Notes on the Troubleshooting and Repair of Optical Disc Players and Optical Data Storage Drives

Contents:

[Document Version: **1.19**] [Last Updated: **05/25/1998**]

Chapter 1) About the Author & Copyright

Notes on the Troubleshooting and Repair of Optical Disc Players and Optical Data Storage Drives

Author: Samuel M. Goldwasser
Corrections/suggestions: [Feedback Form] | sam@stdavids.picker.com

---

Chapter 2) Introduction

2.1) Scope of this document

```
While compact disc (CD) players and CDROM drives account for the vast majority
of optical disc platforms in the known universe, there are other types in use
for both entertainment and data storage applications.  These include:

* LD - LaserDisc - various forms of storage of feature length movies,
  instructional programs, and interactive video games on (usually) 12 inch
  single or double sided discs.

* MD - MiniDisc - Sony's attempt at converting everyone from analog cassette
  tape to optical digital record/play technology.  Data storage versions also
  available.

* DVD - Digital Versatile (or Video) Disc - Super hyped next generation in
  video and data storage.  This *will* replace CDROM but how much further
  it goes remains to be seen.
```

* WORM - Write Once Read Mostly drives - Older optical data storage storage technology using a media that may be written but which may not be erased and rewritten.

* CD-R - Recordable CD. A special case of WORM technology using the CD format which may be played or read in normal CD equipment. The CD-R writers are coming down in price and becoming much more common.

* MO - Magneto optical disk drives - various incompatible or marginally compatible forms of high capacity read/write storage on optical platters, usually in either 3-1/2" or 5-1/4" form factors, single and double sided.

These all use optical technology very similar to that of the compact disc and CDROM. Thus, most problems with these cousins of the CD will be similar. See the document: "Notes on the Troubleshooting and Repair of Compact Disc Players a maintenance procedures, and diagnosis of most common problems. This document addresses those aspects of the technology and repair that are unique to each of these other formats. Problems with Sony PlayStation PSX (and similar) CDROM-like game machines are covered there as well.

Once CD (and DVD) rewritable technology becomes more popular (and lower in price), these will be added. I current have little information on this equipment.

Contributions are always welcome as you will note that there really isn't that much specific information at the present time on anything other than LaserDisk players and even this is sparse. I don't expect that much interest in or offers of CD-R, WORM, or MO repair information. However, MiniDisc has some sort of a following and we are destined to be inundated with DVD problems in the near future as they replace CDs as the equipment of choice. I am still waiting to see the inside of a DVD player - working or otherwise :-).

2.2) For more information on CD and optical disc technology

For an on line introduction to CD and optical disc technology, check out the Philips/Magnavox Electronics Reference WEB site.

There you will find links to a number of articles on the basic principles of operation of CD players, laserdisc and optical drives, TVs, VCRs, cassette decks, loudspeakers, amplifiers, satellite receivers, and other consumer A/V equipment.

A Fundamental Introduction to the Compact Disc Player is a somewhat more theoretical discussion of compact disc audio technology with diagrams and even some equations. If it doesn't put you to sleep, you will find quite a bit of interesting information in this article. In either case, it may prove of value.

Andy Poggio's relatively short article: From Plastic Pits to "Fantasia" provides a nice overview of CD technology.

Philips has a nice Web site which contains a great deal of useful information on CD, laserdisc, and other related topics. Philips and Sony developed the original CD audio specifications and much of the optical disk technology, so

they should know what they are talking about! A few of the links are:

Philips New Technologies.
Philips CD Audio.
Philips Optical Disc.
Philips Laseroptics.

A site with CD-R specific information including some repair tips is:

Rictee's CD-R Page.

An extensive amount of information on other optical disc/k technologies with many useful links can be found at:

Leopold's LaserDisc Page.
The MiniDisc Page.
The DVD Page.
DVD Central at E/Town.

2.3) SAFETY

In addition to the usual safety precautions outlined in the document: "Safety Guidel equipment has the added risk of vision damage from the higher power lasers that may be used for disk writers or recorders.

This isn't that much of a problem with LaserDisk players since the laser power is likely (but not guaranteed!) to be similar to that of a CD player where relatively minimal precautions are adequate.

However, for the technologies which can record or write on an optical disk, the laser power may be much higher and instant irreversible damage to vision is quite possible. Furthermore, these are almost always IR (infra-red) lasers which are for all intents and purposes, invisible. Proper precautions are essential and laser-blocking goggles are definitely recommended whenever the unit is powered without a laser shield in place. Once you damage both of your original equipment eyesballs, you don't receive any replacements (even if they are still under warranty - read the fine print of your contract)!

2.4) General safety precautions

While there are fewer potential dangers involved in servicing an LD player or MO drive compared to a TV, monitor, or microwave oven, precautions are still required when working with the cover removed. These relate to electrical connections to the AC line, getting caught in the mechanisms, and exposure to the laser beam:

* Electrical: There may be a few exposed electrically live parts from the power line, usually around the power cord entrance, power transformer, and on/off switch. If there are, tape them over or cover them somehow so you need not be concerned with a low tech shock! Unless you are troubleshooting a primary side power supply problem, there will be no need to go near the AC line.

Some equipment such as LaserDisc players may use switching power supplies with their own set of problems. Internal drives may include their own DC-DC converters as well (which are not particularly dangerous but can be easily damaged through the careless slip of a probe). In these case, see the document: "Notes on the Troubleshooting and Repair of Switchmode Power Supplies" for more information.

Where an older LaserDisc player uses a helium neon laser, there will be a high voltage power supply for the HeNe laser tube. While this is probably not powerful enough to kill you, a reflex action from touching the wrong terminal can result in collateral damage like ripped flesh from sharp sheet metal parts. These terminals are usually clearly marked and insulated but make a note of their location to be safe and add several layers of plastic electrical tape if they are exposed.

* Mechanical: Some of this equipment including LaserDisc players and higher performance optical drives spin relatively heavy (at least compared to a CD) platters at 3,600 RPM or more. The motors are larger and you really do not want to catch your tie in one of these (yes, I know, you don't wear a tie!).

* Laser: A variety of types of lasers are used in this equipment. It may be a diode type - either visible or IR, or in older LaserDisc equipment, a low power helium neon tube.

  - Low power (Class II, less than 1 mW at the lens) - This power level is typically used for the play-only or read-only equipment (CD, LD) or when in play or read mode for equipment that can write or record (MD, CD-R, WORM, MO).

  - Medium power (Class IIIa, 1 to 5 mW at the lens) - This power level may be used for recording or writing in a CD-R, MD, or MO device.

  - Medium power (Class IIIb, 5 to 30 mW or more at the lens) - This power level may be found in a CD-R or WORM drive in write mode.

  ALL THE HIGHER POWER LASERS ARE LIKELY TO BE IR AND INVISIBLE! You won't be able to see a bright beam you can avoid! The laser in all these devices is infra red, near IR - around 780 nm - border of visible range but for all intents and purposes invisible. While the laser is supposed to be set to low power for playing or reading POWER CIRCUITS CAN FAIL! Don't take any chances.

  With a visible beam, it is easier to avoid exposure and LD and DVD players use low power lasers anyhow. Reflections at these power levels are not strong enough to be a serious hazard. This will change eventually as DVD recorders and writers using higher power visible lasers are introduced. As a comparison, these will likely be similar in power level (5 mW) to the brightest laser pointers currently on the market and are a definite risk to vision at close range. Still, being visible, it is easy to avoid direct exposure.

  However, for an IR laser producing an invisible beam, there is no way to reliably avoid the beam visually. With the optics intact (no damage to the pickup and none of the covers on the pickup removed) and a disk in place on the spindle or the lens covered with black tape (no holes!), it should be safe to work at a reasonable distance. Don't put one of your eyeballs up to the optical block - there could always be a light leak! Proper IR blocking goggles would definitely be a good idea where exposure to these higher power lasers is possible.

  CAUTION: there is usually a very low intensity (in appearance) emission from an IR laser which appears deep red. It will be visible as a spot the size of the period at the end of this sentence when the lens is viewed from an oblique angle. This may be a spurious emission in the red part of the

spectrum or just your eye's response to the near IR energy of the main beam. In either case, do not be mislead into thinking that the laser is weak as a result of noticing this. The main beam is up to 10,000 times more intense than it appears! Take care. However, the red dot is an indication that the laser is being powered and probably functional, though it is no guarantee of the later. You really need a laser power meter or at least an IR detector to confirm the existence of an IR laser beam.

Chapter 3) Technology Specific Principles of Operation

3.1) LaserDisc (LD) Players

This is actually the oldest of the optical disc technologies to be introduced to the consumer market. In fact, most of its applications are for analog video storage - feature length movies and interactive learning tools and video games.

In terms of performance, video quality from the Laserdisc medium can be far superior to even SVHS and SuperBeta when viewed on a correspondingly high quality TV/monitor. Like a CD and unlike tape, access to any scene or even frame is nearly instantaneous. This is definitely a significant advantage for the casual viewer. However, it is the enabling technology for interactive learning and games. With over 65,000 individual frames on a side, this is a potentially very powerful way to present information as combinations of stills and moving segments and permit context dependent control of access or video action.

High-end video enthusiasts swear by Laserdisc technology but this medium never caught on due to its relatively high cost of both the equipment and the software (movies), limited rental availability, and because it is a play-only media. In addition, the capacity (NTSC) of a single LaserDisc is around 1 hour total on both sides requiring frequent disc changes even if the player has dual laser pickups.

The basic eletro-optical mechanism is similar to that of a CD including the techniques used for beam generation, focusing, and tracking. However:

* Older units may use a helium neon laser instead of laser diode for the light source. All newer LD players use laser diodes similar to those found in CD players.

* There will likely be an additional servo for pickup tilt to assure that the laser beam is perfectly perpendicular to the disc surface. Since the information is analog, this is needed to minimize crosstalk between tracks.

* Most mechanical components will be larger and much more robust since spindle speeds can reach 3,600 RPM with the large mass of a 12 inch platter.

* Both CLV (Constant Linear Velocity) and CAV (Constant Angular Velocity)

encoding has been used and both may be supported on one player.

* Most LD players also will play audio CDs so testing with this less demanding medium is a good way to determine if the basic optics and electronics are in working order.

(From: Mark Zenier (mzenier@netcom.com)).

The original version is covered in The "Television Engineering Handbook" edited by Benson from McGraw-Hill, 1986. Don't know about the newer version with digital sound. (Or what the newer edition of the book covers, either).

It's an analog FM system at 8 MHz that records the composite signal, with two FM audio carriers at 2.3 and 2.8 MHz.

3.2) So what about the RCA "CED" video player?

CED stood for something like "Capacitive Electronic Disc" probably with a "Selectavision" label.

It is NOT related to LaserDisc technology and does not use an optical pickup.

If you found one of these, you have a classic dinosaur! The CED system was something RCA spent $200-300 million to develop about the same time that LaserDisc technology was being perfected. Guess which won!

And, this was shortly after the same company spent a similar vast amount of money on another consumer electronics dud. It was also named Selectavision if I recall correctly and used optical scanning of 4 mm (??) movie film.

CED uses a capacitive contact sensor 'sled' running in a grooved disc.

The pickup actually rides on the disc like the stylus on a phonograph record. The sensor detects minute changes in the capacitance between the tip of the pickup and the metallized surface of the disc embossed with millions of tiny bumps and valleys.

This really isn't that bad - the system DID work but suffered from some of the same problems as records - wear, critical tracking requirements, etc.

If you are trying to resurrect a CED player, you better have the discs you want because they will not be available at your neighborhood video store!

Since it is more than 15 years old, there can be any number of problems with the equipment just from age and non-use. These are likely to be both mechanical (gummed up grease, dirt), and electronic (dried up electrolytic capacitors in the power supply, bad connections, etc.).

However, chances are good that it wasn't actually broken to begin with since consumers likely gave up on this technology before it actually failed - there just wasn't enough movies/programming available.

Start by checking the obvious, reseating all connectors, testing power supply voltages and for ripple, etc.

It certainly would be cool to get working.

3.3) Minidisc (MD) recorders/players

The MiniDisc cartridge looks somewhat like a small (2-1/2") version of a 3-1/2" computer diskette. Both players (around) $400 and player/recorders (around $700) have been introduced with disappointing sales. Not enough prerecorded material was available and the prices were too high to lure people away from the convenience, low cost, and limitless variety of the audio cassette medium.

MDs may be pressed like CDs with the information encoded in pits and lands. This is the way prerecorded play-only MiniDiscs are made.

For recording, the MiniDisc technology uses a higher power laser beam (upped to 5 mW at the disc surface) to heat a magneto-optically active coating to above its cure point (where magnetization is lost). A writing coil in close proximity to the back of the Minidisc is used to switch the magnetic field polarity (N or S) of the coating as it cools. Thus, the laser beam may be thought of as 'softening up' the magnetic material but the actual writing is by the coil. This is not the same way most other writable magneto optical drives are implemented. See the sections: "WORM Drives" and "Magneto optical drives" for more details on these other media.

For playback of this magneto-optical (MO) recording, the pickup uses what is known as the 'magneto-optic Kerr effect'. When a polarized laser beam is reflected from the disc coating, its polarization orientation is rotated slightly depending on the magnetic field polarity (N or S). This rotation is small (about 1%) but enough to permit detection. However, since it is so small, it isn't surprising that there can be problems with the optics and front-end electronics for MO readback.

Thus, the MiniDisc pickup and front-end operates in three modes: spatial (pits and lands) read, MO read, and MO write.

The basic mechanism and optical pickup is similar to that of a CD including the techniques used for beam generation, focusing, and tracking. However:

* Additional components will be present to detect the magneto-optic Kerr effect for playback of MO recordings.

* The laser can be switched between low and high power (as well as off). However, this is not a particularly high speed change as the modulation is done by the external magnetic field coil. WARNING: IR, invisible, 5 mW at the lens is enough power to be a significant risk to vision.

* The magnetic field coil will be found directly opposite the lens (and thus it may block any access to the lens unless it is removed for servicing.

* Extensive information compression techniques are used to enable roughly the same amount of audio to be stored on a MiniDisc with about 1/5th the surface area of a CD. For data storage, this is not usually possible so an MD may hold 'only' 125 MB or so of computer information.

3.4) Digital Versatile (or Video) Disc (DVD)

The DVD is destined to replace the CD as *the* optical medium of choice in the near future. This will happen if for no other reason than manufacturers will stop producing CD players (since DVD players will be able to read CDs).

The basic components are very similar and thus cost of manufacture will be similar. So, why produce old fashioned equipment?

The DVD permits storage of up to 4.5 GB per information layer with up to 2 of these on each side (one under the other) for a total of 18 GB if fully implemented. This means (per layer):

* 8 hours of CD quality audio.

* 2 hours of MPEG-II compressed LaserDisc equivalent video (Note: there is much debate as to the actual level of quality but we won't get into that here).

* Multilingual sound tracks.

* Any mixture of these.

The 8-fold increase in storage capacity per layer is accomplished through a number of incremental enhancements to the basic CD technology including:

* Use of a 635 to 650 nm red-orange laser diode instead of a 780 nm IR laser diode.

* A higher quality (actually higher NA) optical system permitting a smaller spot on the disc.

This permits:

* Closer track spacing on the disc (.8 um instead of 1.6 um).

* Higher CLV bit density.

For readout on both sides of a dual-sided DVD, dual optical pickups can be used where the user is willing to pay for this significant added expense!

From a marketing perspective, it is essential for DVD equipment to support the CD format. However, since DVDs and CDs differ in terms of feature size, track spacing, thickness, and so forth, it would not be very effective to simply shine the DVD pickup at a CD! Either of two approaches may be taken:

* Include dual optical pickups. This is probably the best way to assure total compatibility but is obviously an expensive solution.

* Provide optics that may be switched into the beam path to 'simulate' a CD pickup. The shorter 635 to 650 wavelength light is still used in both cases but the beam width and focus are adjusted with an intermediate lens or holographically generated compensator.

3.5) Will DVD be the killer format?

There has been and will continue to be a lot of hype with respect to the incredible advantages of the Digital Video (Versatile) Disc for everything from computer multimedia to HDTV.

Here is my take. My track record isn't great on predicting the future as my crystal ball has been broken for a long time, so don't buy or sell shares in any company based on these comments!

DVD will do very well for data storage since due to its much higher capacity compared to CDROMs (5 to 20 GB versus .64 GB), it will serve an important purpose in the increasingly interactive applications and games to come.

Full size DVD will be overkill for many audio applications. At the normal CD audio sampling rate of 44.1 K/second, the smaller DVD format will hold over 8 hours of music. Whether people will be willing to pay the expected price for a DVD with several hours of music is questionable. There certainly will be many good reasons to do this - full concerts or operas on a single disc, for example. I would expect the average total length of normal musical DVDs to increase beyond what is typical of CDs as well.

However, mini-DVDs are possible. A 3-1/2" format would hold about 1/3 as much as a full size DVD or over 2 hours of music. This or an even smaller format would be ideal for discman applications.

What about multilinqual sound tracks? Sure, this capability may save money by requiring pressing of only one disc to support multiple markets. But, few people will have a need to pay for this.

There are no doubt all sorts of applications that have not been identified yet for which the DVD is ideal. However, the hopes of the industry are pegged to DVD's success for video - in part, to replace the consumer (VHS) VCR. Unfortunately, It is here where I believe DVD has its greatest weaknesses.

Many of the specifications have been developed tailored to today's video standards, not HDTV. The DVD is supposed to be superior to both VHS VCR and laserdisc formats. However, this is in comparison to standards (NTSC and PAL) that are close to celebrating their 50th birthday. Even the quality advantages are questionable as so much depends on the MPEG-2 encoding used to compress the vast amount of video information onto the DVD.

Video tape and laserdiscs do not care what is recorded on them - they are equally good or equally poor for static scenes as well as explosive action shots. This is not true of DVDs. Complex images and rapid scene chances require more bits to minimize artifacts. And, the types of artifacts that are introduced are not those one expects from poor reception or bad tapes. It will take a great deal of effort on the part of the companies who will be converting original movies and other source material to the DVD to do justice to the format. It may simply be impossible for certain action sequences. The result may be 'pixelation' or momentary blockiness, erratic motion, momentary freezes, and so forth - not just slight fuzziness or snow. It is not known how the general viewer will accept these. Developers of source material will not be free to put in whatever they desire. The medium may break down when presented with too much fast complex action or rapid scene changes.

The situation gets even murkier for HDTV where the required amounts of data and data transfer rates increase dramatically. Depending on HDTV format, this could be anywhere from 2:1 or 8:1 - or more. If the DVD is marginal now, what does this say for HDTV?

Initially, DVD will not have record capability. Thus, there will be no compelling reason to switch over and throw out your VCR especially if the quality isn't dramatically better. The majority of consumers don't care that much about picture quality anyhow. Beta, S-VHS, and laserdisc, all have substantially better picture quality than normal VHS and NTSC broadcasts. It has not mattered due to various usability issues and marketing stupidity. The critical mass was never reached with respect to availability of source or rental tapes or discs. Thus, these have been relegated to niche markets

and niche markets don't drive the industry.

Will DVDs turn into yet another Edsel, Selectavision, or Betamax? Only time will tell but the industry must make a deliberate effort to assure the quality of the initial releases or else DVD's future as a video media will be sealed before it gets off the ground even if the technology there.

3.6) DVD FAQ?

Well one, at least:

* http://www.videodiscovery.com/vdyweb/dvd/dvdfaq.html (alt.video.dvd FAQ)

3.7) WORM drives

A large number of technologies have been introduced to provide storage of large amounts of information on optical platters with varying degrees of flexibility.

The earliest were called WORM (Write Once Read Mostly) drives. Writing resulted in an irreversible change in an information layer. Thus, data could be written but not erased and rewritten (though just erasing a block might be possible). Heating with the writing laser beam resulted in damage (ablating) of a coating. Reading is similar to that used for CDs and other optical technologies.

Typical capacity was 650 MB per side. Disks could be one sided or two sided.

This is somewhat similar to the technology used in CD-R drives though many variations have been developed which vary mostly in the details.

Unlike CDs, MDs, and LDs, these optical discs are formatted more like hard drives or diskettes with circular (not spiral) tracks and fixed sectors - some of which are visible to the naked eye since they are physically etched on the disk itself.

The laser power for WORM drives is typically higher than for read-only drives when in writing mode - likely in the 10s of mW range. 30 mW is one number I have heard. Modern drives all use IR emitting laser diodes.

The basic mechanism and optical pickup is similar to that of a CD including the techniques used for beam generation, focusing, and tracking. However:

* These usually spin at high speed - 3,600 RPM typical - so spindle motors and other mechanical components are more robust.

* Laser power can be switched between a fraction of a mW for reading and high power for writing (in addition to off). WARNING: IR, invisible, Class IIIB, dangerous!

3.8) Magneto-optical drives

Most modern optical drives use magneto-optical techniques in some ways similar to the MiniDisc. However, unlike the MD, the laser beam is switched at high speed to alter the magnetic properties of the coating and a write cycle is usually a two step process:

1. Energize the bias coil with the '0' polarity (e.g., N).

2. Erase a block by turning on the laser as that area of the disk passes under the pickup.

3. Reverse the polarity of the bias field to that of a '1' (e.g., S).

4. On the next revolution, write the information by selectively heating only those regions destined to become '1's in the stored pattern.

The laser power for MO drives is typically higher than for read-only drives and likely in the 10s of mW range. Modern drives all use IR emitting laser diodes.

The media is usually enclosed in a cartridge for protection with a door that opens automatically when inserted into the drive. Capacity is typically 650 MB per side for a 5-1/4" disk.

* Additional components will be present to detect the magneto-optic Kerr effect for playback of MO recordings.

* These usually spin at high speed - 3,600 RPM typical - so spindle motors and other mechanical components are more robust.

* Laser power can be switched between a fraction of a mW for reading and high power for writing (in addition to off). WARNING: IR, invisible, Class IIIB, dangerous!

* The bias coil is opposite the lens and may block access for servicing unless removed.

3.9) CD-R Recorders/Players

These use media that is the same size as the CD but can be written once and is then read-only like the WORM disk. In many ways, this technology is similar to WORM except that the format is a spiral track like that of a CD rather than circular tracks and sectors like other optical disk formats or hard and diskette drives.

Although CD-R started out being quite expensive (greater than $10,000 for a recorder), it really was designed as an inexpensive technology and to have total compatibility for reading with CDs and CDROMs. Current prices for multispin (2X, 4X) CD-R recorders are under $500 and dropping. The capacity of a CD-R is the same as a CD - about 650 MB.

Like the WORM drive, a higher power laser ablates a coating inside the CD-R media. With most, this is a blue-green polymer dye backed by a gold coating. Otherwise, construction of the CD and CD-R media are similar.

However, since the pits and lands are not as precisely formed as those of a pressed CD whose master was made on a $250,000 laser cutting lath, some CD players or CDROM drives may have tracking or other problems with CD-Rs.

CD-R recorders and high performance CDROM drives are very similar except:

* The laser in a CD-R recorder can be switched to higher power mode and modulated for writing. WARNING: IR, invisible, enough power to be a significant risk to vision.

* Tracking may need to be more robust as before the disk is recorded, there is only a guide groove rather than the pits and lands of a normal CD.

* Servo electronics must be more complex to control disk speed for recording.

3.10) HP 4020i/Philips CDD2000 Spring Fix for Write Append Errors

(From: Rick Richardson (rick@dgii.com)).

Here is the fix I applied to my two year old HP 4020i CD-R recorder when I started to get Write Append errors when writing CD's larger than about 550 MBs.

I got a tip that this problem was due to a "spring" wearing out or of insufficient strength from David Neal on the cdwrite@pixar.com mailing list (Unix CD-R software mailing list).

Armed with this clue, I searched DejaNews on the subject of CDD2000 & Spring. Here I found basically two theories for the problem - the spring theory and another one that said it is dust on the laser lens that needs to be blown off with compressed air (*not* wiped).

Since my HP 4020i drive is over two years old, I figured I had nothing to lose by opening it up and seeing if I couldn't apply the "spring fix". Also, at the same time I blew off the laser lens with compressed air.

After applying the "spring fix" and blowing the lens with air, the drive now works 100% again. I cannot say with confidence which of the these actually fixed the drive.

I attach the approximate procedure I used for applying the "spring fix" below. I disclaim any responsibility for the correctness or incorrectness of this fix. Apply the fix will void your warranty. You should not attempt the fix unless you have the proper tools and ability.

Tools Needed:

* Torx T-10 screwdriver

* Torx T-? screwdriver (even smaller than above). I did not have this small a Torx screwdriver, so I used a regular slotted screwdriver with about a 1/8" blade from a jewelers screwdriver kit. I was able to wedge the slotted screwdriver into two of the Torx slots and get enough friction to remove the screws

* Very very small philips screwdriver. Again, I did not have this size screwdriver, but was able to use another of the slotted screwdrivers from a jewelers kit. (A jeweler's screwdriver set with Philips types will probably have the correct size. --- sam)

* Two pair of small needle nosed pliers.

* Pair of dikes (cutters) used for electronic work

Parts Needed:

* About 1.25" long straight but springy wire. I found a suitable wire in an old 5.25" floppy drive that was used to apply pressure to the spindle.

Skills Needed:

* Good eye-hand coordination.

* Good eyesight.

* Steady hands.

* Patience.

The first step is to remove the case. Remove two screws with the T-10 screwdriver and four screws with the T-? screwdriver. Remove metal case. Gently release the top circuit board from two plastic alignment posts -- this may require gradual rocking of the circuit board but do not stress the circuit board as it is very thin.

The next step is to remove the main circuit board by disconnecting three ribbon cables and two sets of two pin connectors. The larger ribbon cables are released by moving two pieces of plastic at each end of the cable connector away from the connector body by about 1/8". The cables should then easily slide out of the connector. The smaller cable has a slightly different release mechanism, but again just move it about 1/8" away from the connector body. Slowly rock the two pin cables from their sockets.

You should now be able to see 4 more T-10 screws. Remove these to free the drive mechanism from the other part of the metal case.

The next step is to remove the smaller circuit board on the laser transport assembly. Remove 4 philips head screws. Pull the board up and lay it over - you will not be able to fully remove the board because two wires are soldered to the motor.

If you look at the transport now, you will see a worm gear which drives a regular gear which drives a rack gear. The rack gear is spring loaded to press up against the regular gear. According to theory, the spring which causes this pressure is worn out and/or not designed to be strong enough.

The spring itself is a straight length of springy wire, about 1" in length and rumored to be about .012" in diameter. Since I don't own calipers, I couldn't verify this.

The spring is held in place only by its springiness. Each end fits into a slot and the middle is bowed down an under a notch in the plastic rack gear.

What you want to do is add a *second* spring wire. You should not need to remove the original spring wire. I found a suitable wire in a 5.25" floppy drive I had laying around. I removed the wire from the floppy drive and straightened out a couple of bends that were in it and ended up with a straight piece of springy wire about 1.25" long, which is longer than the spring in the CD-R drive. You want it longer for now because it is easier to

install it that way. It will be cut to length later. Use the two pairs of needle nose pliers to straighten the spring wire.

With your finger, rotate the worm gear on the shaft of the motor to move the transport carriage so that the center of the spring is under the center of the regular gear. You should be able to see the notches that hold both end of the spring now.

Lay your new spring on top of these notches. Using the blade of a small screwdriver perpendicular to the length of the spring, press the spring down in the middle until it is underneath the slot in the black rack gear. This bows the spring about 1/8" in the middle. The spring should now be in place.

Using your smallest dikes, cut the ends of the spring wire off so that they are the proper length. Wear eye protection when doing this, and if possible grasp the end being cut off with needle nose pliers so that the wire won't fly around the room or worse into the drive mechanism.

With the drive still opened up, use a can of compressed air to blow off the dust on the laser lens. DO NOT touch the laser lens as it is magnetically floating in its holder.

Now, reassemble the drive by reversing the disassembly instructions.

Chapter 4) LaserDisc Players

4.1) Considerations when troubleshooting LaserDisc (LD) players

CD and LD players share much of the same optical technology. Many models will play normal audio CDs as well as LDs. If this is the case, start by determining if a CD will play properly. If it does, then you can be fairly sure that most of the optics and front-end electronics are functional.

Modern LD players use the same 780 nm laser diodes as CD players. Really old players used helium neon (HeNe) gas lasers resulting in a visible beam at 632.8 nm (orange-red). CAUTION: these use a high voltage power supply. Contact with this probably won't hurt you but will not be pleasant. The high voltage terminals are probably well insulated but it is a good idea to locate them and double check.

Since most LD players also play CDs (and possibly multiple size LDs as well), there will be optical sensors - LED-photodiode pairs aimed at the disc from one or more locations beneath the drawer assembly. If you have the top off for servicing, room lighting may confuse these sensors resulting in all sorts of strange behavior such as attempting to play a CD using the LD spindle! Cover the entire unit with a piece of cardboard or just the holes in the drawer with matt black paper to eliminate the possibility of both electronic and human confusion!

LD players will generally have one additional servo system compared to CD

players - tilt. This adjusts the angle of the pickup with respect to the disc to minimize interference between adjacent tracks. This would result in degradation of the analog video signal. The tilt servo is usually pretty simple using an IR LED emitter and a pair of IR photodiodes detecting the reflection from the laserdisc. If after manually rotating the tilt motor away from the balanced position, the tilt readjusts itself, there is a good chance this it is operating correctly. There is probably a tilt balance adjustment as well but don't touch it unless you have the service manual if possible.

Spindle motors in LD players are of much higher quality than typical CD players since the spindle must spin continuously at thousands of rpm with the greater mass of the LD as well. Other motors may be similar to those in CD players. Some LD players have two spindles that are selected and moved into position depending on the type of disk being played.

Due to the mass of LDs, the clamper is even more critical to proper behavior than for CDs. Any slippage and LDs may fail to be recognized.

There may still be rubber belts that degrade :-).

Naturally, a video monitor makes an excellent diagnostic tool once it is possible to obtain some output from the LD player. A service manual is almost a must for serious troubleshooting.

4.2) LaserDisc optical alignment?

As noted elsewhere, optics don't generally drift except from abuse.

The following is a further confirmation that optical alignment should not be needed under normal conditions:

(From: Dave A. Wreski (dawreski@nic.com)).

I have been servicing these since they came out. The *only* time I had to do any optical alignments is when some fool decided to mess with the alignments. They do not misalign themselves. In the past the only adjustment we had to do (on Pioneer Laserdisc players) is the 1/4 wave plate which can be done with a scope. All other alignments must be done with a Laser power meter and a polarization adjustment jig from Pioneer. Many dollars!

If the optics are clean and haven't been maladjusted, your unit is suppose to work. If not, look elsewhere in the electrical alignments or motor problems.

4.3) Replacement for helium neon power supply components

Older LaserDisc equipment used a helium neon laser instead of a laser diode. These require a high voltage power supply which can fail. Obtaining an exact replacement is probably virtually impossible today and too costly in any case.

However, it should be possible to substitute a surplus HeNe tube power supply.

These can be had for as little as $25 from various mail order sources. I don't know if LaserDisc players do anything special with optical feedback or anything like that but if it is just a power supply, this may be an easy and inexpensive alternative.

4.4) Kenwood LaserDisc clamping problems

With the larger mass of a LaserDisc compared to a CD, clamping is even more critical. Slipping belts are a common cause of clamping problems.

(From: dwb@rell.com).

I had a problem with my Kenwood machine not locking the disc in place correctly. The drive belt was slipping to bad (couldn't hear it though). The replacement was a NEW mechanism that regeared the assembly for slower feed but more more clamping force.

4.5) Philips Laser disk problems and discussion

"A friend of mine has a Phillips Laserdisc player that is acting up. What it does is the player will just stop playing in the middle of the movie, usually in the same spot."

(From: Douglas W. Jefferys (dougj@freenet.hamilton.on.ca)).

How old is the player? I've worked on the Philips 22VP931 and seen similar things. This is an ancient (ca. 1982) industrial player with a tendency for the radial and tangential mirrors to jam in their servos. (The glue that holds the magnets behind the mirrors weakens with age. If a magnet detaches, the mirror jams solid, but the magnets can also migrate outwards and cause sticky behavior).

If it's an older player, it's *possible* that it's in the early stages of the same failure mode. (That said, all the 22VP931s I've seen that have this failure have had *solid* jams on at least one of the mirrors, so I think it's an all-or-nothing thing.)

Anyways, after fixing the servos (a nightmare - it's a good thing I had help from a knowledgeable source about what to expect when I went into the guts of the thing :-), I did an eyeball alignment (power *OFF*, machine unplugged, a double-check that the power is off and the machine unplugged, and look down through the objective and see if you can see down the entire beam path) and got the same results you did. Worked fine on the early portion of the disk, but slowly screws up later on. High-speed seeks worked marginally early on, and not at all on later portions of the disk.

An examination of the player while playing showed that one of the mirrors was near the limit of its range of movement at the point when the video started freezing up.

NOTE: I'd strongly recommend *against* looking at the mirrors in operation unless it's either a visible-beam system or you have goggles opaque to the laser's frequency. I was willing to be somewhat stupid because it was a

visible-beam system, and I still used a piece of paper to ensure my head was nowhere near the areas where bits of beam were leaking from the player. I wouldn't have even fantasized about attempting this with an IR beam.

About three hours and umpteen incremental adjustments of the optical head's alignment screws (which I had to remove and thereby misalign when fixing the servos), and the thing was working fine.

Summary:

1. Check to ensure the tangential/radial mirrors move freely.

2. Check optical alignment on early portion of disk and 'stuck' portion of disk. Preferably with an optical alignment tool, but if you've got goggles or a visible-beam system and more balls than brains, you can *carefully* look at the mirrors when the disk is playing and use that as a guess as to which way to tweak the mirrors.

One final note: Some of the alignment things can be "one-way" adjustments, and anything on the optical path is vulnerable to scratches. I'd strongly advise trying to find the service manual before attempting any modifications.

If you have contacts with professional fixers, I'd also suggest you bounce your ideas off of them before proceeding. When hacking LD players, you're always one mistake away from owning a very expensive pile of spare parts.

4.6) Pioneer Laserdisc RS-232 commands

(From: Jim Jackson (jim@aviendha.demon.co.uk)).

Here is a list of commands I have for controlling Pioneer players via the RS-232C jack. Hope it helps. I have also heard that there is supposedly a MCI driver for Windows but I haven't personally seen it. I tried these codes on a Pioneer machine I have at work using the Windows terminal program and was able to control the player. This file is from a public domain file for the amiga. I think I also have a C program (also for the amiga) somewhere if you need it.

Communication protocol:

* Computer activates CTS (pin 5) of rs-232 port, (amiga 7-line handshake).

* Then sends a command sequence and expects 'R' and carriage return (CR).

* ASCII digits used for addresses, etc. Returns frame# as ASCII digits.

* Player is string oriented and reverse-polish (arg then verb).

COMMANDS	CHARS	HEX	DECIMAL	COMMENT
Door Open	OP			open the door
Reject	RJ			stop disc rotation
Start	SA			start disc rotation
Play	PL			(address)PL
Pause	PA			
Still	ST			still frame
Step Forward	SF			

```
Step Reverse    SR
Scan Forward    NF
Scan Reverse    NR
MultiSpeed FWD  MF                              (address)MF
MultiSpeed REV  MR                              (address)MR
Speed           SP                              integer SP
Search          SE                              address SE
Stop Marker     SM                              address SM
Frame           FR                              set frame mode
Time            TM                              set time code mode
Chapter         CH                              set chapter mode
Audio Control   AD                              integer AD
0=off,1=Ch1,2=Ch2,3=stereo
Video Control   VD                              integer VD  0=off,1=on
Display Control DS                              integer DS  0=off,1=on
Clear           CL                              clear entry or mode
Frame #         ?F                              get frame number
Time code #     ?T                              get time code number
Chapter #       ?C                              get chapter number
Player active?  ?P                              P00=door
open,P01=park,P05=still
Disc status     ?D                              5 bytes and CR returned
(and a few others....)

SERIAL PORT CONNECTION:

  Computer     Player
 ----------   --------
   TxD 2       3 RxD
   RxD 3       2 TxD
   CTS 5       4 DTR
   GND 7       1 GND

For more info on your type of Pioneer player:

    Pioneer Communications of America, Inc.
    Engineering and Technical Support Deptment
    Sherbrooke Office Center
    600 East Crescent Avenue
    Upper Saddle River, NJ 07458-1827
```

4.7) Pioneer LaserDisc player test program

From: Colin Kraft (ckraft@airmail.net)).

I have just found a RS-232 test program for all Pioneer LaserDisc players on Pioneer's web page. The URL is:

* http://www.pioneerusa.com/drivers.html

It's called testprog.exe and it's quite impressive and handles just about every Pioneer player that has the RS-232 port. It also comes with a nice doc file that cover dip settings for various players and more.

I tried it with my newly acquired LDV4200 and found that it did not work. Right now I am fearing that my player has a problem with the control port. The data seems to be coming through the cable as I get a flashing logic probe when I hook it up but the player does not respond.

I'm not sure about the codes as they are not covered in the otherwise excellent doc file (they always leave something out it seems). However, I think you can get codes for your player through Pioneer.

4.8) Comments on Pioneer 8210

(Portions from: Dave A. Wreski (dawreski@nic.com)).

The 8210 service manual is 120 pages long. This is not an easy unit to work on. It is the very first industrial video disk player that Pioneer made. All of the GM dealers had them when they first came out and I have seen them for sale in most flee markets for around $50.00.

These are built like a tank and use a HeNe laser tube and a bunch of discrete optics that are very hard to align properly without the manual.

4.9) Pioneer '90' series LaserDisc player doesn't play older LDs

"Check those discs you are playing. My 1090 won't play some older Image Discs including my (BOO HOO!) Bride Of Re-Animator disc."

(From: Steven B (lasers@netrus.net)).

The 90 series of laser player had a fault that was fixed by Pioneer at no cost. It also caused a whole new series designation. Call Pioneer!

4.10) Pioneer CD/LD Player Model CLD-S104 with shorted power supply

(From Mark Z. (zmachar780@aol.com)).

Your Pioneer LD has a shorted protective device, a V1B24 or similar. Looks like a diode and is located near the main AC input to the board. Clip it out, replace the fuse, and normal operation will resume. You STILL NEED to replace it; it protects some very expensive chips. Get the reference number off the board and call Pioneer at 800-457-2881.

4.11) Pioneer 503 LD player sled slews to one end after

service

(From: illusion@pqc.com).

I have seen that before. The Sled runs on a differential op-amp. This uses +15V and -15V. One of these supplies is out. There are two fuses in power supply for this. Most likely u blew one when changing spindle motor. This will throw loading motor and sled motor, and maybe even the tilt motor (if it isn't also the loading motor) into overdrive in 1 direction. Loss of either supply will shift the differential one way.

Pioneer CLD-D701 tray locking problem?

"I've owned a Pioneer 701 laserdisc player for many years. Other than its tendency to drift out of alignment slowly and steadily over the years, it has been a good LD player. However, within the last year the tray has developed a strange problem. Each time I turn the 701 on and press the eject button to load a LD it takes about 6 seconds of gear grinding before the tray finally decides to come out. Just a couple of years ago the response was almost immediate.

Once the tray has finally opened, thereafter it behaves normally and responds immediately for as long as the player is left on. Even if it's turned off briefly and back on, the tray behaves OK. However, if I wait to the next day the tray goes back to its nearly 6 second wait again.

There appear to be several opinions as to the cause

First suggests it is a sticky rubber problem:

(From: Jeff Boettler (boettler@us.ibm.com)).

Eject the LD drawer and disconnect from the mains. Then remove the cover. On the 2950 there is a mechanism that clamps the disc that is suspended by metal bars running over the top of the drawer. Remove this, around four screws and locate the motor. There will be a rubber mat that grabs the disc. Clean this with meths and nothing else. Allow to dry and reassemble.

Apparently this problem is accelerated by dirty labels on the LD and BBFC logos that have been removed, which leave a nasty deposit that rubs off on the mat.

(From: Bruce Esquibel (bje@ripco.com)).

I somewhat have a clue - but haven't came up with a 100% fix yet.

The trouble appears to be the upper 'track' that hub/laser assembly uses when it returns from the side 2 position.

This track floats within the metal sleeve on the upper left hand side as you look at the player from the rear (front away from you). It appears the last inch or so is warped or slightly deformed, probably because of age.

If you examine the construction the track is pulled upward via a pair of springs and held in by a couple L-tabs or ears from the track. When the laser is returning from side 2 to stop you can see the track slightly move as the motor on the hub assembly runs on it.

When it just about hits the end, that is when the grinding noise is heard, the gear on the shaft of the motor is spinning, but not meshing with that part of the track. It appears that after so much time the player detects the

error and starts 'slapping' the hub around and eventually it grabs and does its flip.

Odd part about this is that even the slightest pressure on either the track or hub will allow it to cycle without missing a beat.

What I did, which reduced the grinding, but did not fix the trouble completely was to modify the rear spring to be tighter by carefully cutting the loop off and unwinding one turn, making into another loop. I suppose you can find another similar spring which has less turns also. The other bit that helped was kind of cheesy, the rear L-tab from the track seemed to have too much play when the motor ran near it. All I did was stick a small piece of electrical tape under it, on the metal housing which also tightened the track.

I'm pretty sure the track itself is the problem, but it looks like a son-of-a-bitch to replace, even if it is a replaceable part. Another possibility is the gear on the motor shaft getting worn down but being the problem is only at that one end, I really don't think so.

If you aren't into repair (just a joe consumer), I really don't recommend trying either the spring mod or tape bit, the spring can be easily malformed or the L-tab can break off, which either happening will put you in a world of hurt.

All I can add is don't bother greasing the track, was the first thing I tried and it didn't help a bit. Also there was no indication of it needing lubrication anyway. This is a tolerance issue between the gear and track.

The grinding noise, although sounding nasty, isn't really. It's not chewing up anything and I didn't even notice nylon dust around the area where the teeth are grinding. It's more of an annoyance problem than a major malfunction.

4.12) Pioneer LD-3090 turn over problem

(From: Kurtis Bahr (kbahr@erols.com)).

I once fixed a 3090
that had a problem when stopping the LD and the pickup tried to turn back over to side A. It actually made a grinding sound for awhile then finally grabbed into the turning assembly and turned over.

The fix was to lubricate the metal guide shaft where it transfers from the playing shaft to the shaft on the turn mechanism. After this was done it has worked flawlessly.

4.13) Sony LDP-1450 problems and discussion

"I'm the proud owner of a very confused LDP-1450 from a Mad Dog McRee machine.
 It's got six option DIP switches, all are "off" (down), and>it's set for 1200
 baud."

(From: Ruben Panossian (malcor@ozemail.com.au)).

The Extended Function dip switches are for just that, extended functions, which change certain characteristics of the player's operation. There are only three extended functions, using switches 1, 2, and 4 only. The other DIP switches are not used. Factory default is for all of the DIP switches to be set in the "off" position.

The baud rate setting would not matter if you have nothing connected to the interface. BTW, it should be set for 9600 for ALG games.

"Power-Up: Disc rotates 10-30 degrees in random directions, changing directions erratically every half-second or so, and the head makes a weird squeaking sound periodically as it tries to seek (maybe it's making physical contact with the disc??)"

The objective is unable to find focus when this occurs. (usually) The disc will not spin-up to speed, rather, a slower turn and often in reverse. To determine if the player is finding focus you will need to get access to the lower PCB's. Turn the player on its *side* and remove the bottom cover. (Do *not* try to eject the disc in this position!) This is the servicing position.

The large board you will see, behind the lower cover, is called MB-40. You will need to pull this board out a bit so you can work on it. Locate IC313, it is an HA11529. This IC controls the focus (coils), tracking (coils) and communicates to the main system control.

Looking at the schematics, you can see that pin 36 of IC313 drives the focus coils. Pin 26 of IC313 is an output to the system control, which signals when focus is locked. By using a CRO, connect one channel to pin 26 and the other to pin 36. Adjust the display so that you can see the two signal but not on top of each other. You will need a CRO (or DSO, whatever) as the signals are about 3Vpp.

Turn on the LD player (with a disc already loaded) and watch the signals. (the disc should be moving and sounds from the player) You should get a ramping (triangular) signal on pin 36 for a moment then a steady line (0V), indicating that focus has occurred. The signal on pin 26 (focus lock) is high, when focus is not locked, and low when locked. When the focus is locked the player should spin-up and go in to playback mode.

Now, if you are finding that focus locks then searches then locks, in a peculiar way then you will have to do some more checking to determine the problem. This can be caused by many things.

If focus is not locking and the signal on pin 36 is a constant triangular wave then the problem is more than likely in the optical block or the laser not turning on.

Check to see if the objective is free. Next, check the continuity of the focus coils from the connector on the MB-40 board.

You can check if the laser diode is turning on by checking the test point TP302 on the MB-40 board. It is located near IC312 which is a three pin -5V voltage regulator. When there is -5V on this test point the laser should be on. If there is no -5V there then check for -8 to -10V on R334 (any side) If there is no voltage there then there is a voltage rail supply problem. (like you hadn't guessed)

If there is around -10V, then check the base on Q314. This is the right pin if the flat side is facing you, the right way around. It should have 0V on it to turn the laser on. Hmm... I will try again. One pin is connected to the +5V rail (collector), another pin, the emitter, drives the base of Q313 (which then supplies -10V to IC312) which should have +5V on it when the remaining

pin (base) is at 0V. The base is connected to the LD "ON" or LD "OFF" signal. It is an active low signal, so a low signal will turn "on" transistor Q314 and in turn eventually turn on the laser diode. The laser diode also has an APC which complicates things, but don't worry about that at the moment.

If the of base of Q314 is 0V and the collector is +5V then the emitter should have almost +5V on it. If not then the transistor must be real hot or dead. If it is hot, Q313 would be faulty. BTW, this transistor, Q314, is a pre-biased "digital" transistor. It is either fully on or off.

I had a laser power problem like this, on a player out of a TT, which I had previously repaired. This time it turned out that the laser was not turning on all the time. Some times it would be ok for a couple of hours then it wouldn't work properly. By the time I had taken the covers off it was OK again. (Grrrr)

To make a long and frustrating story short, I found that the laser wasn't being turned on when it should all the time. Turned out to be a bad connection on IC902, which is a 80 pin quad flat pack (SMD) and *only* pin 31 had a poor connection. This pin controls the laser diode "on" and "off" signal. I think I may have caused this poor connection when I was poking around previously.

Also be careful when probing around a SMD like IC902. If you inadvertently short out a couple of pins, the slide motor may move (turbo) the optical block towards the spindle and not stop, causing a nice gear jumping noise that brings on a sudden panic attack. Which may cause you to knock over your LD player while trying to find the "OFF" button while still holding a cro probe. Although, I wouldn't admit to doing such a stupid thing, especially publicly. :-)

Now, back to IC 313 on the M-40 PCB.

If you are not getting a triangular wave or steady line on pin 36, but a wavy (sinus) signal then check the soldered joints on pins 38, 41 on IC313 and on R384, R382, R381, C337, C338. These are for phase compensation for the focus coil. If the signal looks strange on pin 36 of IC313 or the laser is turned on and IC313 is not working then IC313 or the serial control input signals may be your problem. I have only seen a couple of poor soldered connections on these, otherwise A+, players but you never know...

If you find that focus is locking in say 10ms intervals (on and off) then the problem may be in the focus loop, which is initiated right when focus is locked. This loop controls the current supplied to the focus coil to maintain a constant current which is proportional to the focus error, so the focal point is maintained as the disc turns. Keep in mind that the focal length is not constant, as the disc is rotating.

Or the problem could get interesting. In other words, *could* end-up being a "dog" of a problem, unless you have a manual. Either way a manual is essential. If you can read and understand the circuit diagrams then you shouldn't have any problems, other than the faults that were devised in hell.

"Self Test: Removing the front cover revealed a "self test" jumper. Shorting the two pins together forced the player to spin up. The player correctly displays video for a few seconds (overlaid on the video is a frame number of approximately 7000), but quality, which starts off great, deteriorates rapidly, and the player then jumps back 100 frames or so and repeats the cycle. The words "NTSC 12" appear underneath the frame number whenever the self test jumper is shorted.

The frames played are identical for any given disc. Mad Dog McRee gave me 7000ish, and Star Rider gave me 6900ish.

When the player is in this mode, pressing the eject button causes the video to mute and the player to spin down. When the disc has stopped

rotating, a further press of the eject button will eject the disc correctly, and a further pressing will reload the player."

Yes, this is normal. Even if the focus error is greater than it's cut-off point the player will spin-up and try to display video. How good the video is will depend on how great the focus error is, I guess. I have done this myself, however, have found the video to be very jumpy and poor if any at all. When the focus error gets to it's cut-off point it re-initiates focus search..

If the video is clear and stable then your problem sounds like it is not with the optical block, focus, etc. (with the test jumper closed)

The test jumper you found is *only* meant for adjusting the "inner" and "outer" frame limits for the disc sizes, hence the displayed frame numbers.

"Theories:

1. The player works but is still configured for a video game; it has to have something useful coming in on the RS-232 port in order for it to work."

No. There were different LDP1450 software revisions though.

With the Extended Function Dip switches all set to the "off" position the player will "spin-up" a disc and go to playback mode, when a disc is loaded.

"2. This might be changeable (or I might get a different set of diagnostic information) if I knew what to do with the six option DIP switches."

Yes and no. This is not your problem, though,.

"3. The player is malfunctioning, probably something to do with alignment of the slide on which the optical head moves, and this accounts for the weird looping behavior I get in the self-test mode."

Possible and no.

"Questions:

1. Am I doing something boneheaded?

No, considering the lack of information you have for this player. You could have done worse...by poking around IC902. I don't think that you will get very far without a service manual. The Sony service manual is relatively expensive, however, it is essential, It is also well detailed and clear, unlike some early player manuals.

"2. Anyone know where I can get a service manual?"

Yes, from Sony :-). Because it is not a real old LD player, they will have the manual.

"3. I have yet to hook it up to a computer. I have a utility that purports to be able to talk to an LD player; would this help, or should I concentrate on getting it to work correctly in stand-alone mode before trying to talk to it?"

This wouldn't help you with repairing the player, rather the opposite.

Also, I forgot to mention one of the first things you should check for. Check the power supply voltages. Obviously +5V is ok. You should have an idea of which voltages are ok by what is working in the player as a start, anyway. There are around 10 voltage supplies or more including at least 5 different voltage rails.

Disclaimer:

If anyone goes blind, destroys their LD player, decapitates their dog Fluffy, etc, by following my suggestions , it is not my fault. Only work on a LD player if you have an idea of what you are doing and understand what the dangers are. i.e., take blame for your own actions.

Chapter 5) MiniDisc Equipment

5.1) Sony MiniDisk player/recorder considerations

The Sony MiniDisk system was supposed to replace cassette tape as the preferred medium for portable music (and data). Yeh, well, I am not holding my breath but it may yet come to pass. The disks are about 2-1/2 inches in diameter and enclosed in a protective case like a 1.44 MB diskette. Thus, dirty disks, at least, should not be much of a problem. A MiniDisk (MD) holds approximately 1/5th as much raw data as a full size CD. Compression techniques are used to achieve the same maximum time for audio - about 74 minutes - supposedly with negligible loss in audio quality. (I won't get into that argument either).

For playback of prerecorded discs, the optics and servo systems are operating in modes which are very similar to those in CD players and thus suffer from most of the afflictions and remedies described elsewhere in this document. The digital decoding and error correction including an advanced form of the CIRC may be substantially more sophisticated for MD players and MD data drives (if you can imagine that being possible) but the circuitry involved should be very reliable.

However, for playback of MiniDisks recorded on MO (magneto-optical) media, there can be many other problems as the optics/electronics are sensing the different polarization of reflected light from the N and S magnetized spots rather than pits and lands. The signal-to-noise ratio of the MO effect may be lower than that of a stamped disc. Thus, prerecorded media with the normal pits and lands on the information layer may work fine but MO media may suffer from tracking, audio noise, or uncorrectable data errors. Servo adjustments for tracking and CLV spindle control may be even more critical than for CD players.

Note that some MDs may include both prerecorded (stamped) and MO sections so that it is possible that only certain portions of these disks will play reliably.

MiniDisk recording requires that the laser diode be operated at higher power (around 4.5 mW optical output compared with less than 1 mW for reading) and that an electromagnetic head in contact with the back of the MD is driven with the EFM coded data pattern. This is not really a write head such as that used in a computer disk drive - the laser beam does the actual writing by heating the MO layer but the magnetic field determines the polarity (e.g., 1 or 0, N or S) of the written spots. Therefore, the actual position of the head is not critical - there is no servo for it! Note that this approach contrasts with that used in many other MO drives where the laser power is modulated to write

1s and 0s. The 'Magnetic Field Modulation' approach used with the MiniDisk claims many advantages in terms of robustness when confronted with less than perfect optical alignment and control of laser power, among others.

CLV servo lock during recording is determined by a signal derived be impressing a reference modulation (wiggle) on the premastered groove wall position - yet another possible area for failure or need for servo adjustments!

CAUTION: the higher power laser output required for recording is substantially more hazardous than that of CD players. However, since under normal conditions even with the case disassembled, the disk and electromagnet will be blocking the lens, there is little danger. However, if you remove the electromagnet and there is no disk in place, this optical power must be treated with respect.

5.2) Sony MDS 302 Minidisc optical blocks

This likely pertains to other Sony models as well.

(From: Shawn (slin01@mail.orion.org)).

These is a very common problem with Sony MD/CD players. I'll bet it is skipping and/or ruining your recordable MD's, right? It causes far more "disasters" with MD because an MD deck that has trouble reading a recordable MD will think it is corrupt and try to write a new TOC, which can ruin the contents of the disc! When this occurs, press the STOP button until the "TOC" indicator disappears (may take up to 10 seconds) and eject your disc, it will come out unharmed.

Anyhow, on to the optical block problems. I will bet your MDS302 will work fine if turned on its side or upside-down. I have seen this problem many times with Sony MD/CD equipment. I have MD players from Sharp which are much older and have suffered great abuses (like being run over by a car) which don't suffer this problem.

My only guess is that it's either a problem with the lens suspension or the focusing coil. It is definitely a problem with the focusing system in the optical block because: A) replacing the block fixes the problem B) sometimes adjusting Focus Bias on the deck will compensate and reduce or eliminate the problem. C) I have fooled around under the cover of the optical block and have experimented using pieces of tape to suspend the lens suspension. I suspect this compensates for either a poorly functioning suspension or a screwy focus coil. I have been able to regain 100% perfect operation using this fudge-fix method!

Unfortunately, to fix this problem properly, you will need the new optical block. We can only hope that Sony will correct this problem! BTW, you could always use your deck upside-down or sideways. :(

Chapter 6) DVD Equipment

6.1) CD and DVD support on same drive

Digital Versatile (or Video) Disc players should be hitting the streets by now or at least very soon. What this means is that DVD players will need repair just like CD players.

While much of the basic construction of CD and DVD players is similar, in order for a single player to work with both CDs and DVDs requires some fancy footwork to avoid the costs of dual laser pickups. This comes about from the change in the laser wavelength (780 nm for CDs, 632 nm for DVDs) and thickness of the disc (1.2 mm for CDs, .6 mm for DVDs). This requires differences in the optics to produce the proper spot size and readback image on the photodiode array.

(From: Bill Studenmund (wrstuden@macro.stanford.edu)).

I saw an overview in a journal on what they're doing, and it's pretty cool. They have a variable aperture in the beam (maybe it's on a hinge and snaps into the beam path?). In one setting, the beam is the right diameter to fill an inner area of the objective, and focuses to a spot the right diameter for reading normal CD's. The spot has correction for the spherical aberration from 1.2 mm of disk.

When the aperture is not in the beam, it fills the full aperture of the lens. There's a holographic grating on the lens so the the combination of the inner and outer areas is diffraction limited for 635 and compensates for 0.6 mm of disk.

Though the signal to noise ratio will be lower as the 1/4 wavelength's a bit off, I doubt it'll be a problem. The electronics have gotten so good that they can read a disk w/o metal backing! That's how the Sony dual-layer disk technique works. There are two surfaces with data, and the one in the disk has no aluminum backing. They get enough S/N to read that layer. It's about 50 um above the "normal" layer, so not much of a defocus.

6.2) Could DVD discs be made with compatible CD tracks?

CDs are 1.2 mm thick. DVDs consist of two bonded .6 mm substrates. In principle, the DVD layer could be made partially transparent permitting a CD player's laser beam to focus through it to some tracks of CD information pressed in their normal position 1.2 mm from the bottom surface.

As a practical matter, it is very unlikely that any existing CD player could be made to work with such a scheme. It would be like viewing the pits through a frosted plastic screen - theoretically possible but substantially reducing the signal to noise ratio. Furthermore, the CD focus servo would very likely lock onto the DVD rather than the CD layer as it goes through its focus search routine.

It might be possible to design such a CD player but why would anyone want one? By the time this matters, DVD players will either be mainstream (CD-only players may not even be available any more) or will have been superseded by something even more wonderful. Why would you pay a premium for a DVD pressing

and then only want to play portions of it on a CD player anyhow?

Chapter 7) WORM Drives

7.1) WORM drive Laser Diodes

(From: Alan Shinn (alshinn@sirius.com)).

Well, I bought a few of those WORM drives I wrote about. The LD puts out at 30mW at 110mA, As measured by using it to heat up a surface mount transistor hooked up as a thermometer with a surface mount resistor glued onto it for calibration.. I wish I had gotten more. Not that I know what I will do with them (the LDs) The drives also have several rare earth magnets so they were quite a fun deal.

Chapter 8) CD-R Equipment

8.1) Differences between CD and CD-R media

(From: Michael Portmann (mikep@adelaide.on.net)).

I have a flyer on Mitsui CD-R media. I quote from this:

The difference between a CD-R and a CD-ROM lies in the structural layers between the polycarbonate substrate and the protective lacquer surface that both discs possess.

The CD-R has one long groove stamped in the polycarbonate substrate to guide the laser. This groove is covered with an organic dye lyer, which, when written upon by the heat of a higher powered laser light from the recorder, will deform to produce the 'pits' and 'lands' of information. The dye is protected by a non-corrosive, highly reflective thin layer of gold. One the CD-R layer is recorded, the deformations in the dye become permanent.

The Mitsui gold CD uses a patented Phthalocyanine Dye & Data shield surface.

They then go on to mention how unlike Cyanine based CD-R, theirs shows less degeneration from continuous exposure to light and heat.

Written by Samuel M. Goldwasser. [Feedback Form] | *[mailto]. The most recent version is available on the WWW server http://www.repairfaq.org/ [Copyright] [Disclaimer]*