X or a WD279X series FDC. The result of the poll is displayed on the screen as follows:

WD1770 or WD1772

or

WD2793 or WD2797

If the WD177X series is displayed, then reboot the drive with the extended internal tests. If the drive passes the extended internal diagnostics, reboot the drive normally and rerun this test. If WD177X is again displayed, then the drive will have to be opened. Once opened, examine the WART board and visually verify the FDC type. If the FDC chip is in the WD279X series, then replace the EPROM. Although provision has been made to include the WD177X series of FDC in this program, such devices have not been used yet in any of the INDUS GT Atari disk drives.

4.9 WRITE DATA

This is a general read/write test, which writes a series of numbers to random sectors on a diskette. The drive must be configured to the same density as the diskette you are using in the test. Make sure you use a 'scratch' disk that does not contain anything you wish to save. This routine will overwrite any data already on the disk.

If error codes 144 or 139 appear, then verify that the drive configuration and the format of the diskette are the same. Next, verify that you are using a formatted diskette. Last, verify that the write protect switch on the front panel is not ON.

If errors persist then re-initialize a diskette with the GT-DOC format option. If drive errors F9 or F7 occur during the formatting process, see section 5 for additional troubleshooting on the write protect circuit.

4.10 TRACK ZERO ADJUSTMENT

This routine is used to realign the track zero sensor in the drive. When you run this test, the screen display should say 'Sensor is okay' for a properly adjusted drive. lf this is the case, then no further steps need be taken. However, if the screen says to move the head in or to move the head out, then the drive will need to be disassembled so you can adjust the track zero sensor. See section 6 for adjustment procedures.

4.11 FORMAT DISKETTE

This routine performs a vanilla format on a diskette in any of the three INDUS GT operating modes. After the format, any errors will be displayed on the monitor screen. The format that this routine does is 'vanilla'. This means that the format process makes two passes: one to lay down a new format and a second pass to verify the new format. Normally a DOS will perform these same two passes and then write special DOS related information to the diskette. This routine does not perform that last step since there is no way of knowing for sure which DOS you may want to operate under. This means boot, UTOC, or directory sector data is not written to the disk.

If F9 errors occur persistently, then verify that the write protect switch is OFF. Any other errors that occur may be the result of a bad diskette. Try to format another diskette. If errors still occur, then try to format the same diskette on another machine. If the diskette formats properly, then open the drive mechanism and verify that the connectors J7, JS, and J9 are all properly seated in the correct positions.

4.12 LED TEST

This routine lights all of the front panel display LED's. You should see an 88 displayed on the drive. If any of the LED segments do not light, replace the front panel.

4.13 DRIVE STATUS

This routine displays a dynamic, extended status report of the drive. After each statement there will be either an F or a T. The F stands for false and the T for true. The last statement on the screen displays which track the drive's read/write head is on during that particular status check. This status test will repeat indefinitely until you exit
the routine by pressing the ESC key.

If the track number displayed on the screen disagrees with the track displayed on the drive, then replace the EPROM and rerun this test.

If FDC, DATA, or CMD errors appear for more than a few seconds, return to the main menu. From there, repeat the status test. This time there should be no errors. lf there are still errors, the problem lies in the EPROM or it is an intermittent problem with the FDC.

4.14 ROM VERSION

As of this writing, there have been three production releases of the INDUS GT Atari disk drive control EPROM: 1.00, 1.10, 1.20. There is also the possibility that a ROM or a PROM will replace the EPROM in the future. If the EPROM in the drive you are working on has a version number of 1.00 or 1.10, then it should be replaced immediately with the latest version of the device. The latest version to date is 1.20.

There are significant differences between the three versions. The following paragraphs detail the major differences. Some of the tests, such as the write Data and the Check Disk routines will not function properly in the DUAL density mode if the EPROM is not 1.20, due to a programming error in the EPROM code.

4.14.1 Version 1.00 to 1.10 Changes

Synchronous Communications

A special high-speed communications protocol was added to the EPROM's code. This new code is supposed to be used by the SYNCHROMESH high speed data transfer mode of the disk drive. As of this writing, this high-speed mode is still in development.

BUSY LED Stuck ON fix

If the drive was currently busy and the computer abandoned it to communicate with another device, the drive would clear back to the non—busy mode (polling various gadgets) and leave the busy LED lit. This error was corrected in EPROM version 1.00.

4.14.2 version 1.10 to 1.20 Changes

Write verify error display

Previous EPROM versions would display an up-down 'A' followed by a right-side-up '2' when the display was supposed to be a 'P?' (PUT error number 9). This was nothing more than an error in the pattern, which the EPROM sent to the LED display. The P9 error indicates a verify error when reading back data Just written to the diskette.

CLOCKIN bus line control changed to DATAOUT

This modification gives the drive the ability to transmit data directly to other devices attached to the data bus. The original ability to control the CLOCKIN line was a left over from an earlier design approach to implementing the SYNCHROMESH high-speed mode.

EPROM CODE optimized for size

When a need came up for some additional functions (see below) in the EPROM, the code was re-written to take up less space on the chip. All functions supported by the earlier versions are still supported, but with more efficient code.

Immediate Diskette Analysis

The current version of the drive control EPROM supports a new front panel function. Holding down the TRACK button and then pressing the DRIVE TYPE button will command the drive to do an immediate diskette analysis. In response to this button sequence, the drive will analyze the diskette, change the drive's density mode accordingly, and switch the LED display to DRIVE TYPE. Note: this can cause strange results if you invoke this command sequence while the computer is sending configuration commands to the drive.

Auto-Boot Feature

The current EPROM version supports a manual 'auto-booting' of the drive's on-board Z80A microprocessor. You can invoke this function by holding down the DRIVE TYPE button and then pressing the ERROR button. The drive will then proceed to execute its normal built-in diagnostics before returning to normal status.

Read/write Head Trap For Shipping

This modification really solves a potential problem. When the protective cardboard shipper is inserted into the drive, it forces the read/write head back against the track zero stop. This 'traps' the read/write head so it will not get knocked out of alignment during shipment. Previous versions of the EPROM, upon power up, would step the read/write head out until the track zero sensor came on to RESTORE operation) and then consider the read/write head to be properly set on track zero. However, if the cardboard insert had forced the read/write head back past the proper track zero position (track negative one??), the track zero sensor would still be active and the drive would think the read/write head to already be on track zero. The current version of the EPROM performs this same power on sequence; but follows it with a step-in sequence to track four, and then restores the read/write head back to the track zero sensor a second time.

Dual Density Sector Number Correction

Previous versions of the EPROM failed to take the dual density mode into account when determining whether or not the absolute sector number was valid. For both single and double density, valid sector numbers range from 1 to 728. In dual density, the valid sector range is 1 to 1848. The error in the EPROM coding resulted in the drive functioning improperly when a sector in the range of 721 to 1848 was requested for either read or write operations. Earlier versions of the EPROM would return a command frame error instead.

4.15 POSITION HEAD

This menu selection gives you three options. The options are numbered 0, 1, and 2. Option 0 clears the disk drive of any previously issued commands and restores the read/write head to track zero. This function is also performed automatically whenever you exit this selection by pressing the ESC key.

Option 1 positions the read/write head to any track on the disk. You will be prompted to enter a number between 0 and 39 for the desired track. Numbers outside this range will not be accepted. Once you have entered the desired track number, you must press the RETURN key to initiate the test.

Option 2 causes the drive to repeatedly move the read/write head between two specified tracks. You will be prompted to enter the first (starting) track. Enter it and press the
RETURN key. Next, you will be prompted to enter the second track. Enter it and press the RETURN key. The usual restrictions on the legal track numbers still apply. The commands will then be sent to the drive to begin the test. Option 2 could be used as a rail noise test, since this routine causes the read/write head to seek between two tracks indefinitely. If the drive's read/write head guide rails are in need of fresh lubrication, you should be able to hear an excessive amount of noise during this test. The position head routines should function properly whether or not there is a diskette is in the drive and regardless of the density of the diskette or the drive's current configuration.

If the drive doesn't track between track 00 and track 39, then the stepper motor or the motor control electronics may be defective. If the problem narrows down to the stepper motor, you will have to replace the TANDON drive mechanism. If the drive exhibits excessive noise during option 2, then lubrication of the drive spindle, the read/write head guide rails, and possibly the stepper tracks are probably in order.

4.16 CHECK DISK

This routine verifies that the drive can read any sector on a diskette. ln a sense it also serves as a diskette media verification test. when you enter this menu selection, you will be prompted to enter the starting sector number and then the ending sector number. Follow each entry with the RETURN key. If you press the RETURN key instead of a number for the starting sector, the entire disk will be verified. Pressing Just a RETURN in response to the second prompt will return you to the main menu. When the test is complete, it displays each error found and the sector in which the error occurred. At any time during this test, you can abort it by simply pressing the ESC key.

This routine is independent of any DOS and will function properly regardless of how your DOS is configured. However, this routine will not function properly on sectors in the range 721 to 1040 on an INDUS GT that has a version 1.00 or 1.10 EPROM.

Chapter 5
Troubleshooting Guidelines

5.1 INTRODUCTION

This section contains general troubleshooting information. We will assume that you have read and understand the material in sections 1.0, 2.0, and 3.0.

The first step in troubleshooting is to verify that the power supply and interface to the disk drive are functioning properly. Next, try to isolate the trouble to the electronic, electromechanical, or mechanical components of the INDUS GT disk drive (see section 3.0). Table 5-1 is a list of some trouble symptoms referenced to paragraphs that include possible causes, and suggested fixes.

TABLE 5-1 TROUBLE SYMPTOMS

TOPIC	PARAGRAPH
Preliminary Troubleshooting Steps	5.2
Drive won't Step or Steps Erratically	5.3
Drive Motor Won't Rotate	5.4.1
Drive Speed Unstable	5.4.2
Drive Speed Stable, But Out of Tolerance	5.4.3
Read Errors - All Tracks	5.5.1
Read Errors - Random Tracks	5.5.2
Read Errors - Inside Tracks	5.5.3
Cannot Read Disk written On Another Drive	5.5.4
Cannot Read Disk written By this Drive	5.5.5
Write Errors	5.6
Front Panel Switches Malfunctioning	5.7
Drive will Not Configure Density	5.8
Drive will Not Select Drive Number	5.9
Front Panel LEDs Not Operating Properly	5.10

5.2 PRELIMINARY TROUBLESHOOTING STEPS

The following preliminary steps should be performed first when you are trying to isolate a suspected malfunction:

1. Inspect the power and I/O connectors. Make sure that they are properly installed and that they have no broken pins. Also make sure that their mating cables plug in properly.

2. Verify that the dust cover lifts smoothly and that the front latch opens and closes easily. The head arm should lift when the front latch is open.

3. Verify that a diskette can be easily inserted and removed from the drive.

4. Take the main housing off of the drive and make sure that all of the circuit board connectors are properly seated and have no broken wires.

5. Check for any loose or missing hardware.

6. Manually rotate the drive hub; it should rotate freely.

7. Check the circuit boards for any damaged or missing components.

8. Attach an INDUS power supply to the drive and turn the power ON. The LED display should flash through a series of codes beginning with 'C', then stop on track 00 for a few seconds, and finally come to rest on track 39. The drive motor should come on during this sequence and turn OFF at the end. Note any deviation from this sequence.

5.3 DRIVE WON'T STEP OR STEPS ERRATICALLY

Verify that the head cable does not interfere with carriage movement.

1. Replace the SN75437 QUAD PERIPHERAL DRIVER on the analog board.

2. If Step 1 failed to fix the problem, the stepper motor is probably bad. Replace the TANDON Mechanism.

5.4 DRIVE MOTOR PROBLEMS

5.4.1 Drive Motor Won't Rotate

1. Short pin 10 of connector J2 to ground.

2. The drive motor should be rotating. If the drive motor does not rotate, the drive motor probably is bad. Replace the TANDON Mechanism.

3. If the drive motor rotates, then replace the LM2917 comparator.

5.4.2 Drive Speed Unstable

1. Check for bad spindle bearings by removing the drive belt and slowly rotating the spindle pulley manually. If the spindle pulley rotates erratically, the spindle bearings are bad. Replace the TANDON Mechanism.

2. If spindle speed drifts slowly, replace the Analog Board.

5.4.3 Drive Speed Stable, But Out Of Tolerance

1. See ***Section 6.3*** on motor speed adjustment

5.5 READ ERRORS

Before you make any adjustments, first verify that any dirt or oils do not contaminate the head, as that may be the cause of the problem.

5.5.1 READ ERRORS - All Tracks

1. Check radial track alignment (see ***Section 6.2.5***). If the alignment is bad, realign the drive.

2. Check compliance (see section 6.2.9). If compliance is bad, replace the Felt Pad assembly and/or clean head.

3. Replace the MC3470A read amplifier on the Analog Board.

4. If you still get no read signals from the drive, replace the Analog Board.

5. If you still get no read signals from the drive, the head/carriage assembly probably is bad. Replace the TANDON Mechanism.

5.5.2 READ ERRORS - Random Tracks

1. Clean the read/write head.

2. If read errors are still present, test for unstable drive speed using the motor speed check option of GT-DOC.

3. If the drive speed is unstable, the drive motor probably is bad. Replace the TANDON Mechanism.

4. Replace the MC3470A read amplifier on the Analog Board. lf the problem is still present, replace the Analog Board.

5. If the problem is still present, the head/carriage assembly probably is bad. Replace the TANDON Mechanism.

5.5.3 READ ERRORS - Inside Tracks

1. Check compliance (see section 6.2.9). If compliance is bad, replace the felt pad, and/or clean the head.

2. Replace the MC3470A read amplifier on the Analog Board. If the Problem is still present, the head/carriage assembly probably is bad. Replace the TANDON Mechanism.

5.5.4 Cannot Read Prewritten Data - Can Read Self-written Data

1. Check radial track alignment (see section 6.2.5).
2. Check for correct drive speed using GT-DOC.

5.5.5 Cannot Read Disks written By This Drive - Disks Can Be Read By Other Drives.

1. Replace the MC3478A read amplifier. If problem is still present, replace the Analog Board.
2. If problem is still present, the head/carriage assembly probably is bad. Replace the TANDON Mechanism.

5.6 WRITE ERRORS

1. Check WRITE PROTECT output (see section 6.2.4).
2. Replace the NE555P, 74LS74, and the 74LS26 ICs.
3. If problem persists, replace the Analog Board.
4. If problem is still present, the head/carriage assembly probably is bad. Replace the Tendon Mechanism.

5.7 FRONT PANEL SWITCHES MALFUNCTIONING

1. Check each switch for any broken or worn pieces.
2. If the switches are in good condition, then replace the front panel.
3. If the problem is still present, replace the WART Board.

5.8 DRIVE WILL NOT CONFIGURE DENSITY

5.8.1 Drive Will Not Configure Density vie Software

1. Run the self-tests as outlined in section 3.4 & 3.5.
2. If the self-tests pass, replace the EPROM.
3. If the problem is still present, replace the WART Board.

5.8.2 Drive Will Not Configure Density via Front Panel

1. Refer to section 5.6 on switch malfunctioning.

5.8.3 Drive Will Not Configure Density vie Rear Switches

1. Check for broken DIPswitch leads.
2. If leads are broken, replace the DIPswitch.
3. Replace wart Board.

5.9 DRIVE WILL NOT SELECT DRIVE NUMBER.

1. Check for broken DIPswitch leads on rear of drive.
2. If any leads are broken, replace the DIPswitch.
3. Replace wart Board.

5.10 FRONT PANEL LEDS NOT OPERATING PROPERLY

1. Replace the front panel.
2. If the problem is still present, replace the EPROM.
3. If the problem persists, replace the WART Board.

Chapter 6
REPAIR GUIDELINES

6.1 OVERVIEW OF REPAIR GUIDELINES

This section outlines the steps necessary to verify the operation of an INDUS GT disk drive during troubleshooting, or after replacing a part or subassembly. The checks and adjustments (in the order presented) will help you to isolate the problem area. However, if a specific check or adjustment is required, you do not necessarily have to perform all of the preceding checks. The values and tolerances stated in the checks and adjustments are typical values for working drives. If the values you measure are within those tolerances or close to the limits, the defective drive's problem is probably due to some other cause. Completing the other checks and adjustments may disclose the actual cause of the problem.

6.2 THE TANDON DRIVE MECHANISM

For convenience, we will assume that the drive has been disassembled to the point of having the main housing removed.

6.2.1 Visual Inspection

Before applying power to the drive, or doing any checks or adjustments, visually inspect the drive:

1. Check for loose or missing hardware.
2. Make sure the front latch opens and closes, and the head arm raises when the door is opened.
3. Make sure the front panel is securely attached.
4. Manually rotate the drive hub. It should rotate freely.
5. Make sure the circuit boards are securely seated.
6. Check the connectors for placement and seating.
7. Check for damaged or missing components.
8. Make sure that a diskette can be inserted and removed.

6.2.2 Equipment Required

Except where noted otherwise, the following equipment is required to perform the checks and adjustments discussed in this section.

1. INDUS GT power supply
2. A number 1 Phillips screwdriver
3. Jeweler or precision flat-blade screwdriver (for motor speed adjust)
4. Spring inserter/remover
5. Flat blade screwdriver 3/16-inch tip
6. GT-DOC or equivilant diagnostic program
7. Digital voltage meter (DVM)
8. A dual-channel, wideband oscilloscope, Hewlett Packard Model 174BA or equivalent
9. A certified alignment diskette, Dymek Model DK 501-05 or Dysan Model 224/2A
10. A gram gauge

Your test equipment should be calibrated properly or you may not get reliable results from the tests called out in this section. Most test equipment has a calibration sticker on it somewhere. Check the expiration date or the calibration period. Get any out-of-cal equipment calibrated before performing the tests in this section.

6.2.3 Power/Drive Select Check

The drive select check verifies that the BUSY LED can be illuminated and that power is being supplied to the drive.

The following steps are required to perform this test.

STEP 1. Turn the power switch on the drive to OFF.

STEP 2. Connect the defective drive to the computer system as drive 2.

STEP 3. Boot the GT-DOC in disk drive 1.
This implies that the computer power is ON and that drive number 1 is ON.

STEP 4. Using the DVM verify that the INDUS GT power supply voltage is between 14.5 and 15.6 VDC when the drive is OFF.

STEP 5. Apply power to the defective drive.

STEP 6. With a DVM verify that the power supply voltage is between 12.2 and 13.8 VDC.

STEP 7. Attach the defective drive to your Atari computer as drive number 2.

STEP 8. From GT-DOC. select drive number 2 for testing.

STEP 9. From GT-DOC, select the LED test (menu item J).

STEP I0. Visually verify that the BUSY LED is illuminated.

STEP 11. Press the ESC key and verify that the BUSY LED extinguishes properly.

If the power supply voltages measured in **STEP 4** and **STEP 6** are not within the allowed range. Repeat the entire test sequence with another power supply. If the voltage measurements in **STEP 4** or **STEP 6** fail again, replace the WART board and repeat the test sequence again.

If the BUSY LED does not light, then replace the front panel. Repeat the above test. If the results are the same, replace the UART board and repeat the test.

If the BUSY LED fails to extinguish, verify that the UART board has the latest version of the drive control ROM (see ***section 4.14***). If the latest ROM is installed and the BUSY LED does not extinguish when the above test is run, replace the WART board. Repeat the test to verify proper operation of the drive.

6.2.4 write Protect Output Check

The write protect output check establishes the correct operation of the write protect circuit, i.e. that the write electronics are disabled when a write protected diskette is used.

STEP 1. Connect the positive and negative test probes from your DVM to pins 3 and 4 respectively, of connector J7 on the WART board (***board ID J7***).

STEP 2. Set the DVM to the 20 VDC scale.

STEP 3. Insert a write protected diskette. The DVM should display a reading between 4.4 VDC and 5.0 VDC.

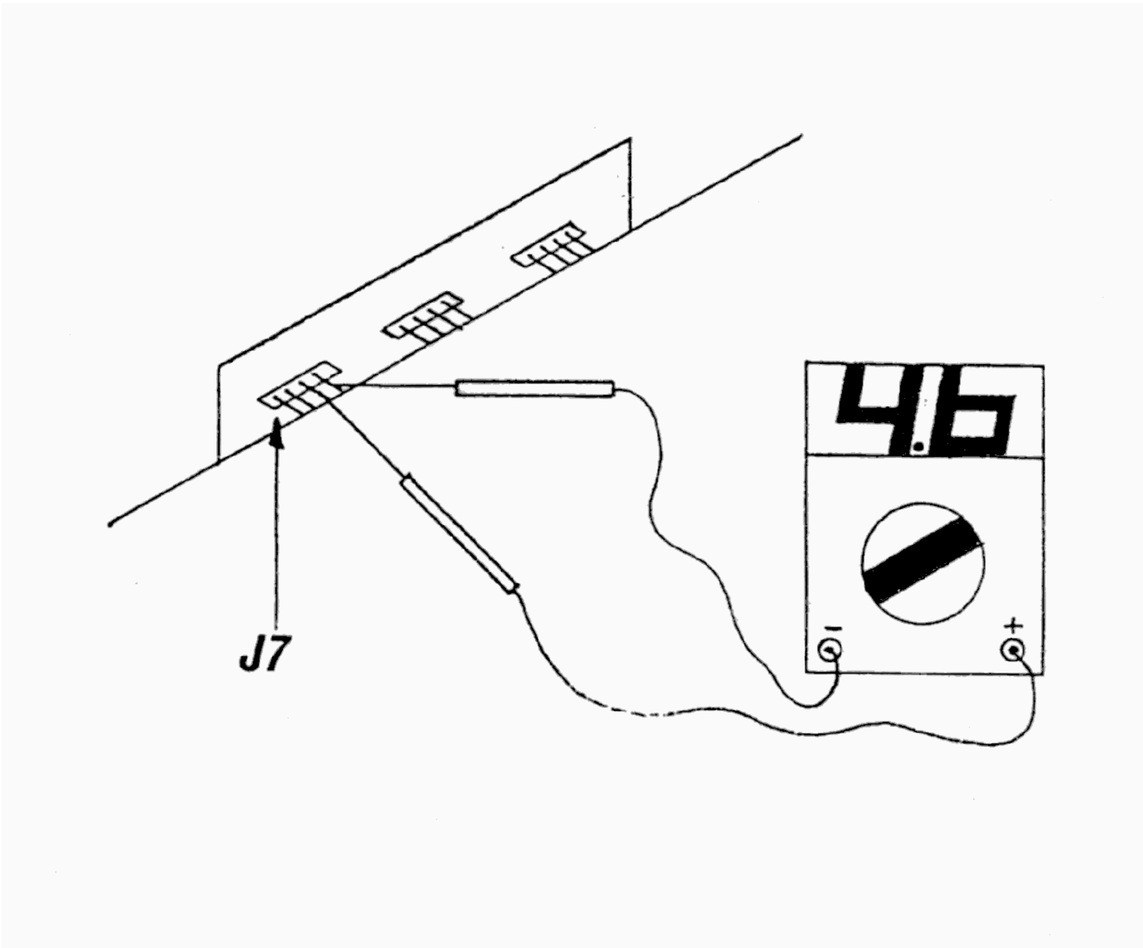
STEP 4. Remove the diskette from the drive. The DVM should display a reading between 0.0 and 0.8 VDC.

NOTE: A defective WART board, connector, or a broken wire can be responsible for a write protect problem. The following steps will help isolate the write protect problem.

STEP 1. Disconnect connector J7 from the UART board.

STEP 2. Connect the plus and minus test probes of a DVM to connector J7 on the WART board (see Figure 6-1).

<u>**FIGURE 6-1 DVM Connection to WART Board**</u>



STEP 3. With the DVM set to the 20 VDC scale, observe that the voltage is between 4.4 VDC and 5.0 VDC.

If STEP 3 fails, replace the WART board & repeat the test.

If STEP 3 passes, then go on to STEP 4.

STEP 4. Replace any broken wires on the Analog board.

STEP 5. If the problem persists, replace the Analog board.

STEP 6. It this does not correct the problem, then either the photo-receiver or the LED transmitter is bad and the TANDON assembly will have to be replaced.

6.2.5 Radial Track Alignment and Adjustment

The Radial Track Alignment procedure locates the read/write head at the proper radial distance on the hub centerline, ensuring the track location is accurate. Adjustment is necessary only after servicing or if diskette interchange problems are suspected.

NOTE: The alignment diskette and drive must be allowed to stabilize at room temperature for one hour before checks and adjustments are performed.

RADIAL TRACK ALIGNMENT CHECK

NOTE: The Radial Track Alignment Check can only be performed with an oscilloscope.

STEP 1. Set up the oscilloscope:

Channel A: Test Point l on the Analog Board

Channel B: Test Point 3 on the Analog Board

Ground: Test Point 2

Read Differentially: A plus B, B inverted

Time Base: 20 milliseconds per division

External Trigger: Pin 4 of connector J12 (Board ID J8), positive edge

Adjust amplitude for at least four divisions on the oscilloscope, AC coupled.

STEP 2. Apply power to the drive.

> *NOTE: The Track 16 radius is 1.9167 inches from the center of the hub. Other track locations are computed based upon 48 TPI.*

STEP 3. Boot up GT-DOC in drive 1 (see ***section 5.6***).

STEP 4. Select the drive number of the defective drive.

STEP 5. Select the Position Head from the menu.

STEP 6. Select the option to position head to one track.

STEP 7. Type 16 in response to the Track number.

STEP 8. Insert a certified alignment diskette.
Dymek Model DK 501-05, into the drive.

STEP 9. Adjust the oscilloscope to observe a Cats Eye pattern (see ***Figure 6-2***).

STEP 10. Verify the smaller of the two Cats Eye patterns is not less than 75 per cent in amplitude of the larger other one.

> *NOTE: The 75 per cent figure is for use with an alignment verified against a standard alignment diskette.*

STEP 11. Using GT-DOC, position the head to Track 0 then, position it back to Track 16.

STEP 12. Verify the Cats Eye pattern (75 per cent).

STEP 13. If all the checks verify, the radial track alignment is acceptable.

STEP 14. If any check does not verify, the stepper motor must be adjusted.

Figure 6-2 CATS Eye Patterns

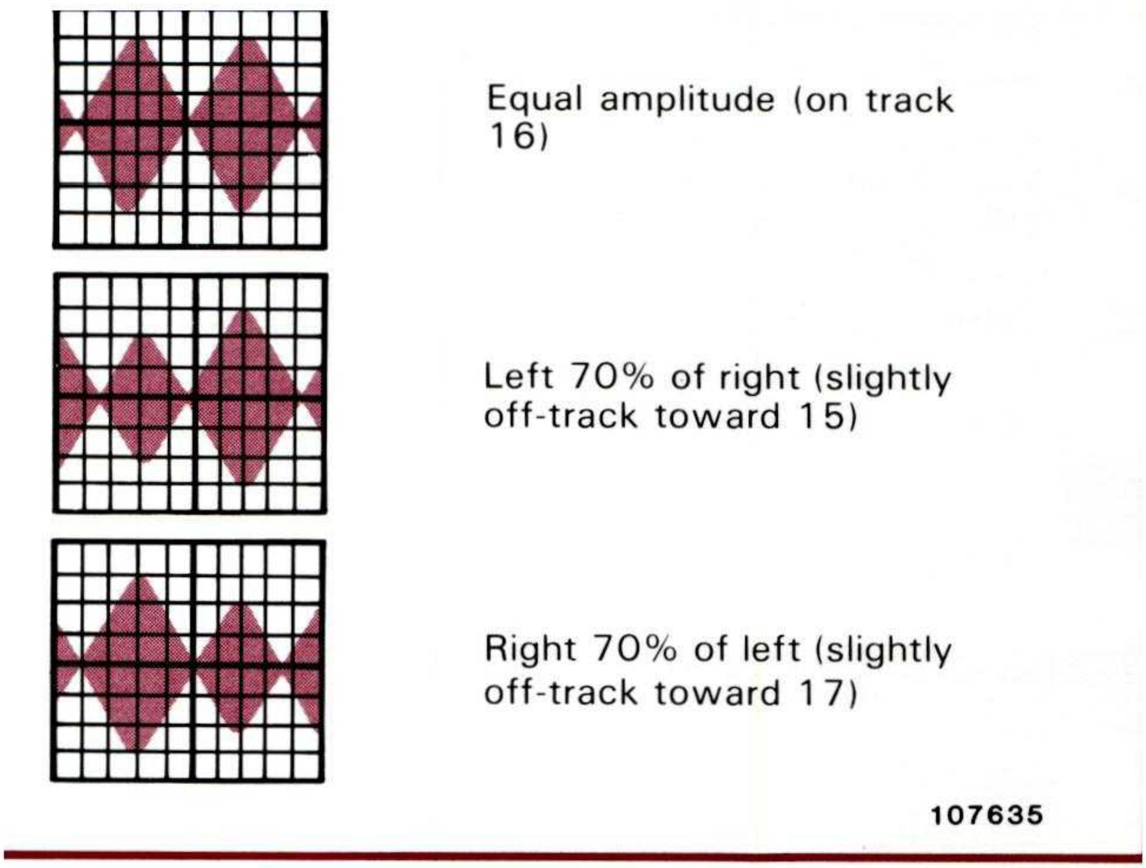


Figure 1. No Head Radial Alignment Necessary

RADIAL TRACK ALIGNMENT ADJUSTMENT

There are _two methods of adjusting the radial track alignment. The first, and most accurate, involves the use of an oscilloscope. The second, and less accurate, involves using GT-DOC in its Check Disk mode. Both methods are explained below.

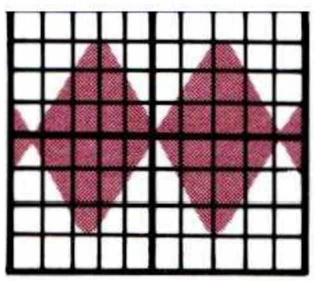
Radial Track Alignment Adjustment With An Oscilloscope

STEP 1. Loosen the two Number 1 Phillips retaining screws on the stepper motor (see ***Figure 6-3***).

STEP 2. Using a flat blade screwdriver between the chassis camming bar and the stepper motor, rotate the stepper motor.

STEP 3. Observe the Cats Eye pattern.

STEP 4. Adjust until the Cats Eve patterns are equal in amplitude.

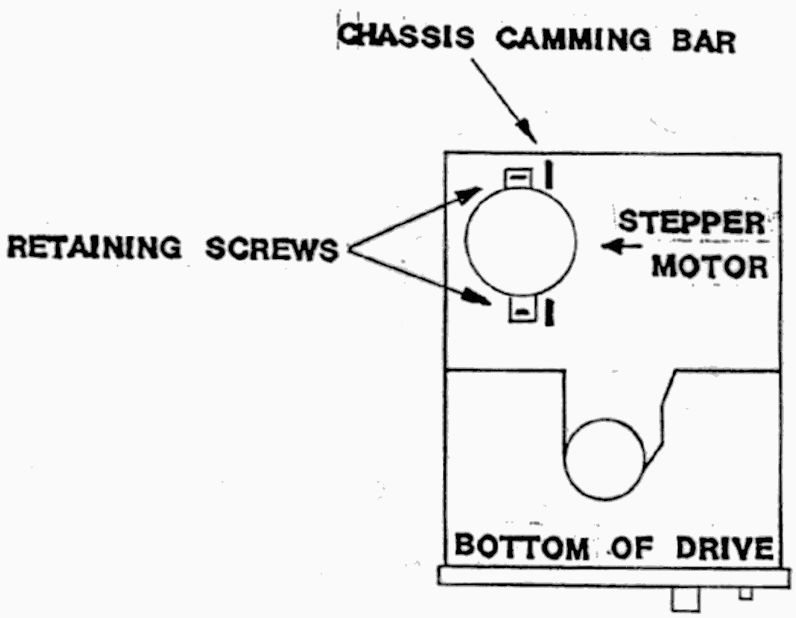


Equal amplitude (on track 16)

STEP 5. Tighten the stepper motor retaining screws.

STEP 6. Recheck the Radial Track Alignment

Figure 6-3 Stepper Motor- Retaining Screws & Camming Bars



STEPPER MOTOR RETAINING SCREWS AND CAMMING BARS

Radial Track Alignment Adjustment with GT-DOC

STEP 1. Boot up GT-DOC as outlined in **section 4.0**

STEP 2. Select the number of the drive to be adjusted.

STEP 3. Select the Check Disk option on the menu.

STEP 4. Loosen the two Number 1 Phillips retaining screws on the stepper motor (***see Figure 6-3***).

STEP 5. Insert a Known Good Disk.

STEP 6. Press PETURN in response to the starting sector.

STEP 7. Press RETURN when ready to begin.

STEP 8. Using a fiat blade screwdriver between the chassis camming bar and the stepper motor, rotate the stepper motor.

STEP 9. Continue rotating the stepper motor back and forth, locating the left and right extremes of where the drive stops reading the disk.

STEP 10. Adjust the stepper motor so that it is positioned in the center of the two extremes.

STEP 11. Tighten the stepper motor retaining screws.

STEP 12. Verify the Alignment by rerunning the Check Disk option on the whole disk, then run the write Data option on the same disk.

STEP 13. If either check does not verify, then readjust the stepper motor until it does verify.

STEP 14. Reformat the test disk on the known good drive.

STEP 15. Re-verify the alignment by running the Check Disk and write Data options.

6.2.6 Azimuth Check

Azimuth Checks the READ/Write head's relative angle to the centerline of the diskette. The Dymek Model DK 501-05 contains the azimuth bursts on Track 34.

The head's azimuth is not adjustable. If the head fails the azimuth check, the head carriage assembly is defective. Because of the INDUS repair policy, the TANDDN mechanism must be replaced.

STEP 1. Set up the oscilloscope

Channel A: Test Point 1 on the Analog Board

Channel E: Test Point 3 on the Analog Board

Ground: Test Point 2 on IDE Analog Board

Read Differentially: A plus B, B inverted

Time Base: 0.5 millisecond per division

External Trigger: Pin 4 of connector J12 (Board ID J8), positive edge

Adjust the amplitude for at least four divisions on the oscilloscope.

STEP 2. Using GT-DOC, Position Head, position the head to Track 34.

STEP 3. Insert a certified alignment diskette, Dymek Model DK 501-05, into the drive.

STEP 4. Verify the head azimuth is no greater than +-12 minutes by comparing the four azimuth bursts with those in ***Figures 6-4, 6-5.and 6-6***.

Figure 6-4 An azimuth Of Exactly Zero Minutes:
(The optimum head azimuth alignment)

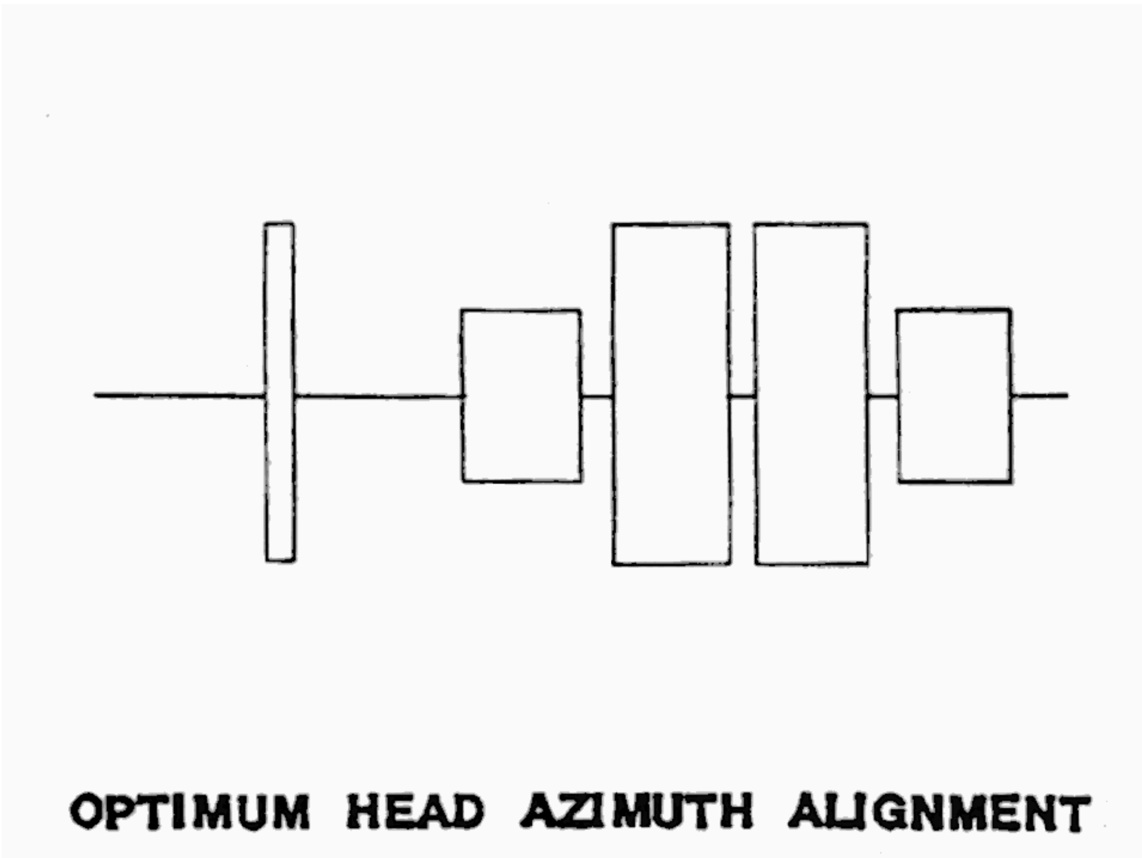
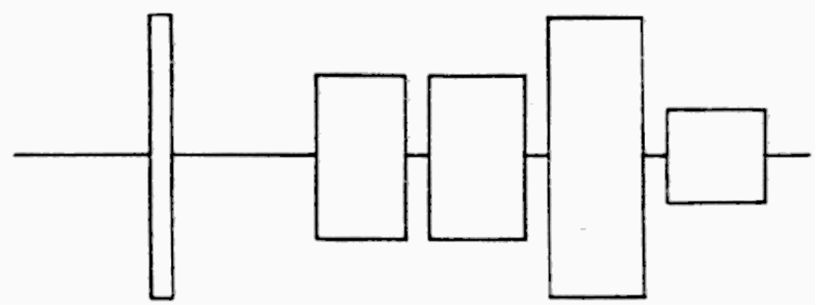
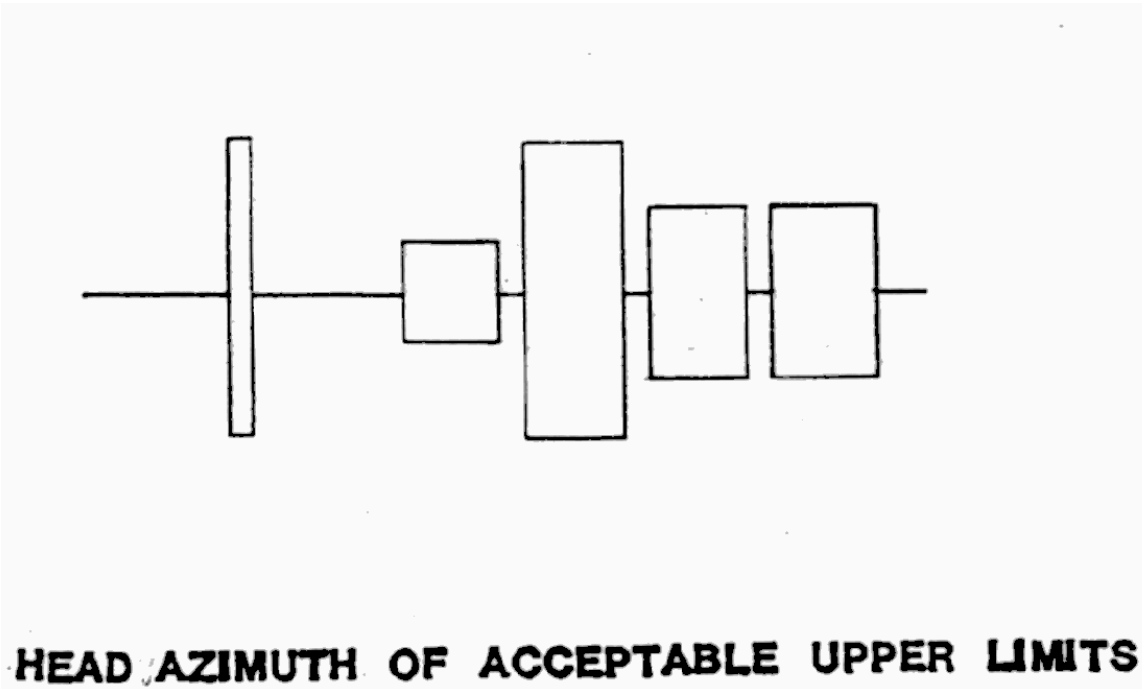


Figure 6-5 An Azimuth of Exactly Minus 12 Minutes:
(The lowest allowable azimuth error)



HEAD AZIMUTH OF ACCEPTABLE LOWER LIMITS

Figure 6-6 An Alignment of Exactly Plus 12 Minutes
(The highest allowable azimuth error)



6.2.7 Track 0 Sensor adjustment

The Track 0 sensor circuitry provides a signal that identifies Track 0 to the logic electronics. The electronics disable the step-out function when Track 0 is reached.

STEP 1. Loosen the retaining screws on the base of the Track B sensor.

STEP 2. Retighten the screw on the spindle side o+ the sensor to provide some friction on it. The screw at the rear of the sensor is for the Track 0 stop (see ***Figure 6-7***).

STEP 3. Moue the sensor to the rear of the drive as far as it will go.

STEP 4. Run the Track Zero Adjustment option in GT-DOC.

STEP 5. Insert an 810 (single-density) formatted disk.

STEP 6. Slide the Track 0 sensor toward the spindle very slowly until the screen displays "Sensor is ok'.

STEP 7. Retighten the screw on the spindle side of the sensor.

STEP 8. Repeat the Track 0 sensor check.

6.2.8 Track 0 Stop adjustment

The Track 0 stop screw should be adjusted after the Radial Track alignment has been performed, or when the carriage seeks to a track lower than Track 0.

STEP 1. Select the Position Head option of GT-DOC.

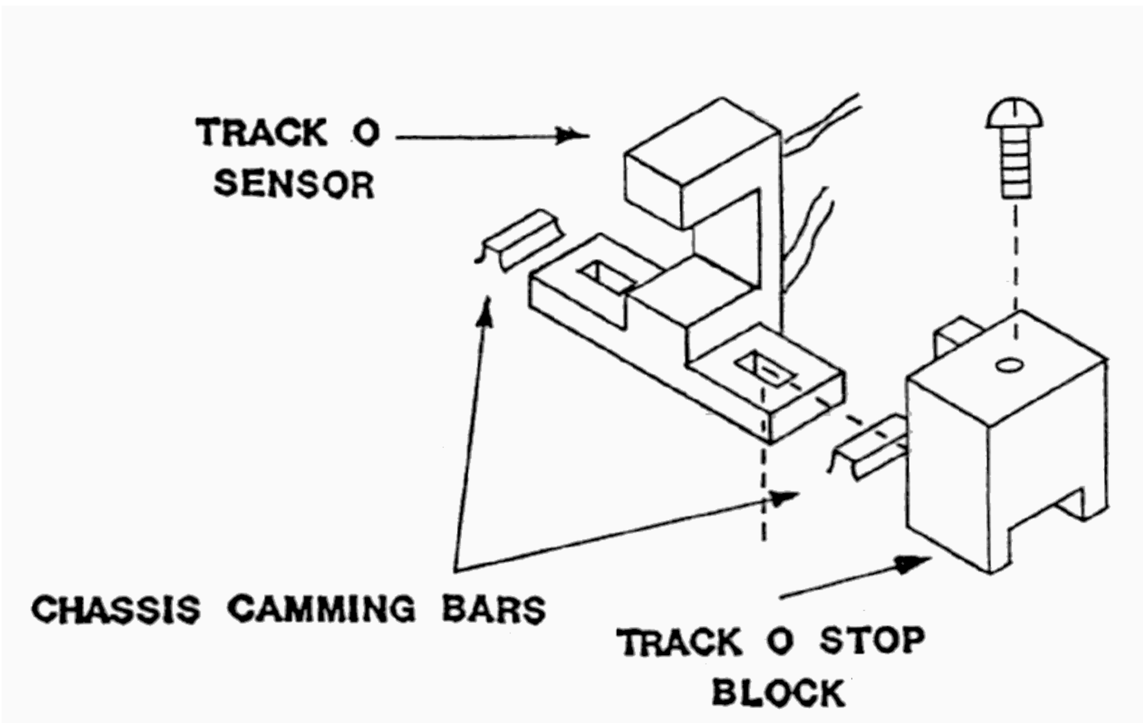
STEP 2. Position the head at Track 0.

STEP 3. Loosen the Number 1 Phillips screw at the rear of the Track 0 sensor (see ***Figure 6-7***).

STEP 4. Slowly push the Track 0 stop block into the Track 0 sensor until the Track 0 stop hits the head carriage.

STEP 5. Retract the Track 0 stop 1/32 of an inch. Tighten the Track B stop block screw.

Figure 6-7 Track 6 Stop Block



6.2.9 COMPLIANCE CHECK AND ADJUSTMENT

Compliance is the maximized output of the head when the pressure of the felt pad is centered over the read/write gap.

Compliance Check

STEP 1. Set up the oscilloscope:

Channel A: Test Point I on the Analog Board

Channel B: Test Point 3 on the Analog Board

Vertical Amplitude: 100 millivolts per division

Ground: Test Point 2 on the analog Board

Read Differentially: A and B, B inverted

Time Ease: IB microseconds per division

External Trigger: Pin 4 of connector JI2 (Board ID J8), positive edge

STEP 2. Using the Position Head option of GT-DOC, position the head to Track 32.

STEP 3. Insert a certified alignment diskette. Dymek Model DK 501-05, into the drive.

STEP 4. Observe the output waveform voltage.

STEP 5. With a gram gauge, carefully apply fifteen grams pressure to the upper arm.
NOTE: Fifteen grams is about the weight of a quarter.

STEP 6. If the output shown on the oscilloscope increases by more than ten per cent, adjust the compliance.

Compliance Adjustment

Compliance is adjusted by using the same procedure used in the compliance check.

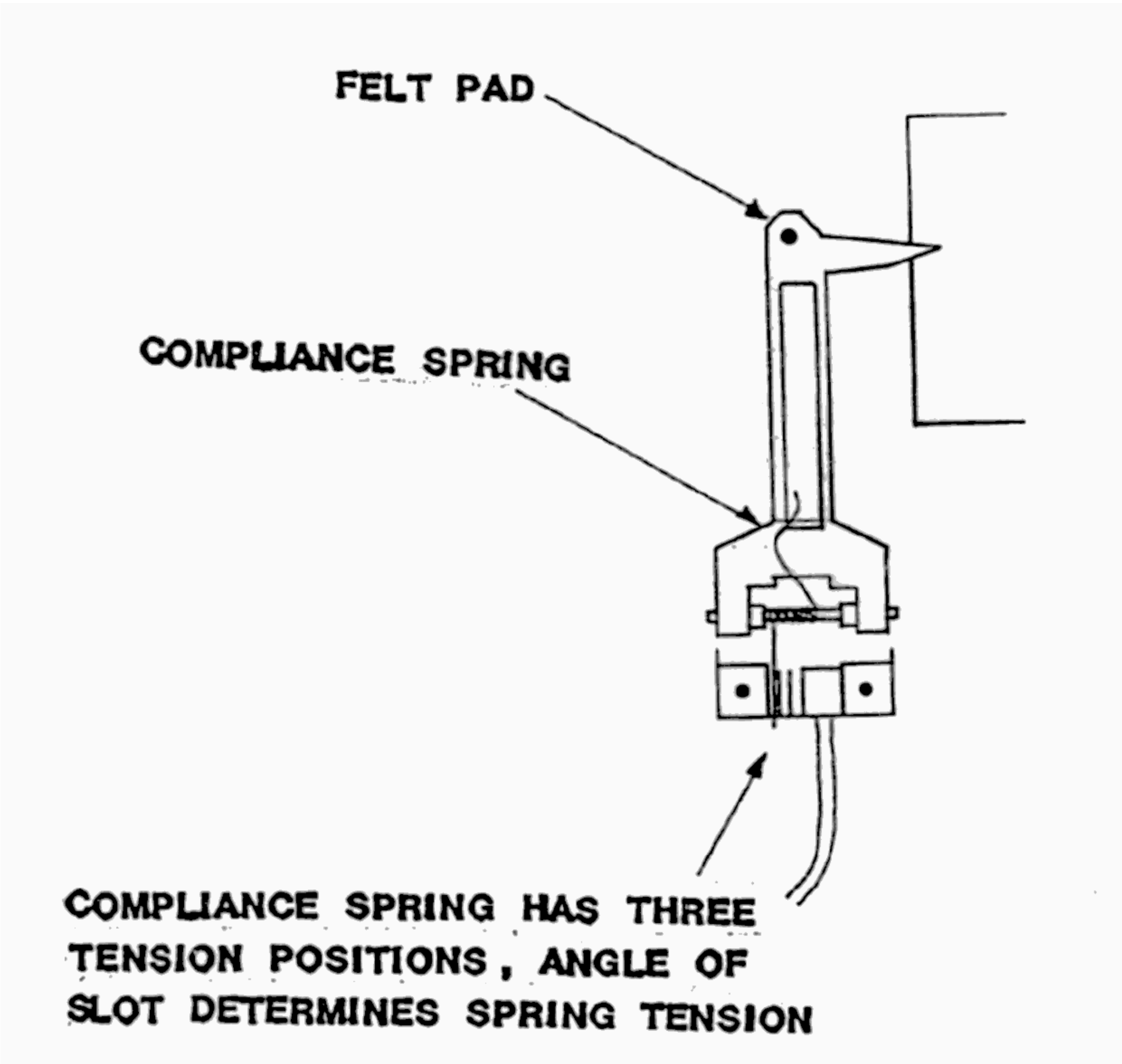
In addition:

1. The spring tension for the pad arm has three positions for the spring end in the lower portion on the head carriage assembly (see ***Figure 6-08***).

2. While monitoring the oscilloscope, change the spring tension position. if output amplitude is not affected by different positions of the spring, replace it.

3. If the pad is worn, replace it.

Figure 6-8 Upper Arm and Compliance Spring



UPPER ARM AND COMPLIANCE SPRING

6.3 Motor SPEED ADJUSTMENT

The drive motor speed test checks to see if the speed is within the specified tolerance. Theoretically the motor speed should be at 288 RPM plus or minus four RPM. The recommended speed is 288 RPM plus or minus one RPM.

STEP 1. Insert a diskette into the drive.

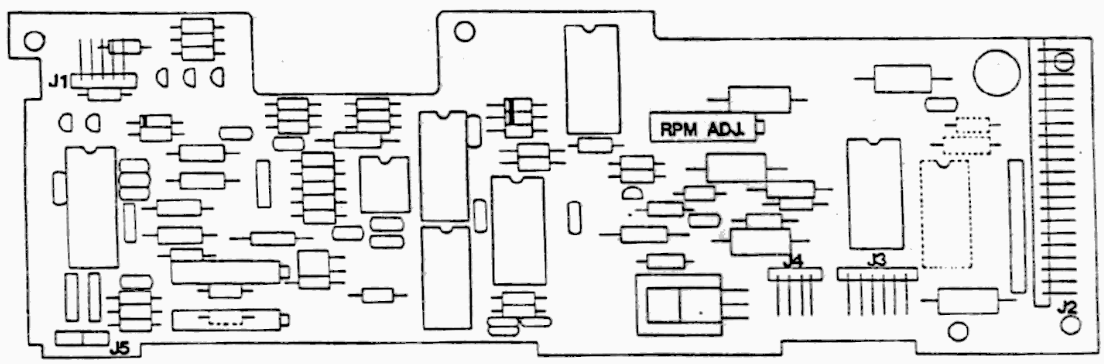
STEP 2. Select the Motor Speed option of GT-DOC.

STEP 3. Select the Index Mark speed check.

STEP 4. Locate ***R31*** on the Analog Board (see ***Figure 6-9***), This is the speed control pot.

STEP 5. Adjust R31 until the motor speed is within 288 RPM plus or minus l RPM.

Figure 6-9 Location of Speed Control Pot



INDUS GT – ATARI MODEL

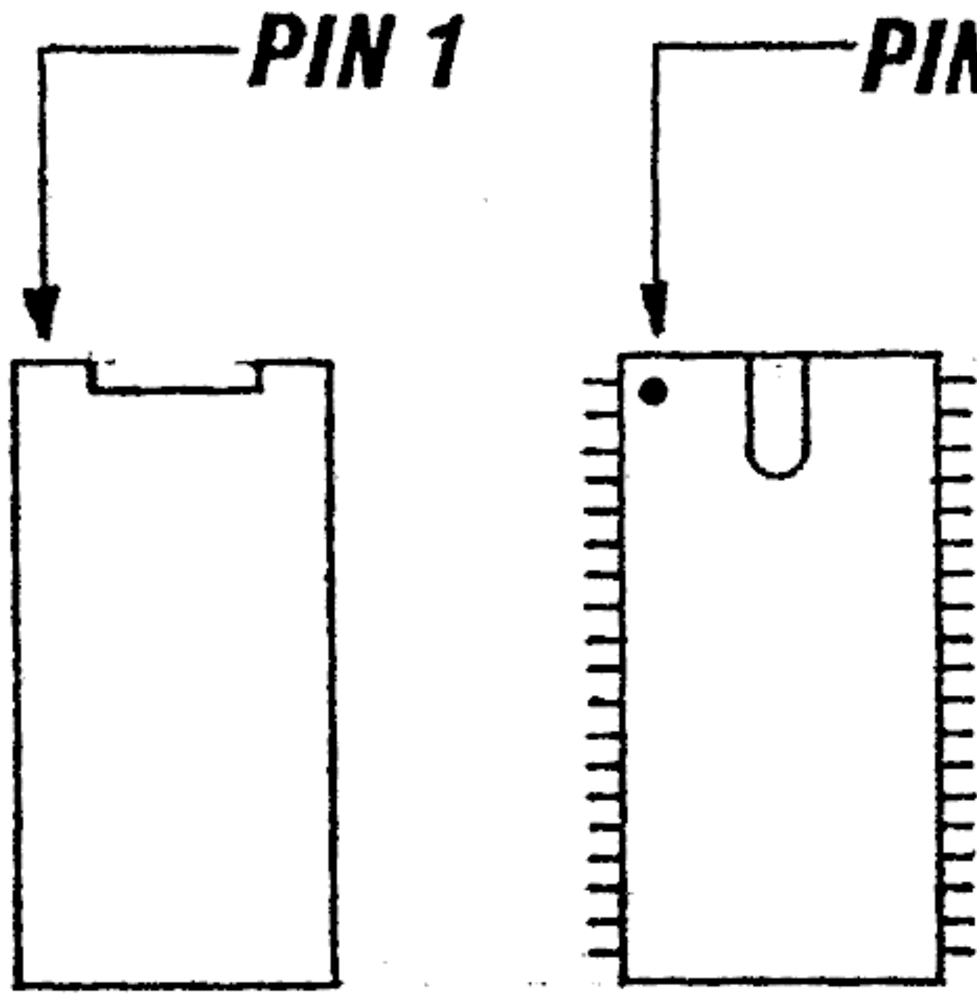
6.4 REPLACING INTEGRATED CIRCUITS

When replacing any integrated circuits it is recommended that an IC extractor/insertion tool be used. Screwdrivers and pocketknives can cause extensive damage to the pins of an IC.

It is recommended that before you replace an IC that you check it for any bent or misaligned pins. Also, make sure that the IC is firmly seated in its socket. If you find a bent or misaligned pin, gently straighten the pin, insert the IC back in its socket and recheck the drive. In some cases this will fix the problem.

When it comes to replacing any IC, pay close attention to the pin I mark on the IC as well as the pin 1 mark on the IC socket (see ***Figure 6-10***). Pay close attention when inserting an IC so that every pin is correctly lined up with the corresponding hole in the IC socket. The IC should be firmly seated in its socket.

Figure 6-18 Pin 1 Location On ICs And IC Sockets



6.5 REPLACING THE CIRCUIT BOARDS

When replacing either the WART or Analog Board take care to avoid causing damage to them. when removing a defective circuit board use properly grounded tools and working surfaces. This is necessary to avoid damage to any of the static sensitive IC's.

When installing either a new WART or Analog board, the same care applies to them as did to the defective circuit boards. A new circuit board can he easily damaged ii care is not taken to insure its safety.

When shipping the circuit boards back to INDUS SYSTEMS for replacement care must also be taken to ensure their safety. The circuit boards should not be allowed to touch each other during transport. Also, the package should be labeled with "***CAUTION, static sensitive material enclosed*** ".

6.6 REPLACING THE LED PANEL

STEP 1. Refer to Section 2.3.7 regarding the removal of the LED panel.

STEP 2. If all segments of one or both numeric readouts are out, replace the LED panel and recheck it for proper operation using GT-DOC.

STEP 3. If the same results occur then replace the EPROM and recheck it for proper operation.

STEP 4. If the same results occur, replace the WART board.

6.7 REPLACING CONNECTORS

When replacing connectors take care not _to damage any of the wires. When replacing connectors replace only one wire at a time. That way no confusion will result over which wire goes in which hole in the connector.

Chapter 7
Schematics & Drawings

Chapter 8
Parts Lists