DD emulator – Technical description and Installation

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Dynamic Drum system on S-VHS/VHS recorders by JVC

JVC produced in the 90's and early 2000's S-VHS/VHS video recorder models with perfected picture search modes. The system that eliminates noise bars on all picture modes was called "Dynamic Drum System", hereinafter referred to as "DD" in this document. The system tilted the head drum for the heads to follow picture tracks on tape accurately even on variable speed picture search modes forward and reverse. It was based on mechanical "gearbox", a motor turning a worm gear that in turn rotates miniature nylon gears, which unfortunately now 20… 30 years later crack and split, which make them first noisy and later jamming the DD and in worst case misaligning the VCR.

JVC has programmed the VCR to POWER OFF, if the system control processor does not receive position sensor signals from DD system. There are 2 signals, the first one, that indicates, that DD motor runs correctly, the second signal comes from position sensor and indicates the processor neutral position of the head drum.

When **POWERing ON** the VCR, the DD system initiates by running back and forth once and when successful, the position sensor changes status = drum neutral position is found for TAPE PLAY. (In head drum structure 2 spring loaded screws assist in finding and keeping the head drum in neutral position.)

<u>Following modes do not activate Dynamic Drum system:</u>

PLAY, PAUSE (STILL), SLOW, 1.5x PLAY, 2xPLAY. The picture is perfect without DD system.

<u>Dynamic Drum system gets active, when following modes are used:</u>

3x, 5x, 7x or 9x picture search modes forward

3x, 5x, 7x or 9x picture search modes backward.

If in startup initialization phase or in any of the picture search modes the signals from DD gearbox sensors are not correctly transmitted, the **VCR POWERs OFF in 3… 4 seconds.**

In case of gears cracking, DD system first becomes noisy, in second phase it starts jamming occasionally, but may start to operate after new start-up. In third phase before the final breakdown one or both nylon gears have not only cracked, but splitted: their axles have started to slip causing drum guide ring (tape path) misalignment. The VCR starts POWERing OFF after every POWER ON sequence in 3… 4 seconds.

DD emulator working principle

DD emulator was developed by the writer for a) disabling the need for properly running DD gearbox (see Fig 1.) and for tricking the IC3001 SYSTEM CONTROL PROCESSOR to think, that DD system is working properly.

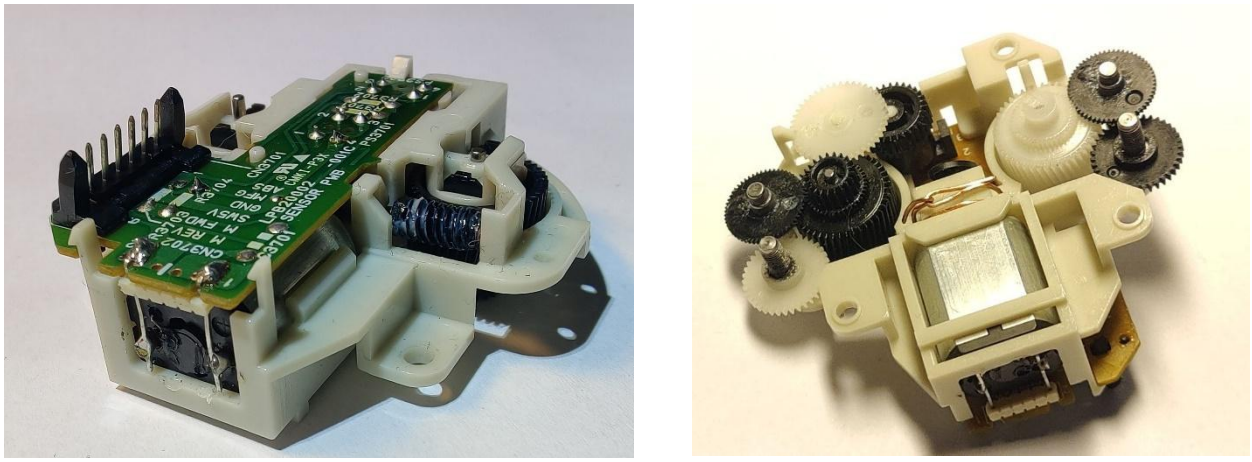

Fig. 1. Dynamic Drum gearbox from JVC HR-S9700. The same 2nd gen. gearbox has been used on many other models like HR-S8600, HR-S7600U, HR-S9500, HR-S9800U and several clones like Philips VR1500 manufactured after 1998. There is also another type of belt driven 1st gen. Dynamic Drum gearbox, that according to current knowledge was used on JVC VCRs manufactured after 1995 and before the production of 2nd gen.. DD emulator has not yet been tested with 1st gen. DD system.

The Oscilloscope screenshot below illustrates the signals from DD gearbox sensors at POWER ON phase.

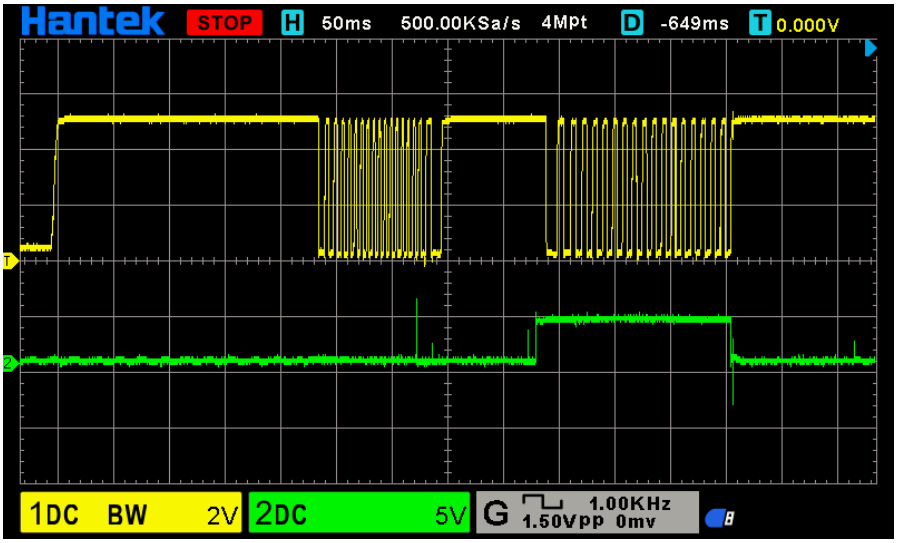

Fig. 2. Example: VCR startup pulses generated by Dynamic Drum system. Yellow pulse on MFG terminal. Green pulse on ABS terminal. Similar pulses, but with variable length depending on picture search mode are generated during operation.

Actual device “DD emulator”.

DD emulator mimics (emulates) the function of DD gearbox and it’s sensor signals. The “magic” happens in software, that is running in Raspberry pi Pico. Many other controllers could have been used like ESP8226, ESP32 or Sparkfun etc., but RPI Pico was selected.

In addition to RPI Pico there are 4 resistors acting as voltage dividers for reading motor power voltage FWD and REV. The LEDs (Yellow for ABS and Green for MFG) indicate, when signal is sent to IC3001 SYSTEM CONTROL PROCESSOR of the VCR. The 2 other resistors ballast suitable voltage for the LED’s and limit their power draw. The signals are read from and transmitted back to VCR main board socket CN3501.

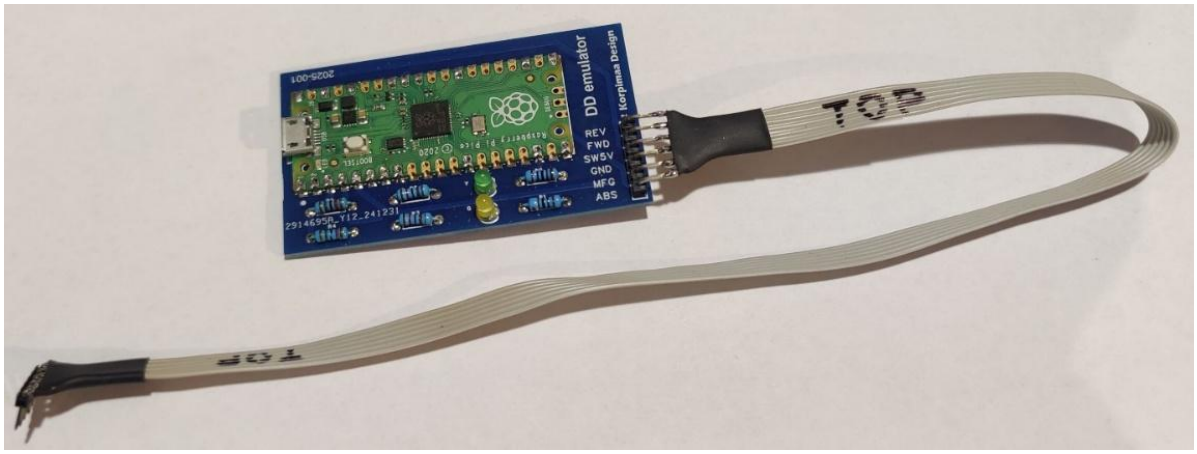

Fig 3. Actual device **DD emulator** with ribbon cable and connector (6 pins at 2.0mm pitch), that mounts to main board socket CN3501.

The extent of the installation depends on the condition of Dynamic Drum system.

1 DD emulator basic installation contains installation instructions, when the Dynamic Drum system is in good working order and you want to be proactive and disable it before it breaks and bricks the VCR. This method is also reversible and it is easily possible to bring the DD system back to use.

2 DD emulator extensive installation contains installation instructions, when the Dynamic Drum system has already failed and the VCR POWERs OFF after startup and jams occasionally and has bad misaligned picture in PLAY mode.

1. DD emulator basic installation

IMPORTANT!

- Mandatory. Used as proactive approach when the DD is still functional or when the DD broke while the head happened to be in the neutral position.
- Do not remove DD gearbox – dismantling the DD gearbox will risk it's internal alignment and guide ring (tape) path alignment in head drum.
- Do not touch the gears. This installation method will disable Dynamic Drum system in neutral position and is reversible: you can at later date continue using the Dynamic Drum system after re-installing DD gearbox PCB.

Disconnect power lead from mains socket.

Remove the cover of VCR.

Step 1 Removing video head drum

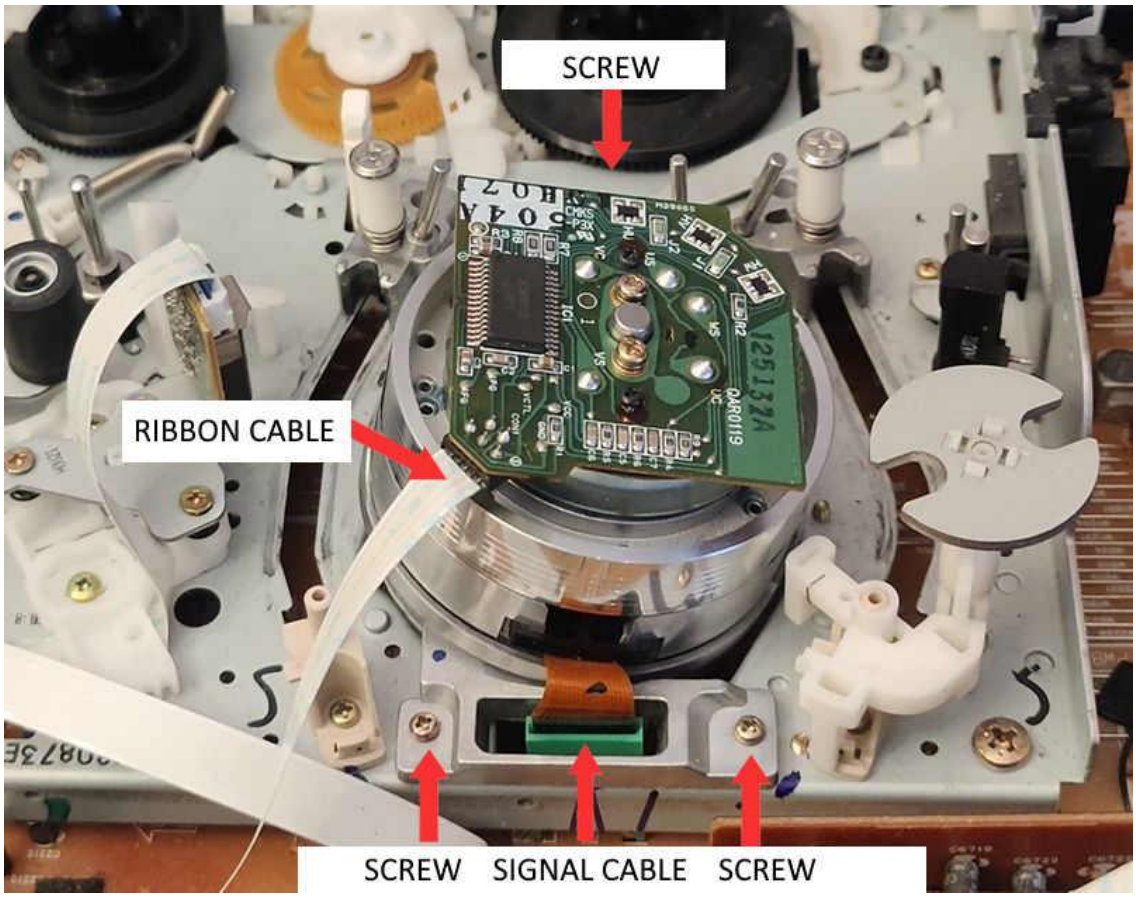

Fig 4. 2 ribbon cables and 3 screws for video head drum mounting.

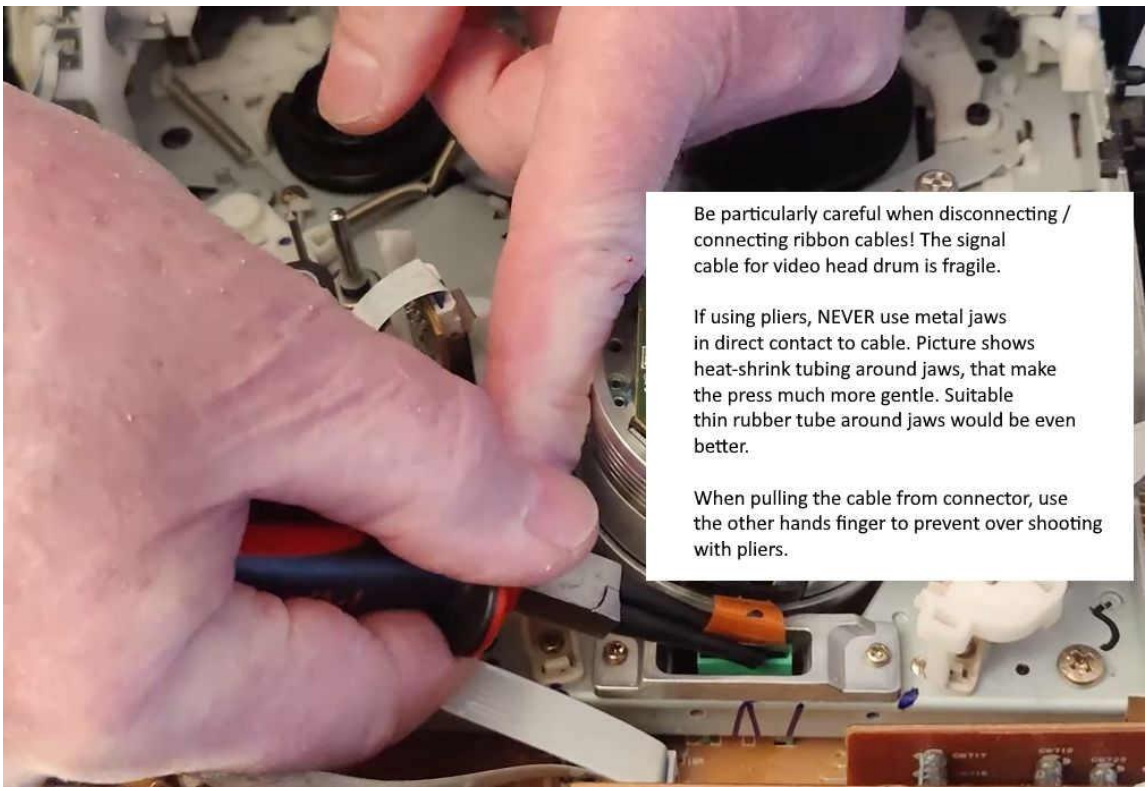

Fig 5. Use only soft pliers when pulling off ribbon cables.

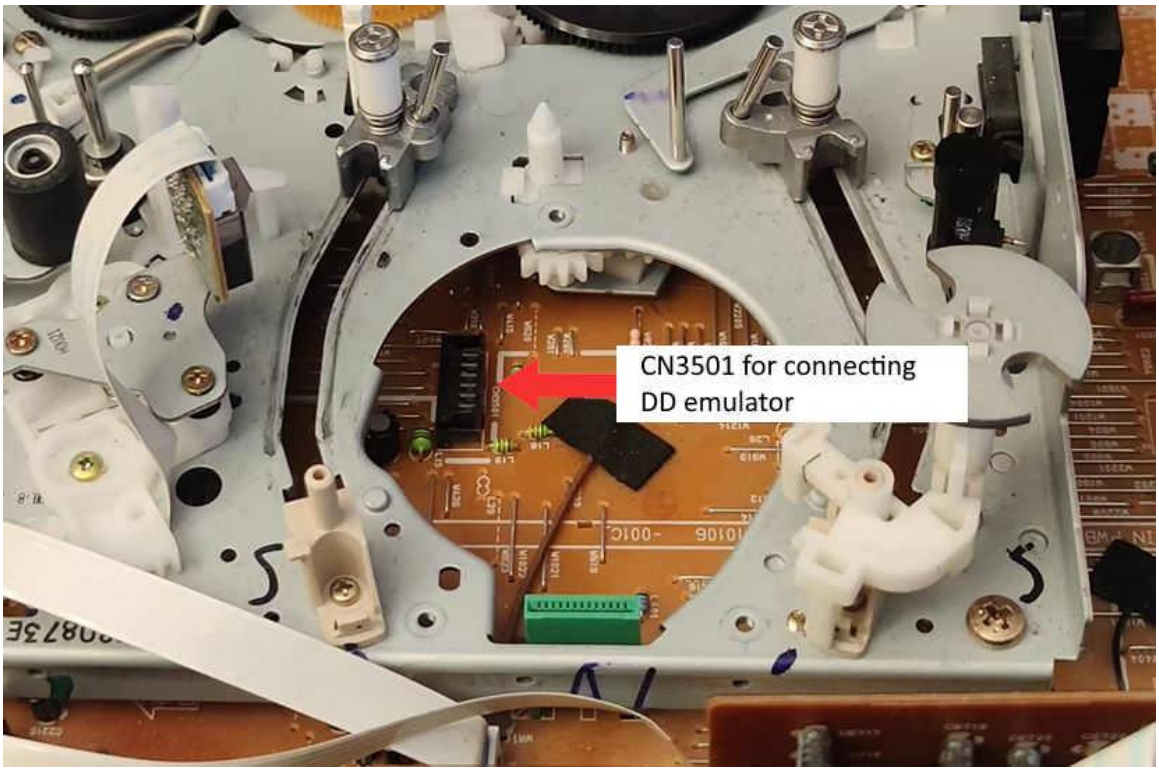

Fig 6. CN3501 main board connector for Dynamic Drum system electrics and for connecting DD emulator.

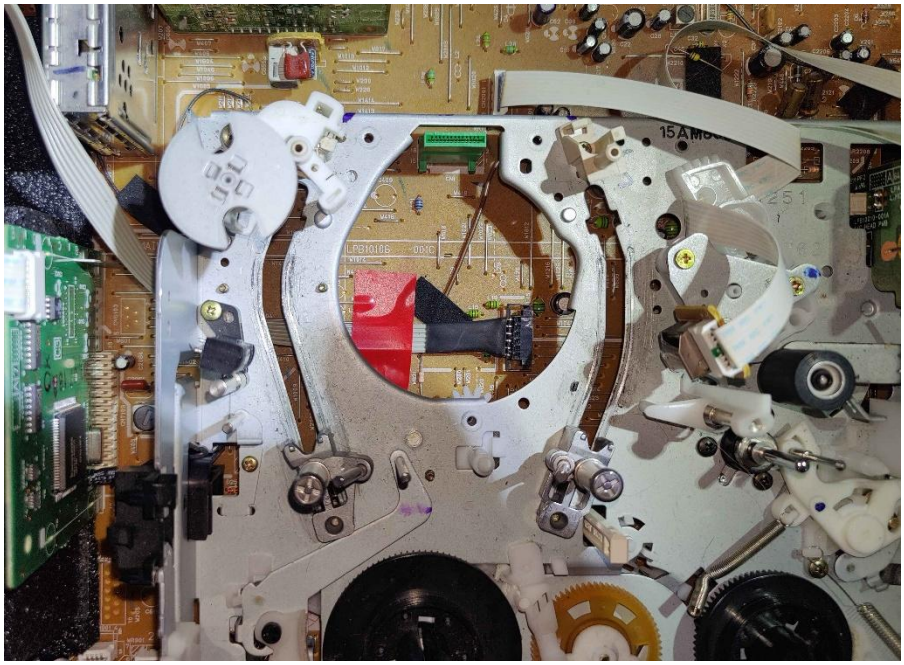

Fig 7. DD emulator ribbon cable to socket CN3501 main board.

Connect DD emulator ribbon cable to main board connector CN3501 as shown in Fig 7. Pay attention, that the threading arms move under the deck. Therefore it is important to route the cable so, that it does not interfere with threading. A simple way for fixing is by electro tape (red in Fig 7.). On the other hand DD gearbox, that remains in place, keeps the cable down.

Step 2 Removing PCB from DD gearbox

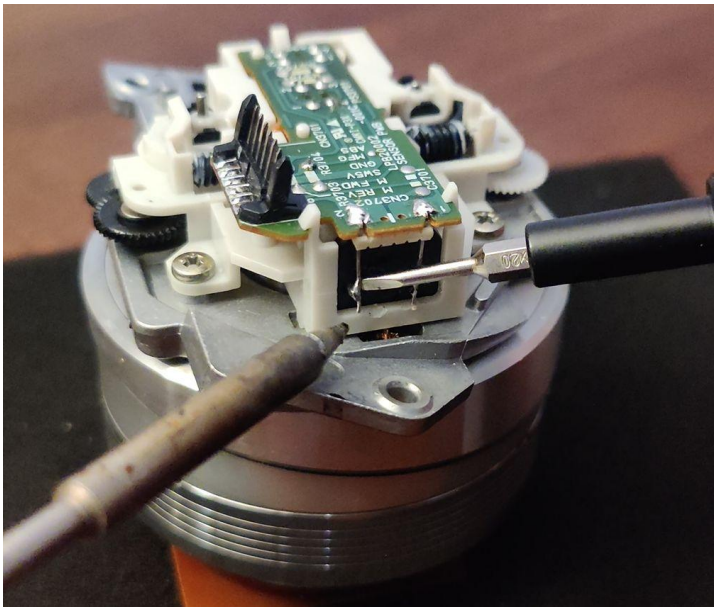

Fig 8. Desolder motor power wires from motor end.

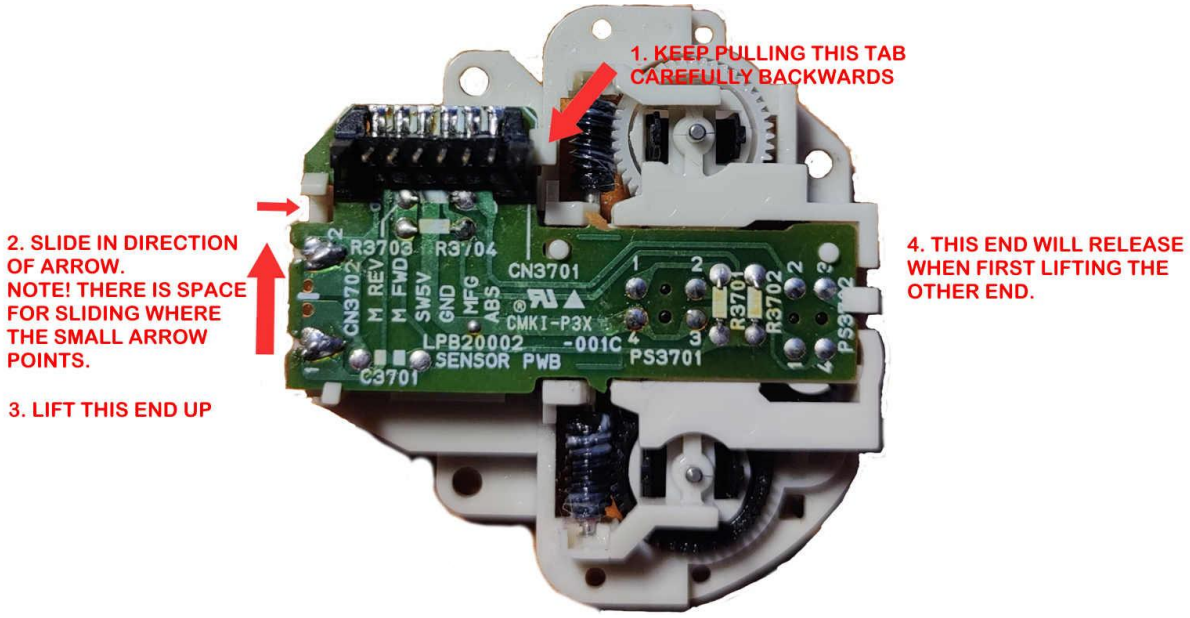

Fig 9. Remove DD gearbox according to instructions written in this figure.

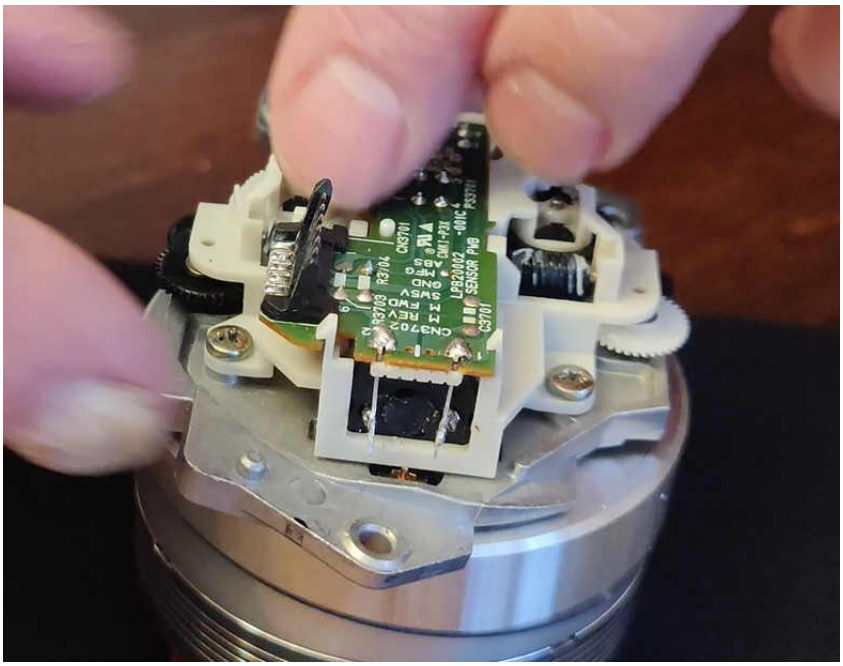

Fig 10. DD gearbox PCB removal.

Place the head drum upside down on soft cloth or similar in order not to cause any damage to it. Remove PCB from DD gearbox as shown in Fig 9. and Fig 10. DO NOT REMOVE DD GEARBOX FROM HEAD DRUM IF IT IS IN FULLY WORKING CONDITION AND WELL ALIGNED. REMOVING DD GEARBOX RISKS THE ALIGNMENT OF GEARS AND CORRECT FUNCTIONALITY! When handling the video head drum, DON'T TOUCH THE HEADS! Always rotate drum/heads away from the area your are working on.

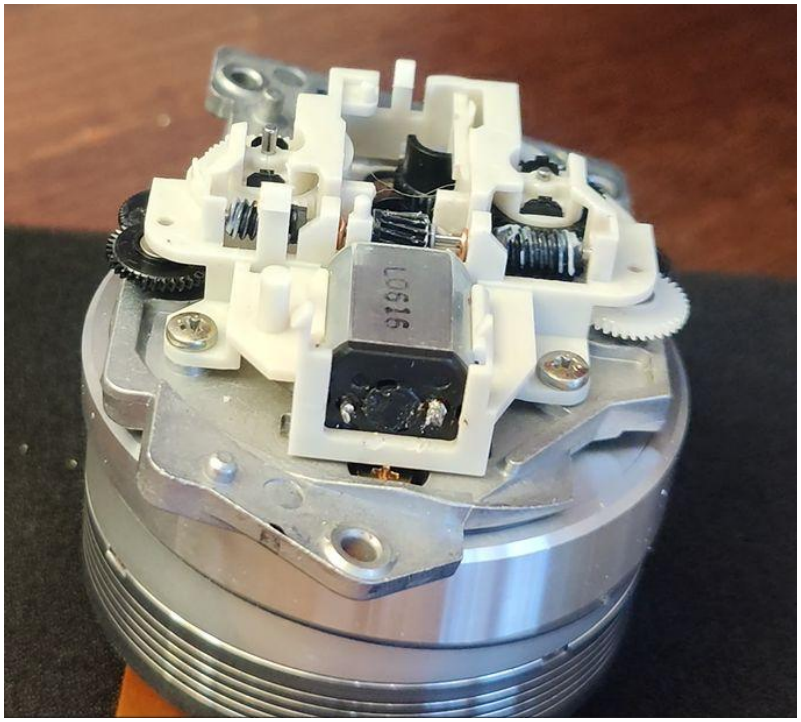

Fig 11. DD gearbox without PCB. Now there is enough space for ribbon cable under the drum and free access to CN3501.

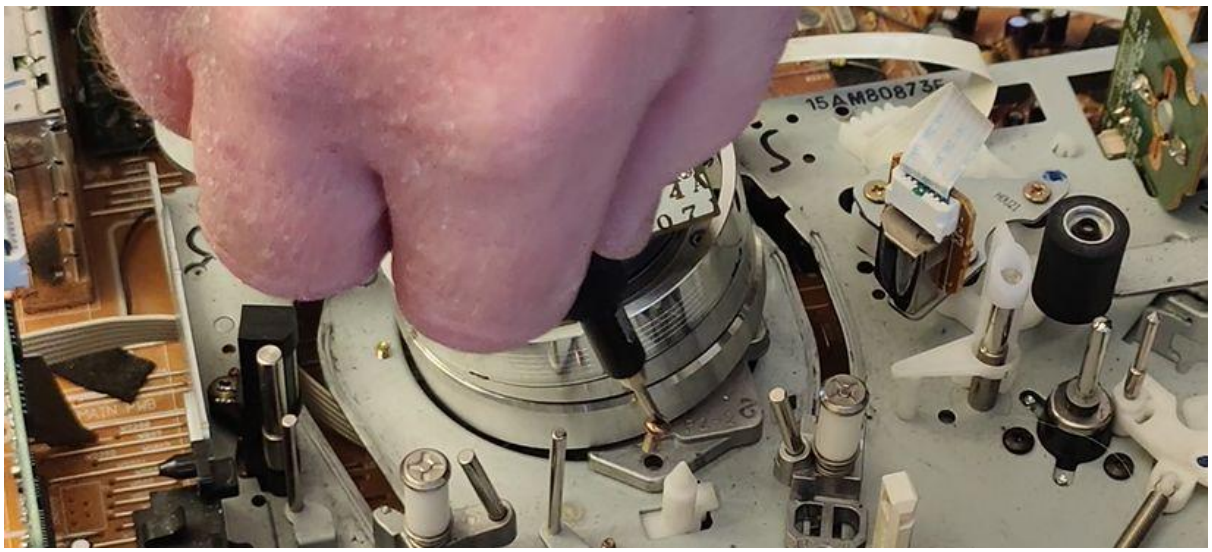

Fig 12. Video head drum mounting.

Mount video head drum back to deck in reverse order of removal: 3 screws and 2 ribbon cables.

Fix DD emulator to suitable location inside the deck using zip ties, double sided tape or both. It is important to keep it away from deck metal parts, from other PCBs and from electrical connectors. Fig. 13. Shows example of fixing it using zip ties.

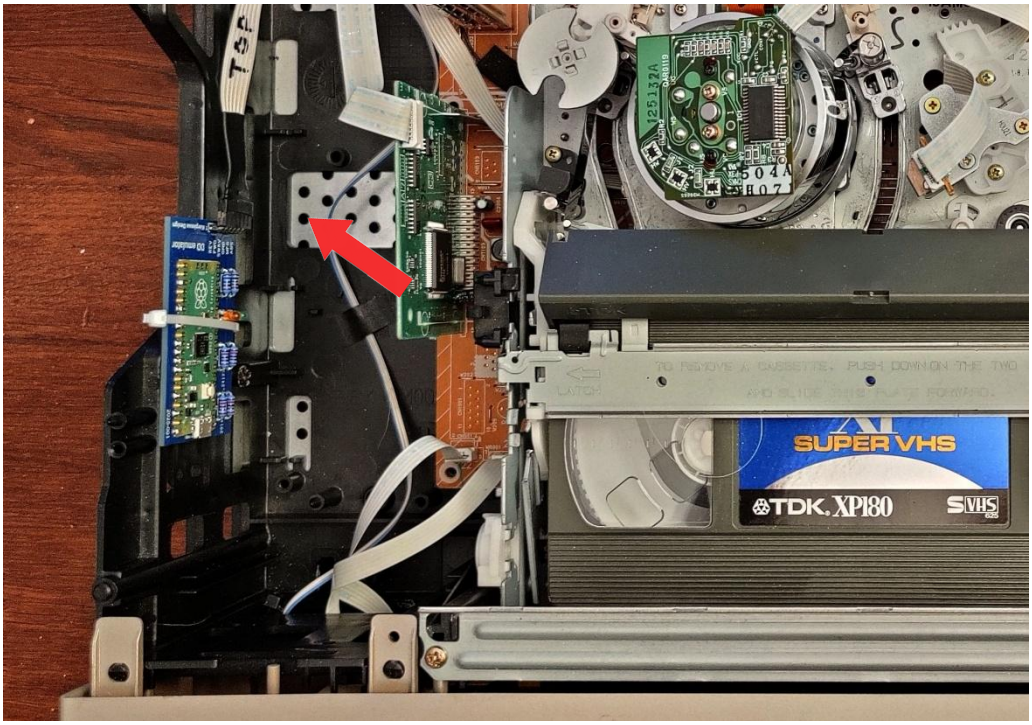

Fig 13. Example of DD emulator fixing to plastic side panel using zip ties.

After installing the DD emulator according to the aforementioned instructions, the installation shall be checked by reviewing the produced picture at playback using a known good recording. Reason: it is quite possible that the DD broke down while the head drum was in the neutral position. In that case the head drum and guide ring positions are already perfect, and since the DD motor is disconnected, the head drum position will stay that way and the installation is done. Only when on normal playback the picture is not correct and shows signs of mistracking, the head drum and/or guide ring are out of alignment and the extended procedure is needed to align them. If there is any chance to avoid it, take it. If you are unlucky and the DD did not brake while the head was in the neutral position, then continue this instruction at the next step.

2. DD emulator extended installation

IMPORTANT!

- Extended installation requires removal of DD gearbox from video head drum and may not be reversible if the alignment gets lost i.e. it is very difficult to completely adjust the DD gearbox to factory settings after one or more gears have been removed for inspection or repair.
- The intention of this installation alternative is to only make the tape alignment correct for PLAY (tape playback → automatically same as with fixed drum for other functions too), leave the DD gearbox disconnected from video head drum and store it in a safe place, for example in a plastic bag inside VCR in suitable empty space.

Disconnect power lead from mains socket.

Remove the cover of VCR.

Install DD emulator as described in chapter "**DD emulator basic installation**".

After installing the DD emulator according to the aforementioned instructions, the installation shall be checked by reviewing the produced picture at playback using a known good recording. Reason: it is quite possible, that the DD broke down, while the head was already in the neutral position. In that case the head position is already perfect, and since the DD motor is disconnected, the head position will stay that way and the installation is done. Only when on normal playback, the picture is not correct and shows signs of miss tracking, the heads are out of alignment and the extended procedure is needed to also align the head. If there is any chance to avoid it, take it. If you are unlucky and the DD did not brake while the head was in the neutral position, then continue this instruction at the next step.

Instead of only removing DD gearbox PCB, remove the DD gearbox unscrewing the 3 screws, that mount it to Video head drum.

Mount the video head drum back to deck without DD gearbox but first with all 4 gears in place, which stay mounted to drum after removing DDgearbox. See Fig. 14. For this. **Do not touch or rotate the gears now!**

Fig 14. DD gearbox removed from video head drum, but with gears in place.

After mounting the video head drum, connect ribbon cables in reverse order of removal.

Play a good quality tape recorded in LP or EP tape speed that is known to have good alignment (SP allows much more misalignment and is less suitable.)

Now that DD emulator is connected, the VCR should operate normally (= no shut down in any modes). Examine quality of video playback.

If video playback picture is good in all recording speeds EP, LP and SP and in all picture modes (excluding small stripes in picture search modes), there is no reason to touch the alignment and you can stop here, put back the cover and start using the VCR.

If video playback picture is misaligned and has tracking errors or noise bars or is totally scrambled, you shall continue with the alignment presented in youtube video

https://youtu.be/w7tVzDlCa9w

and/or in the following instructions:

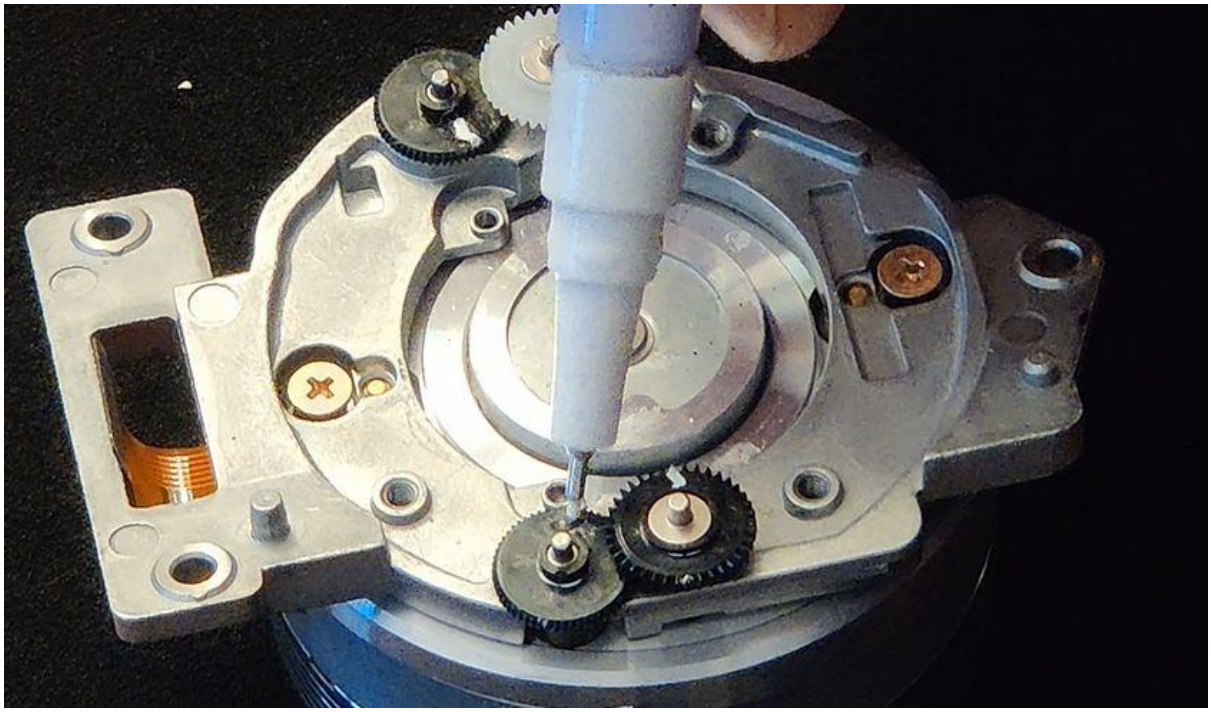

Fig 15. Mark the position of gears towards center point of video head drum.

Mark the position of gears towards the center point of head drum. The gears on the right (black and white) come off by screwing them counterclockwise. Screw them off one by one, but very carefully count and write down how many revs are needed to remove them from the head drum.

Don't rotate the gears on left in Fig 15. even if they have cracked / splitted. Pull them off directly. These gears adjust the guide ring (= drum tape path) and they have friction fit to collar of screws inside the drum, but visible from the opening on side. These gears are the first to crack/split. Partial cracking may still be OK regarding alignment, but if the gears split, their axle loose friction (torque) to

alignment screws, which means, that guide ring movement no longer follows drum tilt and gets misaligned.

Before starting any adjustment, repair the gears by welding them (= very carefully closing the crack by melting the nylon using small and sharp soldering iron tip.) WARNING!: This may be one off method and if you don't know how to do it, you will destroy the gears. No instructions here!

An easier option is to glue them using 2 component epoxy or super glue. The gears may not be used for Dynamic Drum tilt anymore, but they will be used as thumb wheels when adjusting the alignment.

Fig 16. Mark the collar and the gear from side on supply side.

After repair, place the gears back to their positions without rotating them.

Mark the collar of guide ring alignment screw from the opening on side and in same position on the gear tooth.

Now that you have made the marking, turn the screw clockwise and measure how many degrees the collar rotates before it hits end of movement. If this figure is around ¾ revs or 270 degrees or close, the screw is quite close to well aligned position. After that, rotate if counterclockwise ¾ revs / 270 degrees. This is the starting point of alignment fine tuning, and possibly already quite close to tune.

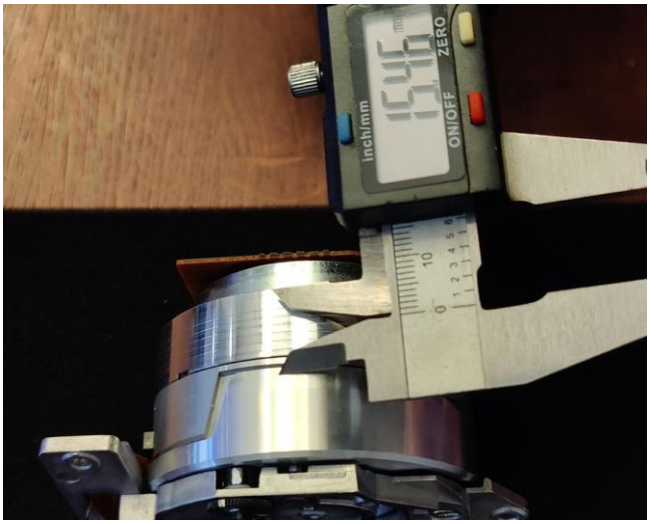

Fig 17. Measure the distance from guide ring to top of drum. 15,46mm is quite close to good alignment on supply side.

Finally check according to Fig. 17. that the distance from guide ring to top of drum is about 15,46mm. This may be correct, but in any case good starting point for fine tuning of alignment. Be careful not to scratch the head drum or tape path with sharp tool. Both are made of aluminium and are quite soft!

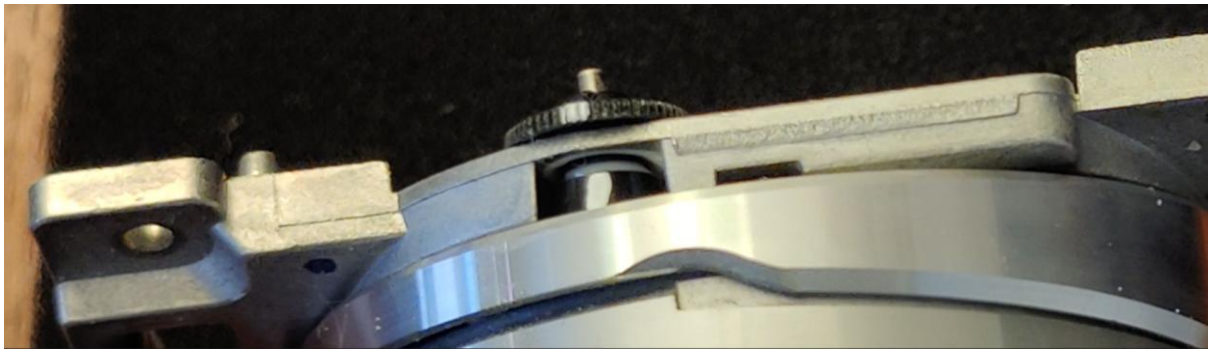

Fig 18. Mark the collar and the gear from side on exit side.

Same as on supply side, make marking on exit side after repairing the cracked / splitted gear and push it back to place without rotating it. Now rotate the gear clockwise and measure how many degrees the collar will rotate before it hits end of movement. If this figure is around ¾ revs or 270 degrees or close, the screw is quite close to well aligned position. After that, rotate it counterclockwise ¾ revs / 270 degrees. This is the starting point of alignment fine tuning, and possibly already quite close to tune.

Experimentally it has been discovered, that the adjustment is symmetric on both sides, i.e. the VCR has good alignment if the guide ring alignment screws are both turned ¾ turns counterclockwise from their end of movement position. Your VCR may differ from this depending on it's manufacturing tolerances.

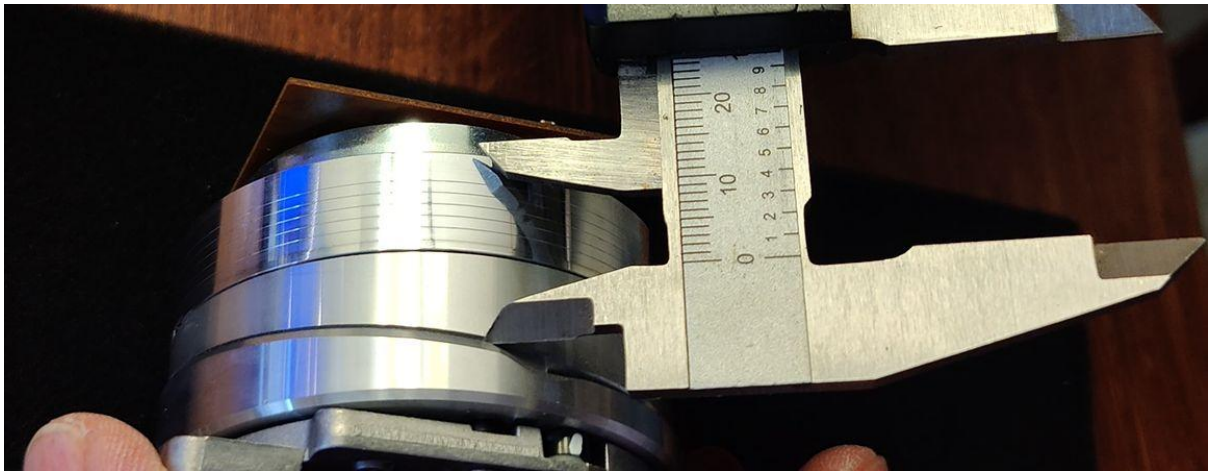

Fig 19. Measure the distance from guide ring to top of drum. 23,40mm is quite close to good alignment on exit side.

Now measure the distance on exit side the same way. Roughly correct figure is 24,30mm.

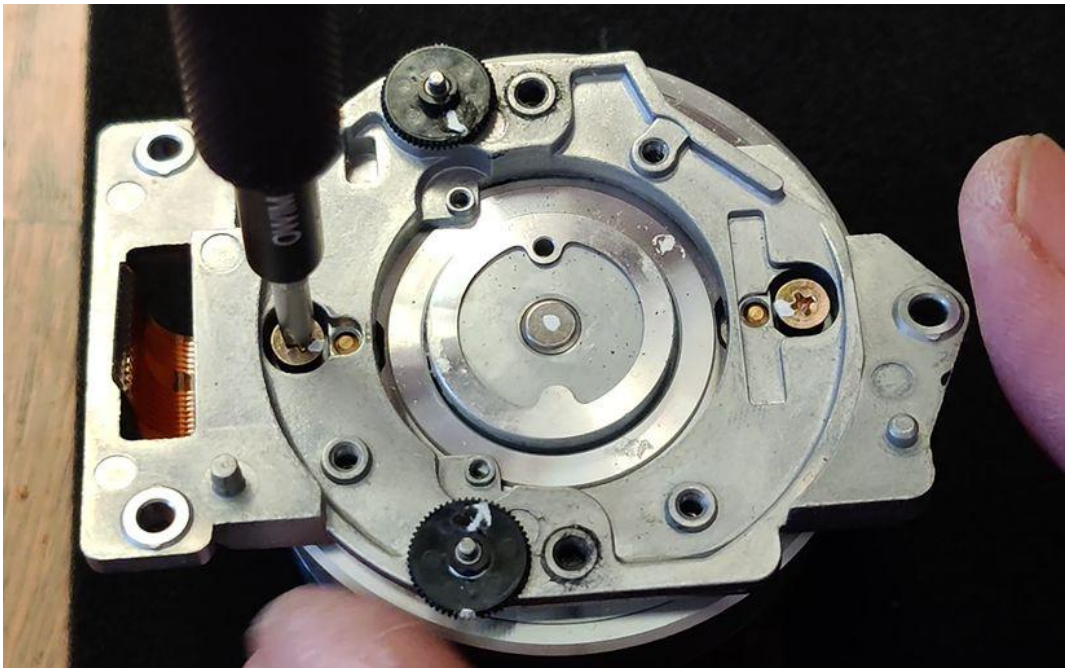

Fig 20. Mark also the position of spring loaded screw towards the center of head drum.

Also mark the position of spring loaded screws (Fig 20.) and turn them clockwise ¼…1/2 revs in order to get more firm and stable neutral position for the drum. If you intend to mount back DD gearbox at later date and make it working, remember to rotate these screws back to their original factory set position.

Now you are ready for fine tuning. Mount the drum back to deck without the gears screws, but both guide ring adjustment gears in place. DD gearbox must not be mounted back.

The drum guide ring (tape path) alignment is presented in Fig 21. And Fig 22. You will need to make the adjustment in steps:

- First supply side adjustment in small 1…2 mm increments, if necessary back and forth several times until top of screen shows no noise bars or disturbances.
- As supply side adjustment gear is hidden under the deck when the drum is mounted, you must unscrew the drum and raise it to turn the gear with a finger. Then screw the drum back and test playback. You can raise the drum without detaching ribbon cables, but be very careful not to stretch the head signal cable!
- Do not touch or adjust the guide rollers on threading mechanism, supply side and exit side. They are perfectly aligned and not affected by DD system failure!
- After supply side is done, adjust exit side by monitoring playback picture quality and especially noise bars or disturbances at the bottom of the screen
- Don’t mix minor line misalignment caused by head switching, that may be visible.
- All testing should be done using LP or EP mode recording.

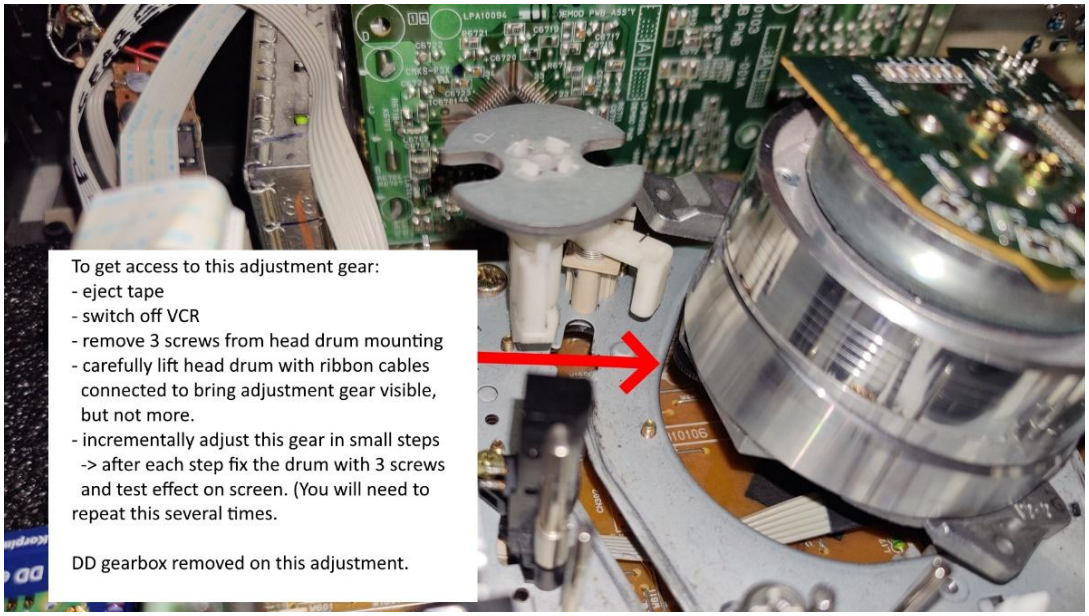

Fig 21. For supply side alignment, it is necessary to raise the drum to get access to adjustment gear by finger.

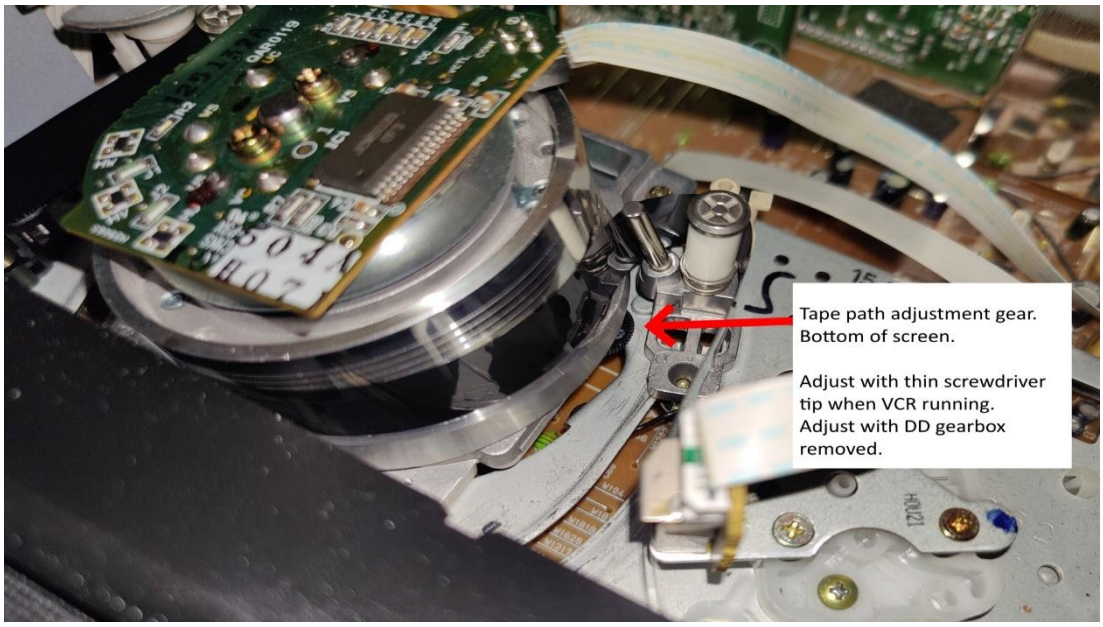

Fig 22. Exit side is easy, because the adjustment screw is accessible wit a thin screwdriver when VCR is running.

After fine tuning is done and you have reached perfect alignment in PLAY mode, you have completed all settings.