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Troubleshooting CD-Player Slartup Problems

A STARTUP PROBLEM IS A CATCH-ALL TERM FOR ANY SITUATION WHERE A CD PLAYER OR CD-ROM DRIVE REFUSES TO RECOGNIZE OR PLAY/ACCESS A DISC. IN THIS MONTH'S INSTALLMENT WE'LL DESCRIBE IN DETAIL WHAT HAPPENS WHEN you insert a CD and push PLAY, and we'll look at what to do if the unit doesn't want to cooperate.

What's a Startup Problem?

With an old-style record player (you know, vinyl **LPs,** technology that was state-of-the-art sometime before dinosaurs roamed the earth), the tone arm could be plunked down anywhere to start play. Not so with a CD player. Aside from the fact that you cannot even get to the pickup on a CD player to move it by hand and plunk it down, a lot must take place successfully before the first note is sent to your loudspeakers.

Startup problems cover all situations where the player does not successfully read the disc directory. Nearly everything in the optical deck and much of the main-board electronics needs to be functional to read the directory. Therefore, any failure in any of a rather large number of places can prevent successful startup (and subsequent play).

On a changer, a startup-sequence failure will probably result in similar symptoms, but then the unit will move on to the next position in the carousel or cartridge. It is likely that the player will remember that it was unsuccessful at loading a disc for each position and eventually give up after all possible discs have been tried.

Possible causes of a startup-sequence failure include a defective disc, dirty lens, defective laser or photodiode array, bad focus or tracking actuator or driver, dirty track, insufficient or dried-up lubrication, dirty or bad limit switches or sensors, defective spindle motor, faulty electronics or control logic, damaged parts, faulty optical alignment, and/or need for servo adjustments. The bad news is that this is a large number of possibilities. The good news is that with such a large number of possibilities, there is a good chance that the problem will be minor and inexpensive to fix; actual failure of the (expensive) optical pickup itself is relatively far down the list of likely causes.

First, be sure that you do not overlook the trivial: Are you loading the disc correctly? Most CD players want the disc label-side up. However, there are some, like Pioneer magazine-type changers, that want the label-side down. If you have just acquired the CD player, don't overlook that possibility,

Startup Sequence

The exact sequence of startup events and the symptoms they cause when they fail will vary depending on the type of player and its design. For example, the display might flash, be blank, display "— : —" or the word "disc" or "error," etc. In any event, the unit won't play the disc. By understanding the following summary as it applies to your player, you should be able to determine what is going wrong.

When a CD is inserted, the player should go through the following routine:

1. Drawer closes (or with portables, lid is closed manually) and CD is clamped to the spindle.

2. Interlock engages, if present (always in portables). If there is no interlock, there may be an optical sensor or the optical pickup may act as its own disc sensor.

3. Pickup resets to starting (index) location towards center of disc, which is usually located using a limit switch or optical sensor.

Before describing the remaining steps, it would be helpful to explain a bit more about the organization of the photodetector. The illustration in Fig. **1** is typical of units that have a three-beam pickup. Blocks E and F are not present (or at least not used-they will be disabled and grounded) in units that have a single-beam pickup. The four-quadrant (ABCD) photodetector is found in all systems. The main return beam is detected by the ABCD array. The tracking beams return to E and F. Detector E is offset slightly off track to one side and F is offset to the other. Average signals from E and F will be equal when the array is centered on the track. Now, let's return to our discussion.

4. Laser is turned on and focus search routine is started to position the lens at the correct vertical position. Once correct focus is achieved, the focus servo is activated to maintain it. Focus, which must be accurate to 1 pm, operates as described in the next paragraph.

5. The optical path in the pickup includes a cylindrical lens or astigmatism that causes the laser-beam spot to be circular when it is correctly focused, but elliptical when it is not. When it is not correctly focused, the major axis of the ellipse is offset 90 degrees, depending upon whether the lens is too close or too far (e.g., major axis of -45 degrees for too close and +45 degrees for too far). Focus

Error is equal to (A + D) - (B + C), which will be 0 when focus is correct since, with the circular spot, the outputs of all four quadrants will be equal.

6. The disc starts spinning up to 500 rpm and the constant linear velocity (CLV) servo is activated to maintain correct speed. The CLV servo uses a PLL (phase-locked loop) to lock to clock transitions derived from data read off the disc. Data is derived from A + B + C + D (look at Fig. 1).

7. Tracking servo is activated to keep the laser beam centered on the track. With a three-beam pickup, two additional laser spots are projected onto the disc, one in front of and one behind the main beam. Those are offset on each side of the track just enough so that the Tracking Error = E - F = 0 when the beam is centered. With a single-beam pickup, similar information is derived using only the main beam; Tracking Error = (A + B) - (C + D) = 0 when tracking is correct.

8. Disc directory is read and displayed.

9. Unit shuts down awaiting command or goes into play mode, depending upon how it was activated.

Some of the steps listed above may be performed concurrently. If any of the first nine steps fail, the laser is turned off and the machine will display some kind of error or no-disc message and then return to idle mode, or in the case of a changer, load the next disc and try again.

Validating the Startup Sequence

WARNING: The procedures below may require access to the optical pickup while the laser is powered. The laser diode is infrared (IR), 780 nm, and for all intents and purposes invisible. The only indication of laser output will be a tiny red-appearing dot of light when the lens is viewed from a safe position of at least 6 inches and an oblique angle of at least 45 degrees. Don't be fooled into thinking the laser is weak-the actual beam intensity may be 10,000 times greater than it appears! However, the red dot is a good indication that the laser is at least powered (though not necessarily that it is operating correctly-an IR detector and/or a laser-power meter are really needed for that; see below).

To narrow down possibilities, try following this procedure when the disc is not recognized, but the drawer closes completely:

Start by double checking the drawer closing/opening mechanism. Without exception, Sony CD players that have belts need them cleaned and eventually replaced. If the drawer does not really close completely, then the disc may not be clamped properly, or other erratic problems could occur.

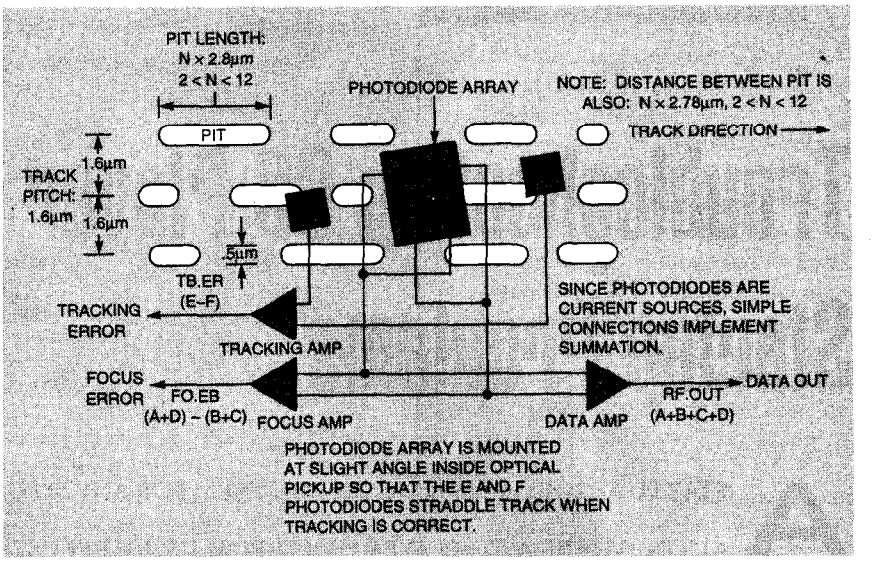

FIG. I--HERE'S HOW THE PHOTODIODE ARRAY in a unit with a three-beam pickup is arranged. Also shown here is the geometry between the array and the information pits on a disc.

Once you have verified that the drawer operation is fine, you need to determine that the lens is clean. In general, the lens should look shiny with a blue tinge. Any gunk or crud can and will degrade performance. You may have to remove part of the clamping mechanism to get at the lens. If the lens is not perfectly shiny, clean it carefully as explained previously in this series (see "Service Clinic," July, 1998). A dirty lens-perhaps one not even visibly dirty to your naked eye-can result in any number of startup (or other) problems. Therefore, cleaning the lens should be done before looking for more obscure mechanical or electronic faults.

If lens cleaning does not improve the situation, the next step is to verify that the pickup has reset itself to the inner (center) track of the disc. If necessary, manually move the pickup away from the center by turning the appropriate pulley or gear. If there is a linear actuator or rotary positioner (no gears or belts), just push the pickup gently and see what happens when a disc is loaded. If you are not able to move the pickup from one stop to the other, make sure any shipping lock is disengaged! The pickup should move smoothly toward the center, usually tripping a limit switch and stopping. If there is no movement, if the movement is jerky, or if the pickup gets stuck at some point, then either lubrication is needed or the motor or drive circuitry may be faulty Also check for broken or damaged gear teeth, a slipping belt, and misaligned or damaged tracks. Measure the voltage across the motor that moves the pickup. If there is none, or if it is very low (under a volt or so), then there is a problem with the motor, its driver, or the system controller. (we'll discuss more about motors shortly).

Determine if the machine attempts to focus. On portables, you can simply bypass the door interlock to get the operations associated with reading the disc directory to begin (you may also need to press PLAY-that need is model-dependent). In some component CD players, a disc actually has to be present to block an optical sensor. You should see the lens moving about 2 mm up and down (at least one of these directions will have a smooth movement) one or two times. If a disc is in place, the lens should quickly stop at the appropriate focus position. Admittedly, however, observing the lens may be difficult or impossible with the disc in place. Dentists are probably good at this!

If the focus action is identical whether a disc is in place or not (it keeps up the search pattern and then gives up), verify that the laser is being powered. In most cases and as outlined above, you will be able to see a tiny spot of red light when the lens is viewed from an oblique angle during the focus search. From a safe distance of at least 6 inches and 45 degrees or more off to one side, you should be

able to see this dim red light in a darkened room while the unit is attempting to focus.

If you do see this, you can assume that the laser is at least being powered, although this is not a sure test for an actual IR laser beam or proper optical-power output. In most cases, however, the red light indicates that the laser is working. An IR detector would confirm at least that there is an IR emission. If there is no dot of red light, then either the laser diode is bad, it is not being powered, or you are not looking from the correct angle.

For a more exact test, you can purchase an inexpensive IR-detector card from most electronics distributors or build your own using a photodiode, a few resistors, a general-purpose transistor, and a standard LED-all powered by a 9-volt battery. Figure 2 shows the circuit for this device. If you do build one, you will also find it useful for testing IR remote controls. (This is the same circuit we showed you when we discussed remote-control repair in the June 1997 installment of this column.)

If the lens is hitting the disc at the top of its excursion, there is a possibility that the spindle table has been pushed too far down, perhaps by something falling on it, for example. A bent shaft and wobbly spindle is also a possibility caused by this kind of damage. This kind of fault is much more likely to occur with a top-loading "boom-box" or portable than to a drawer-loading machine. While the lens hitting the disc with the spindle table set at the correct height is not impossible on some players, it is unlikely. On most lenses, a ring around the outside of the lens itself prevents the critical central area from actually contacting the disc, so accidental contact does not usually damage the lens. However, it can scratch the disc. Similarly, if the spindle is too high, the lens might not be able to reach high enough to focus properly.

On a player with the height adjusted properly, there is usually about 2 mm between the laser shroud and the bottom of the disc. The spindle height is not super-critical, but if it is way off, you cannot establish proper focus. Incorrectly adjusted focus offset or gain can also result in the search pattern being too high or too low. Either of those can result in inability to recognize discs, noise, or even erratic tracking during play.

Once focus is established (and sometimes concurrent with this operation), the spindle should start to rotate and quickly reach 500 rpm. The speed may be ramped up or controlled in some other search pattern since there is no speed feedback until the data coming off the disc becomes available. A partially shorted drive motor will keep the disc from reaching full speed even though the spindle and disc are turning.

Check the voltage on the spindle motor when it starts. It should reach 2 volts or more. If you read less than this, but not zero, a partially shorted motor or a weak driver is likely. A permanent-magnet-type motor can sometimes be revived by a quick squirt of degreaser through the ventilation holes and/or by disconnecting it (very important, or else you could fry your driver circuit and create a new problem!) from the circuit board and applying 9 VDC or so to it with each polarity for a few seconds to spin off the "gunk." If one of those fixes helps, you can continue to use the player until you get a replacement motor (which might never be needed depending on the severity of the original problem). In some models, the design of the driver circuits is the underlying cause of motor failure, and there are circuit-board changes that would need to be performed to avoid the problem in the future.

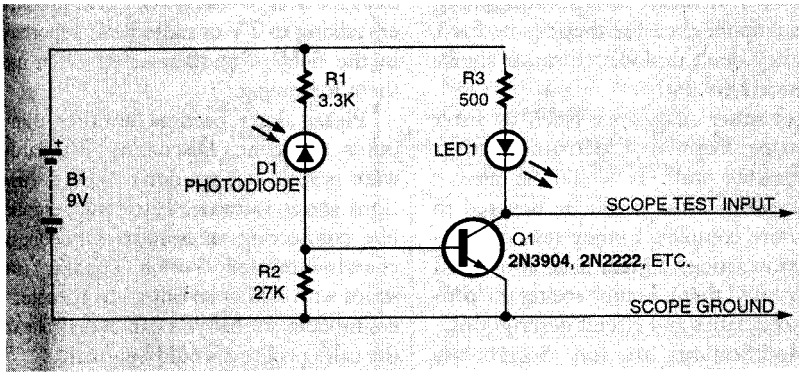

FIG.2-THIS SIMPLE IR TESTER is a sure way to confirm that the laser is emitting an IR beam. You can also use it to test IR remote controls.

If the voltage reads zero at all times, there may be a bad driver, or the machine may not realize that focus was established and is not issuing the spindle-motor start command. The required speed of 500 rpm, just over 8 revolutions per second, can be estimated by using a disc that has a dramatic label, or you can simply put a small piece of tape on the side of the disc that is visible and watch it spin.

Keep in mind that a dirty lens can sometimes create symptoms that are similar to those of a bad spindle motor, so always clean the lens first when servicing a CD player. I almost learned this the hard way.

Once the disc is up to speed, the speed control (constant linear velocity-CLV) and tracking servos will be activated (in some equipment, the tracking servo may have been active all the time), and directory data will be read off the disc. Either of those could be faulty and/or misadjusted, making it impossible to access the disc directory.

During the time that the disc is spinning and the player is attempting to read the disc directory, listen for the "gritty" sound that CD players make during normal operation. It is a byproduct of the focus and tracking servos constantly adjusting the lens position. The rapid movements of the lens produces an audible sound, and its presence is a good indication that the laser is working and that focus is being maintained.

Related Problems

Before we wrap up for this month, Let's look at some related problems.

Pickup **attempts to reset past inner track:** In this case, the sled motor doesn't stop at the inner track but keeps clicking, clunking, or whirring until the controller gives up and displays an error. This might be due to a dirty, worn, or gummed-up limit switch, bad connections, bad mechanical alignment, broken parts, or logic problems.

Most limit switches are mechanical and easily checked with a multimeter. Those that use exposed contacts can be cleaned and burnished; sealed switches found to be erratic should be replaced, though spraying inside through any openings might help. I have disassembled and cleaned similar type switches (they snapped apart) but it is not fun. Make sure the limit switch actually gets tripped when the sled reaches the area of the innermost track. Check for bad connections between the switch and the

controller.

Logic problems may be difficult or impossible to locate even with schematics. However, you might get lucky as I did once with a CD-ROM drive with a bad 74LS04 in the drawer-switch interface.

Player won't let you go near it and/or use your favorite lamp: Symptoms here could include a player where, if you touch or go near it, the audio becomes noisy, begins to stutter, skips or even stops completely. Note that this might be similar to other tracking (seek and play) problems. However, since a possible cause of this sort of behavior is more general in nature and can affect many different aspects of CD-player operation, these faults are described separately.

One area that may be overlooked as a cause is the shielding of the pickup's low-level signal cable and any metal parts of the optical deck. Those should all be connected to analog ground of the electronics board. If that ground is missing or broken, there can be all kinds of strange symptoms. If you have recently disassembled the unit and it is now behaving in the manner described, that is a very likely-and, fortunately, easy to fix-possibility. Check for a missing ground strap, jumper, or clip. (Hint: It has probably fallen under your workbench!)

Turning to other possibilities, external interference could make its way into the electronics and produce all sorts of strange behavior. On some poorly designed players-or where you are located close by a radio station-outside interference can get into the player via the audio cables or line cord. A light dimmer on the same circuit might also produce interference via the power supply. Once inside, almost any type of behavior is possible. If your problems seem to depend on the time of day, check out this possibility by relocating the CD player and seeing if the behavior changes substantially. Disconnect the audio cables and see if the unit now displays the disc directory and appears to play properly (try headphones for this, if possible).

It may be difficult to eliminate the effects of the interference without moving away from the radio station or not using your favorite lamp. However, relocating the CD player or even just its cables and/or plugging it into a different outlet might help. Fortunately, those sorts of problems are not that common.

Wrap Up

Once again we have reached the end of our allotted space. I do hope that you are finding this series both interesting and helpful. Next time we will continue with a look a tracking problems (play and seek). Join me again at that time. In the meantime if you have any problems or questions that just can't wait, go to my Web site at www.repairfaq.org. Questions to me should be addressed via e-mail to sam@stdavids.picker.com.

Important note: I regret that time (after all, there's only a finite number of hours in a day) keeps me from answering mail sent via the postal service, but I will respond to e-mail in a timely manner (often within 24 hours) as long as you provide a valid reply address (e.g., I can hit the reply key for my mail program and not have the e-mail bounce!). See you next time.

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