Adjusting the radial alignment a Tandon TM100 -2A drive without an alignment disk

Preface

Many vintage computers of the late 1970s-early 80s came equipped with the Tandon TM100 -2A 5.25 inch floppy disk drive (seen opposite). These drives present a problem for vintage computer collectors. For whatever reason their radial alignment can change over time leading to a failure to read or write disks accurately. Screws exist on the drive for the adjustment BUT it requires a special alignment disk from Tandon which nowadays are rare as the proverbial hen's teeth!

Fellow vintage computer enthusiast Philip Avery describes a technique for radial adjustment of these drives WITHOUT the alignment disk. It still requires some gear, namely an oscilloscope, a computer capable of running a 5.25 inch drive and software which allows the computer to position the drive head over particular tracks. However it works, as can be testified by successful fixes for both my Kaypro and IBM PC Tandon TM100 drives.

Philip has documented this process and it appears below in his own words. The usual disclaimers apply . *WE MAKE NO GUARANTEES THIS WILL WORK FOR YOU. IN FACT, IT COULD RUIN YOUR DRIVE IF NOT DONE CAREFULLY. USE THIS METHOD AT YOUR OWN RISK*

Tez
28th June, 2010

Update: 6th November, 2010. Below Philip's method is another, simpler procedure described by Rick from Australia. Rick posted this on the New

Zealand Vintage Forums in reponse to Philip's article. I haven't tried it myself, but appears useful to those without a scope or a TRS-80 Model III. I've copied and pasted the text into this blog posting. Read Philip's article first if you haven't already, alternatively jump straight to Rick's here.

Update 2: 4th September, 2022. If you try alignment by these methods but still can't seem to get a good signal or find the right track using software that parks you over one (like ImageDisk), it could be the stepper motor coupling. Check out this 2022 article which details our experience with a TPI (Texas Peripherals) drive. Tandon drives may have similar issues.

Introduction

The aim of this article is to show the steps required to radial alignment of a Tandon TM100 -2A 5¼" floppy disk drive without using the special Alignment Disk. This is intended for the Vintage Computer hobbyist who has some electronics' knowledge, an oscilloscope and the desire to keep their 5¼" floppy disk drives operational.

Firstly, aligning a drive is not a "fix all" for lots of drive faults. Before any alignment adjustment is attempted, the drive must operate 100% reliably in its own right. That is - it must format, verify, read & write 100% reliably on a disk that has been formatted/written to only by that drive. If this isn't the case, then those issues need tackling before the alignment is adjusted. All an alignment correction will do is enable floppies written by another drive, to work in this one, and vice versa.

The official & correct way is to use a special factory-produced Alignment Disk & adjust the drive so that an optimum signal is obtained. However these days those disks are becoming rare and expensive. An alternative (though not as accurate) method is to use a floppy that has been formatted in a drive that has known good alignment, ie a drive that can

read/write to floppies generated by other drives. On a computer with two drives, it's preferable to use a floppy formatted by that system's good drive. We adjust the troublesome drive so that a peak signal is obtained while reading this particular floppy.

Procedure

1. Check that the "head split-band" screw on the stepper motor (see photo 1) is tight, as these commonly come loose, causing inconsistent tracking errors. Remove one plastic pin & swing cover to access this screw (photo 2).

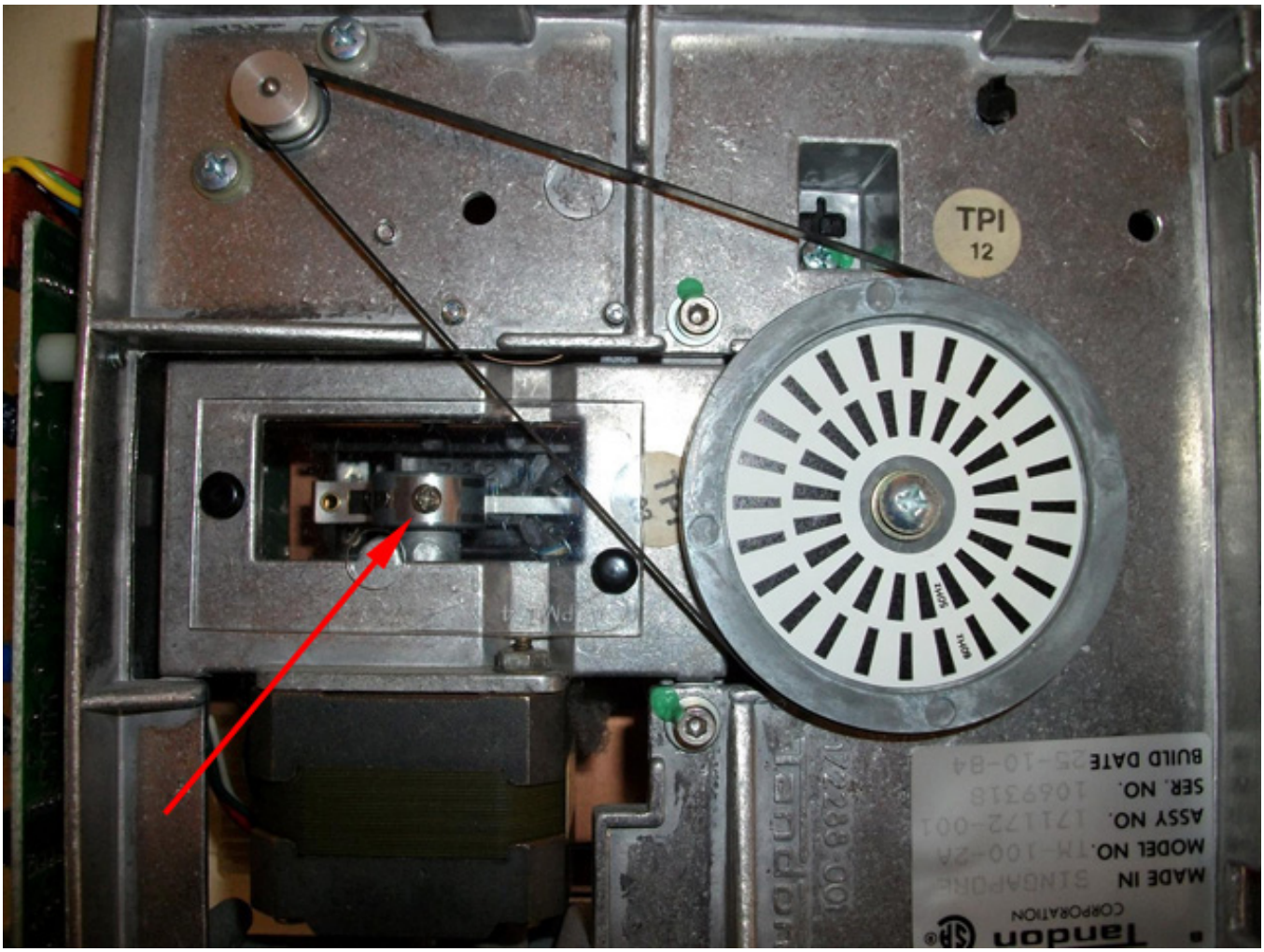

Photo 1. The head-split band screw on the stepper motor under its plastic cover

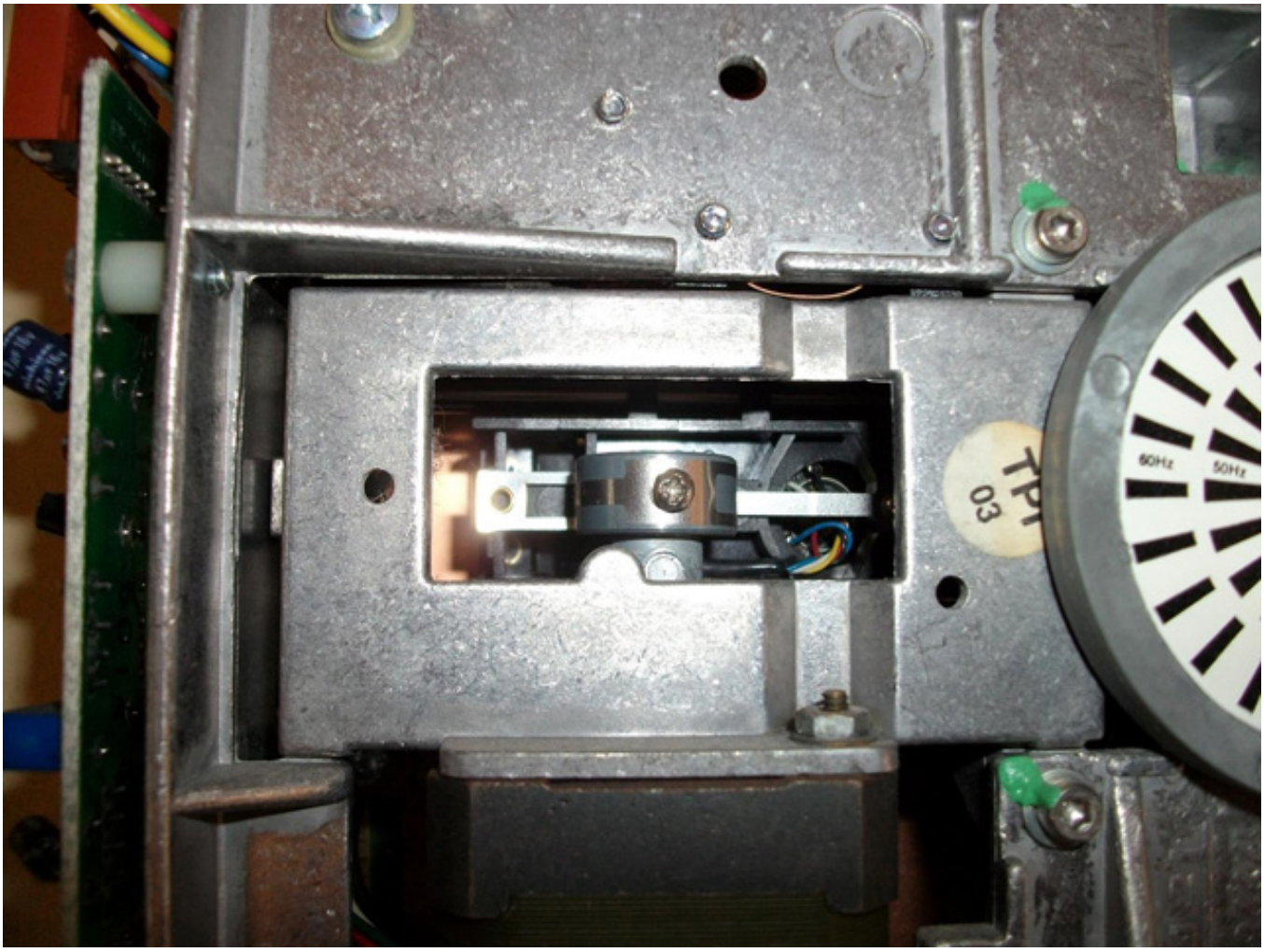

Photo 2. Plastic cover now removed allowing access

2. Bulk erase a floppy, then format it in a known good drive. It's important to bulk erase it as this avoids aligning to old, possibly mal-aligned tracks and also verifies all 40 tracks are readable, ie the drive is not 'one track out'. To bulk erase, I simply pass a strong magnet within about 20mm of the floppy & do several passes over the entire surface.

3. Insert the above disk in to the drive under test and direct the drive to seek a midway track, say track 20. I use a TRS-80 Model III to align these drives which has excellent Disk Diagnostic software (Floppy Doctor) which allows seeking to any given track. Once there, it will continuously read a given sector & ignore any errors. If you can't find such software for your system, usually it's possible to construct a small program in Basic to achieve this.

4. Connect scope to TP1 or TP2 (ground of scope to TP6) & you should see a signal of 0.3V to 0.6V peak to peak (see photo 3). On my scope I use these settings: 0.1 Volts/div and 20 usecs Time/div. (If you can't see a signal, replace the floppy in the drive with one that has been written successfully to by that bad drive. This will show the best-case signal — what you'll aim for when reading a floppy from a good drive. This will also verify your scope settings, connections. Once a signal is established, re-insert the above floppy from a good drive).

Photo 3. A strong signal from the drive head positioned over a track

5. Loosen the two retaining screws underneath (see photo 4) and the one on top beside the Adjustment cam (see photo 5). To avoid shorting the pins above the Adjustment cam, either protect these with some insulation, or use an insulated-shank screwdriver to adjust the cam screw. (see

photo 6). Turn the cam slowly, no more than half a turn in any direction, while observing the scope and aim for the maximum signal.

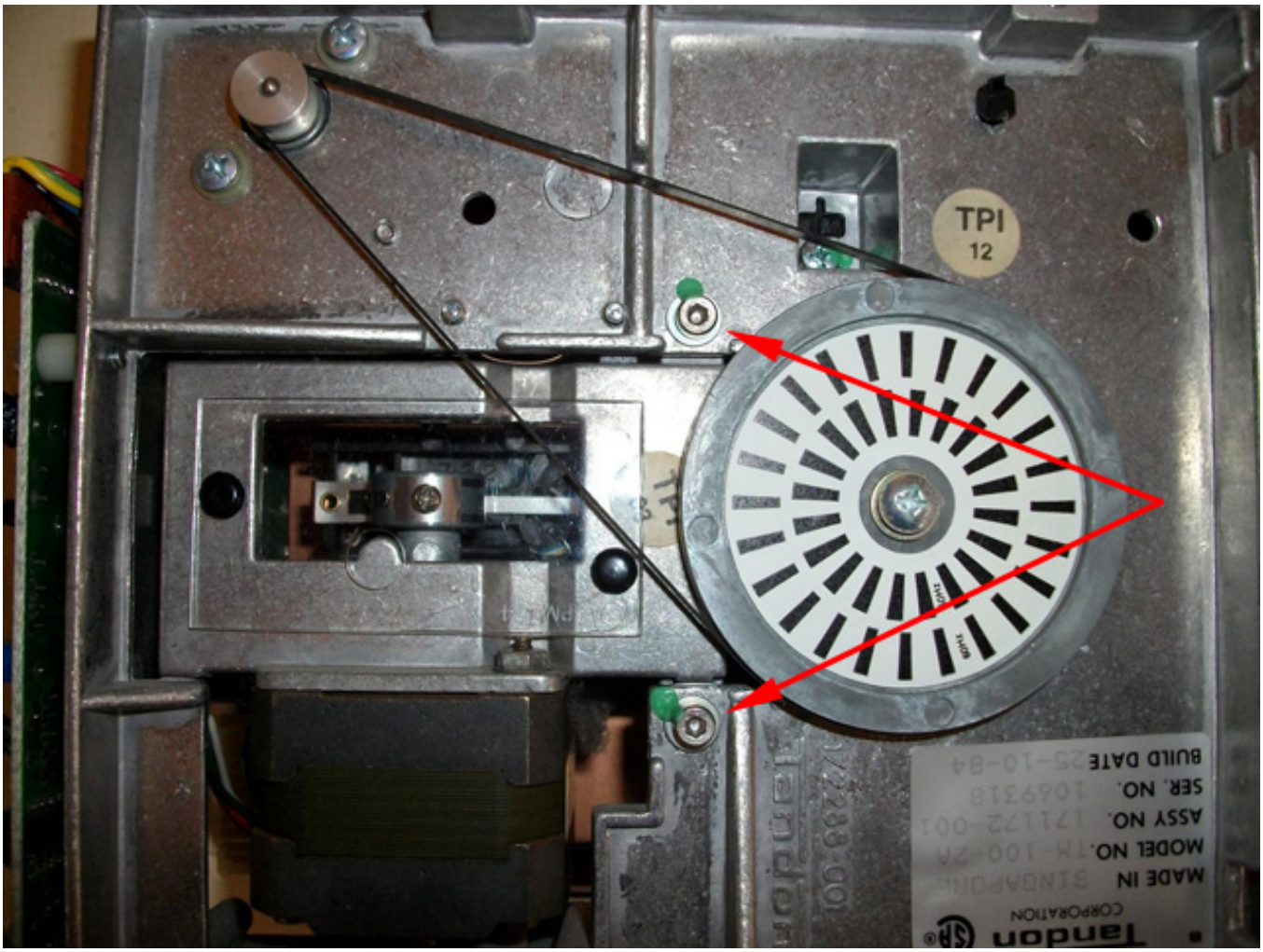

Photo 4. Retaining screws underneath drive

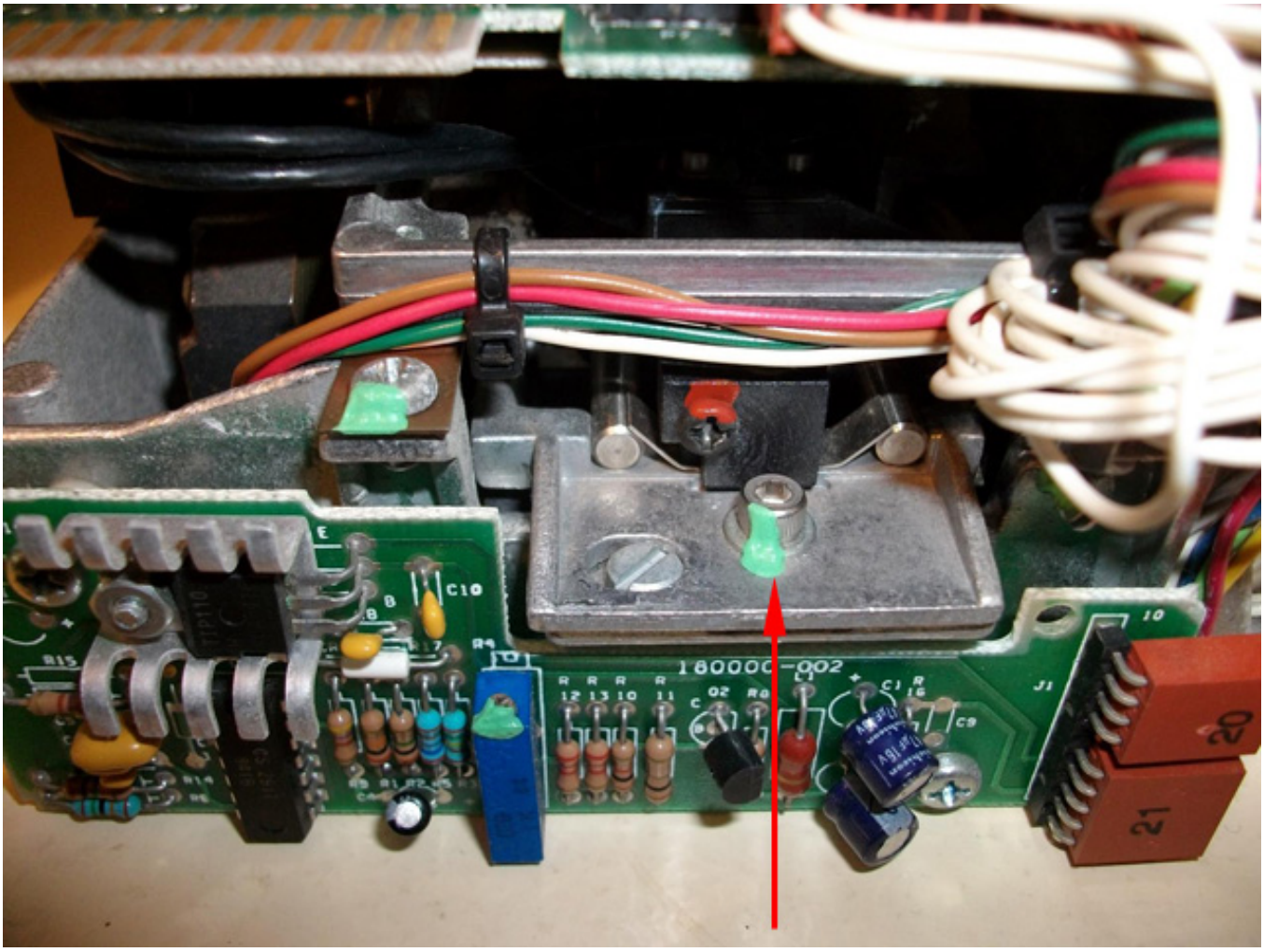

Photo 5. Top retaining screw

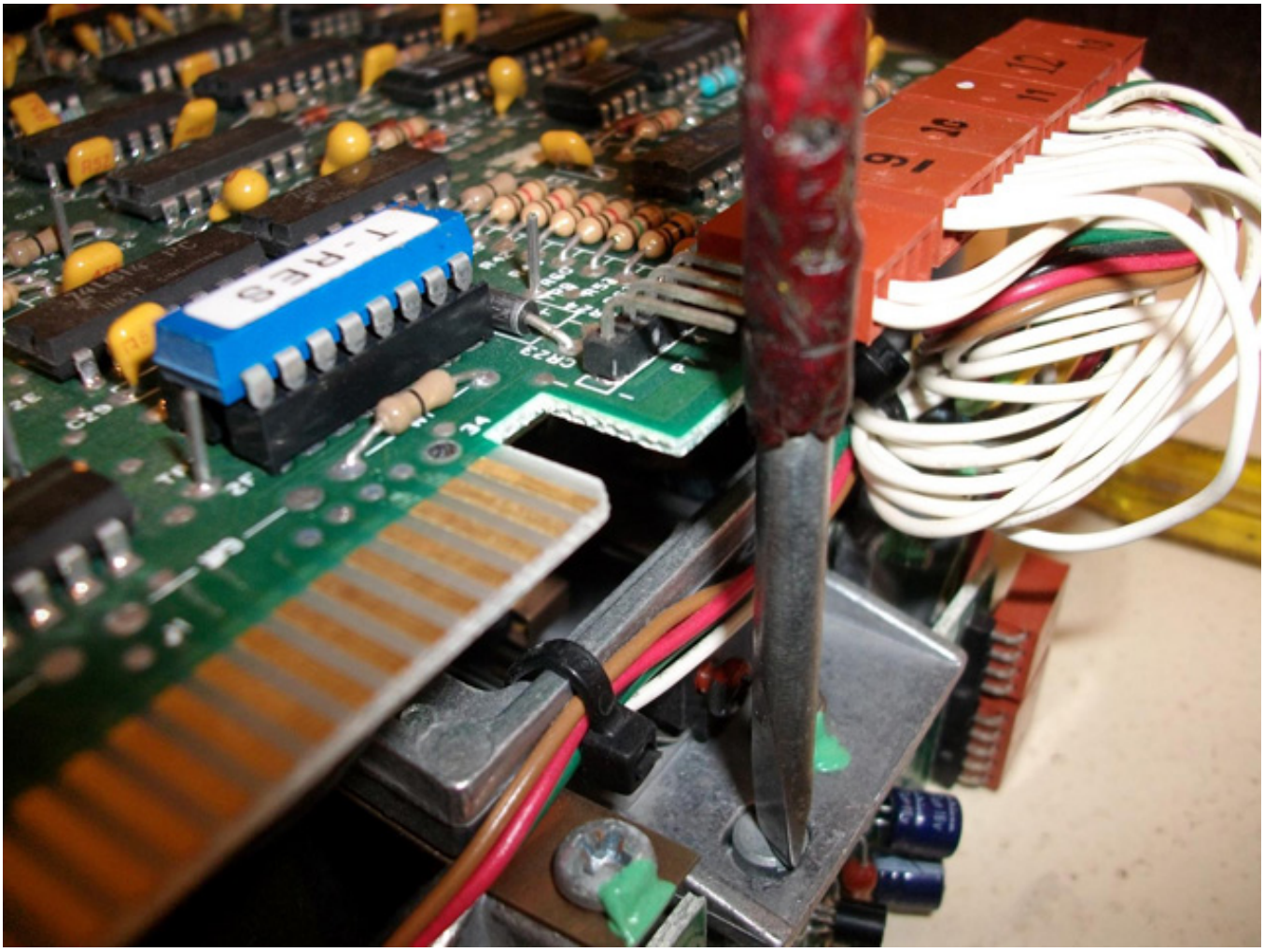

Photo 6. Adjusting the cam screw. Note the insulation to prevent shorting of the pins on the circuit board

6. At this point I lock the top retaining screw (only mildly tight) then step over the disk to ensure all tracks produce a decent signal. It's worth noting that with the higher tracks (above say track 30), it is normal that there is a substantial drop-off in signal as there is less media in those inner tracks (smaller circumference). This is why the signal strength ranges from 0.6V down to near 0.3V for a good drive. Sometimes it takes several adjustment attempts to get an overall good signal. I then lock down all three retaining screws.

7. The next step is to verify the drive is aligned to the given correct track. It is possible to adjust the cam to read an adjacent track, so for example you could be set-up to read track 1 to 40, not track 0-39. Using Floppy

Doctor's stepping function, I start at track 40 (one beyond the proper track count of 0-39) and ensure that there is no signal (hence the need to initially bulk erase). I then step back to 39 which is where the first sign of signal should occur. Then continue stepping & eventually reaching track 0, ensuring there is a good signal there and that the track 0 sensor activates. It shouldn't be possible to step further back than Track 0.

Your Tandon drive should now be able to interchange floppies with other floppy disk drives.

Philip Avery
23-Jun-2010

From RickNel (2nd Nov, 2010)

> *The blog post was very timely for me (thanks Tezz and Philip). I have a pair of these Tandon TM100-2 5.25" floppies in my S-100 machine and one had drifted off alignment over a long period.*
>
> *I started following it through, and have now got my second drive nicely aligned, but with some deviations. Let me suggest a couple of extra points.*
>
> *First - use ImageDisk for the control and testing - it's free and very versatile. I don't have a TRS-80 so thought I might have to write some code to goose that read signal for the scope. Then I had another look at the Alignment module that is part of Dave Dunfield's excellent ImageDisk free utility (DOS platform - reads, makes images and writes to any floppy format incl CP/M). Easy to Google it.*
>
> *Hooking the Tandon up to a PC, I used the ImageDisk align utility to quickly find out that my problem was not just alignment, but one of the heads not firing at all. I took the controller board off the drive, and noticed that the diskette had a buckle in it where it passed between*

the heads. The plastic frame that sits on top of the aluminium chassis may have shrunk a bit over 30 years, or I may have pressed it back into position too firmly after cleaning out the drive, or maybe a combination of both. Anyway, with these drives it is worth checking that the disk slot is exactly at the right level for the fixed head. Problem fixed by levering one or two of the plastic holding posts about 1mm out of its snug hole in the aluminium chassis. The test for correct position is easy - the disk slides in without pushing, shoving or twisting!

I had hooked up my scope as instructed, but it turned out that ImageDisk provides an easier check on your console screen. You can navigate the heads to any cylinder/track and read one head at a time for data. It just keeps reading the same track till you tell it to do something else. Once I had adjusted backwards and forwards till I could read data consistently on both heads at track 20, I just stepped through all the tracks, both sides, and made finer adjustments to ensure they were all reading correctly.

Then ImageDisk can do test reads and writes for any track. I'd recommend confirming outermost, innermost and centre tracks at least, before you are satisfied and start tightening up the screws again. Keep the drive in the test rig and keep testing while you gently tighten the screws one at a time - the tightening can be enough to nudge it a fraction off alignment.

The scope test will give a more fundamental hardware spec alignment, but read and write were enough for me!

I also recommend going the extra step of taking the controller board off the drive for the adjustment process. It is only held by two screws then a slide and a wiggle. Unplug all the cables first.

Carefully unlace the two sets of head cables, that come from the front of the drive, from their cradles in the plastic frame. You can then re-

> *connect the board standing on its end at the back of the drive, loose from the chassis. Then run your tests and do your adjustments with all the mechanics of the drive in full view, and with most electronics out of the way of screwdrivers, crowbars, chainsaws or other tools you may be using. Just be careful that there is some slack in the head cables while the board is in that position, so the cables do not put any drag on the head carriage and inhibit its movement.*
>
> *I found it much easier to control the fine adjustment of that pretty crude cam screw with the board out of the way.*
>
> *Rick*
> *s100fan(at)gmail.com*

Aligning a full-height floppy disk drive when the alignment screw proves inadequate. Check the stepper motor coupling!

Introduction

Full-height disk drives take a bit of maintenance, but they do preserve that original look, feel (and sound) of whatever vintage computer they are associated with. I like to keep them going if I can.

Figure 1. Two handsome floppy disk drives in my TRS-80 Model 4

Recently one of my TRS-80 Model 4 drives had been misbehaving. At one point I thought I'd fixed it, but the problem returned. Philip Avery and I managed to repair it eventually, but the solution involved more than just a simple alignment as described in our previous article. This fix required adjusting the stepper coupling, which appeared to have moved from its original position thereby throwing the drive alignment way out of whack.

What follows is an account of our diagnostic procedures and what we did. The drive was a TPI (Texas Peripherals) model used in the TRS-80 Model 4 but most full-height, belt-driven drives have similar mechanisms. Hopefully the explanation below will help others with similar problems.

Symptoms and initial observations

The drive concerned was the top drive in the TRS-80 Model 4 above. It could format and write disks just fine. It could also read its own written disks. However no other drive could read them! There was no interoperability.

We set up our workbench and started to look into the problem (Figure 2)

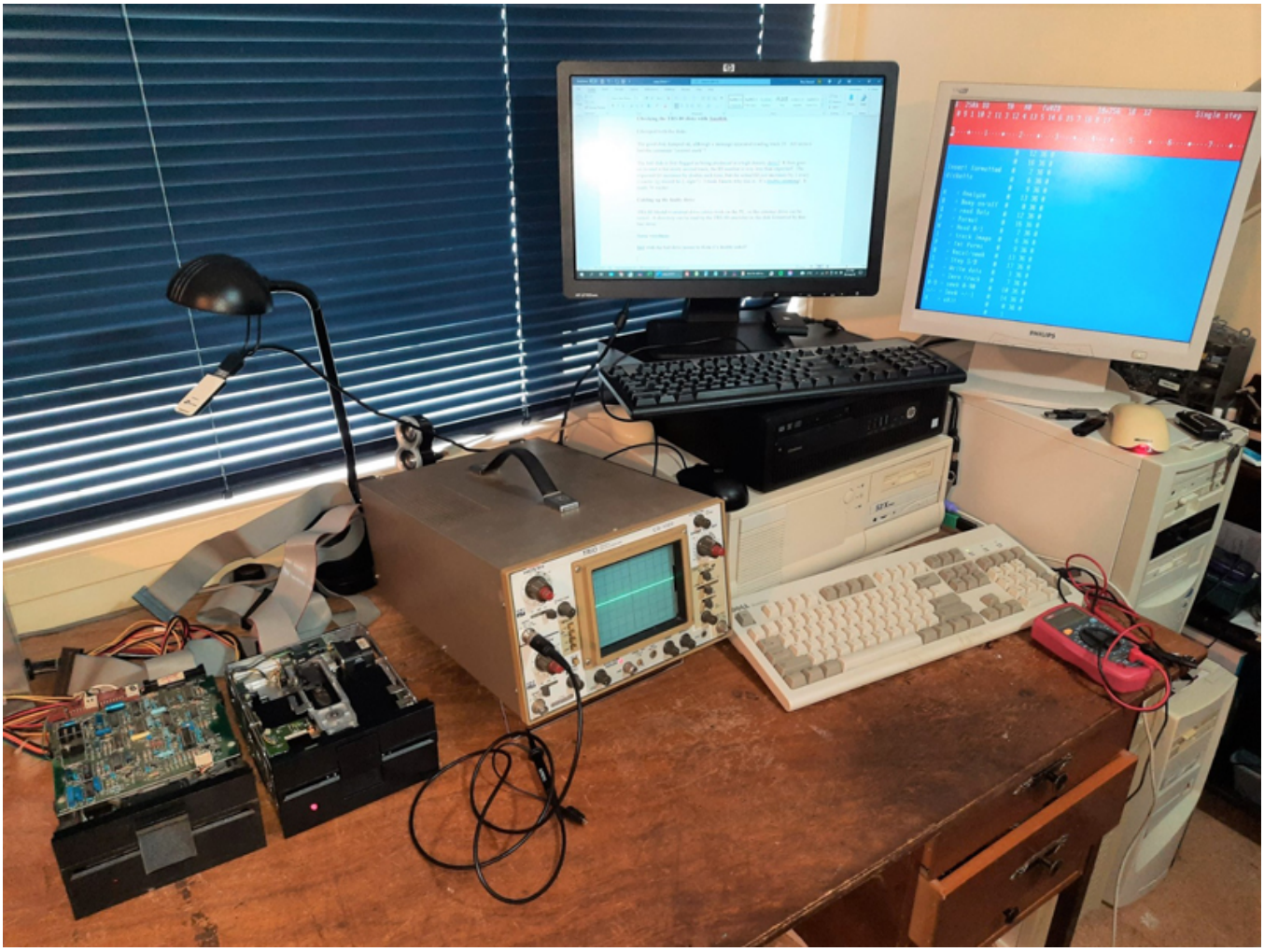

Figure 2. The workbench ready for action!

Using the alignment function on Dave Dunfield's excellent ImageDisk program, we soon discovered the faulty drive was badly misaligned. We deduced this because:

- When the LS-DOS disk formatted on the faulty drive was read in a "known-good" drive, ImageDisk registered track 0 as track 2 and checksums weren't matching up!? However, with a known-good MS-DOS disk (formatted in a known-good PC Drive) and a known-good LS-DOS disk (formatted in the other Model 4 drive), returning to track zero in ImageDisk showed we were indeed on track 0. Also with the latter, no errors were shown when we hovered over the track.
- When read in the faulty drive, known-good LS-DOS and MS-DOS disks showed a "?" in ImageDisk when set back to what was suppose

to be track zero. When stepped forward two tracks, ImageDisk suddenly reported we were on track 0!? Conversely the LS-DOS disk formatted on the same (faulty) drive appeared normal in ImageDisk.

Conclusion: The drive was about two tracks out of alignment!

Why this misalignment happen and how to fix it

What would make the drive suddenly jump so far out of alignment? Acting on a hunch, Philip checked the screw on the “stepper motor coupling clamp" (Figure 3a and 3b). Hmm...This wasn't fully tight! Could this have caused the stepper assembly to jump a couple of tracks?

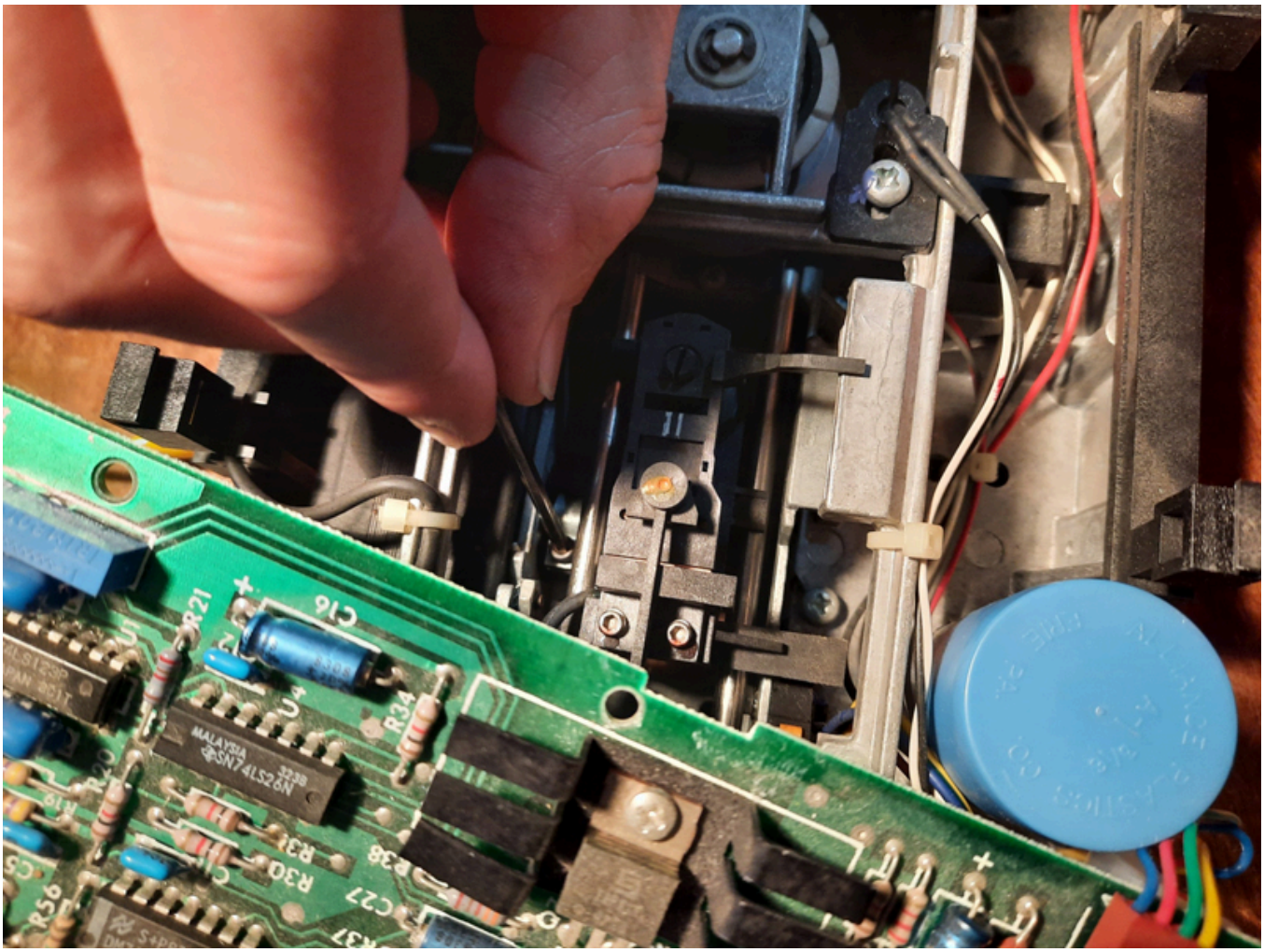

Figure 3a. Tightening the stepper motor coupling clamp

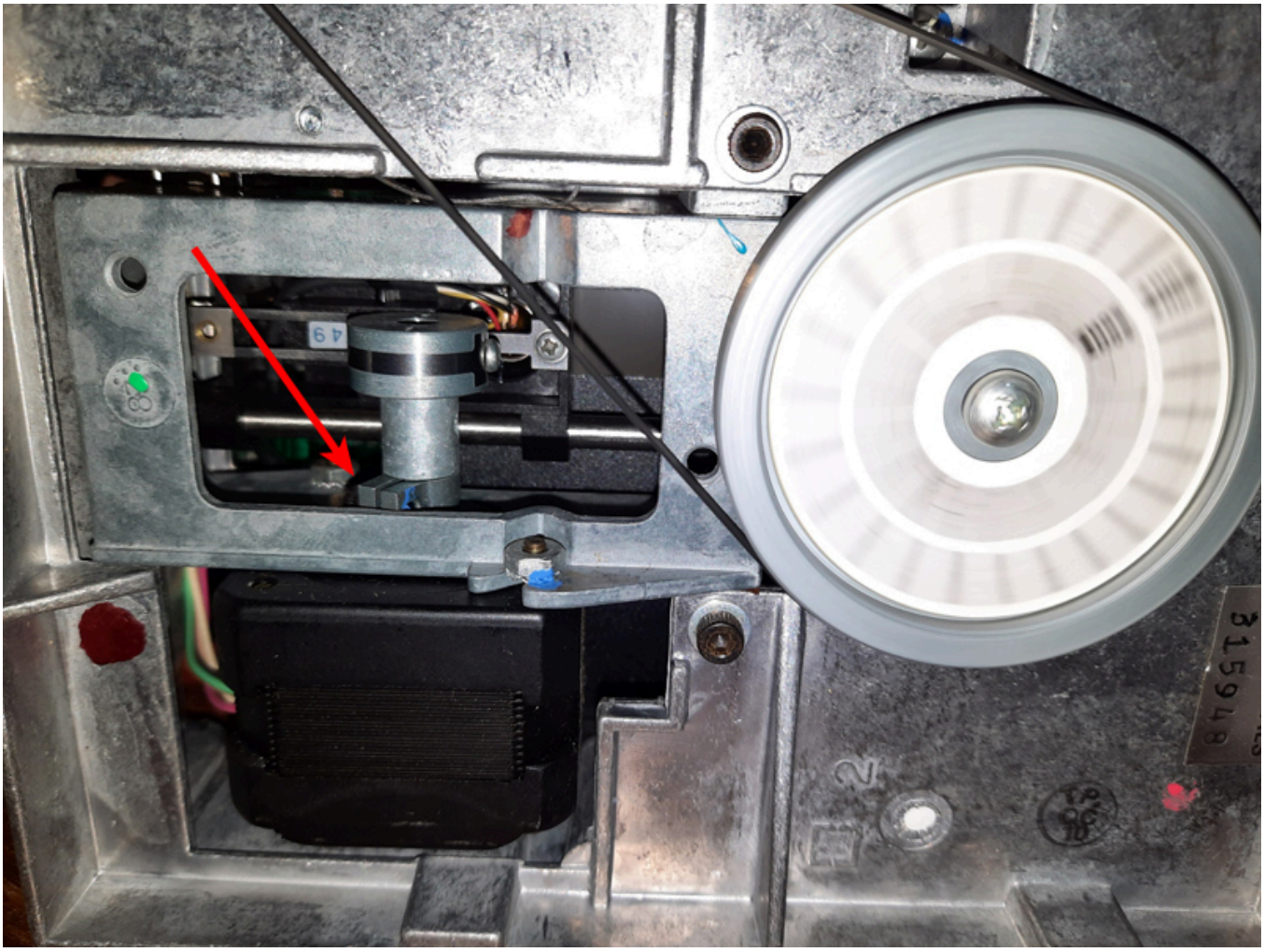

Figure 3b. The stepper motor coupling showing the position of the clamp screw (hidden in photo)

We tightened the stepper motor coupling clamp screw and at this point also serviced the drive with a drop of oil in the appropriate places (each end of stepper motor & also the clamping hub). We also cleaned and silicon-greased the rails.

Time to get aligning. Using a combination of oscilloscope, disks formatted in a known-good drives and ImageDisk to position the head over particular tracks, we managed to correct the offset of the drive (or so we thought) by turning the alignment screw. (Figure 4). ImageDisk was now reporting we were indeed on track 0 when we requested a return to track zero.

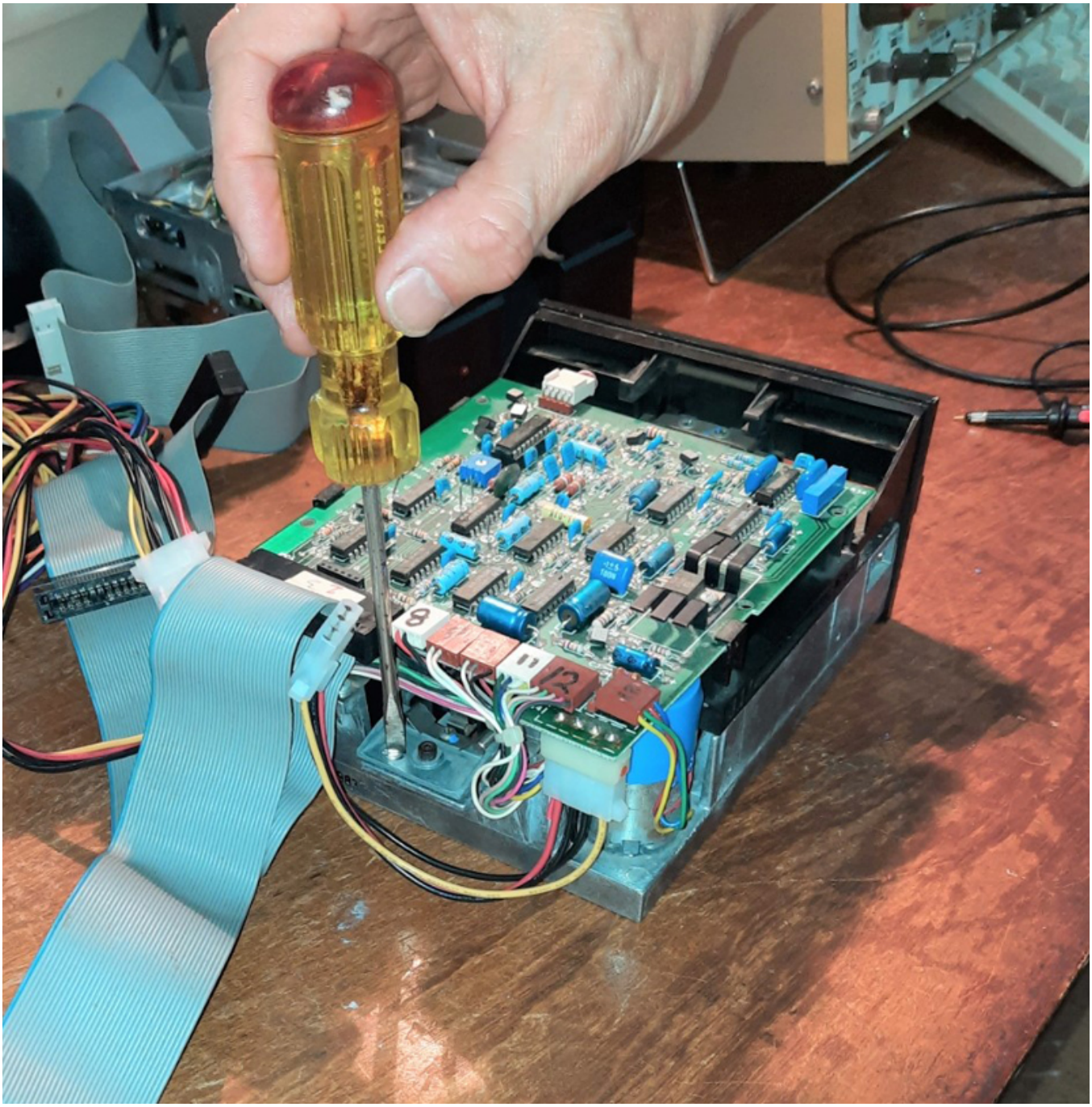

Figure 4. Aligning the heads with the alignment screw

However, the signal appeared faint on the scope at about 35mV?? (Figure 5). A good signal should be 250mv if not more. Our newly aligned drive gave the occasional successful read but only after several tries. We compared the same signal on a good drive using known-good PC and LS-DOS disks and found the faulty (now adjusted) drive's signal over tracks was only about 1/7 the strength compared with the good drive, even at peak adjustment.

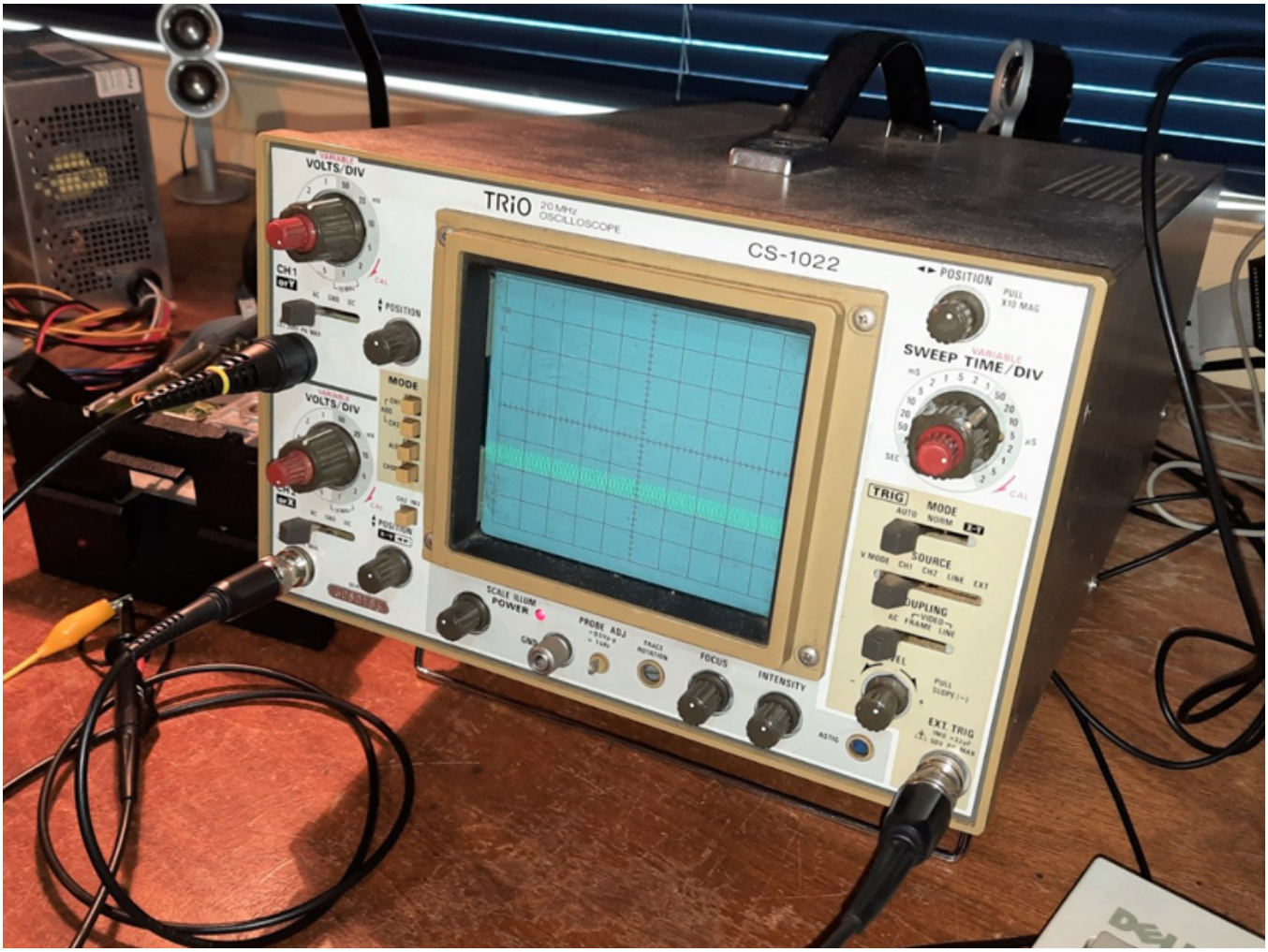

Figure 5. A weak signal, but the best we could get via the alignment screw (note: each divisions is 50mv)

Why couldn't we get a stronger signal? Philip figured this may indeed be because the loose stepper coupling had slipped previously by two tracks & that the alignment screw cam might not give us the range of adjustment necessary to correct this.

We needed a coarse adjustment! To achieve this Philip loosened the (retightened) coupling clamp screw & adjusted the stepper coupling manually to move the head independently of the stepper motor (Figure 6).

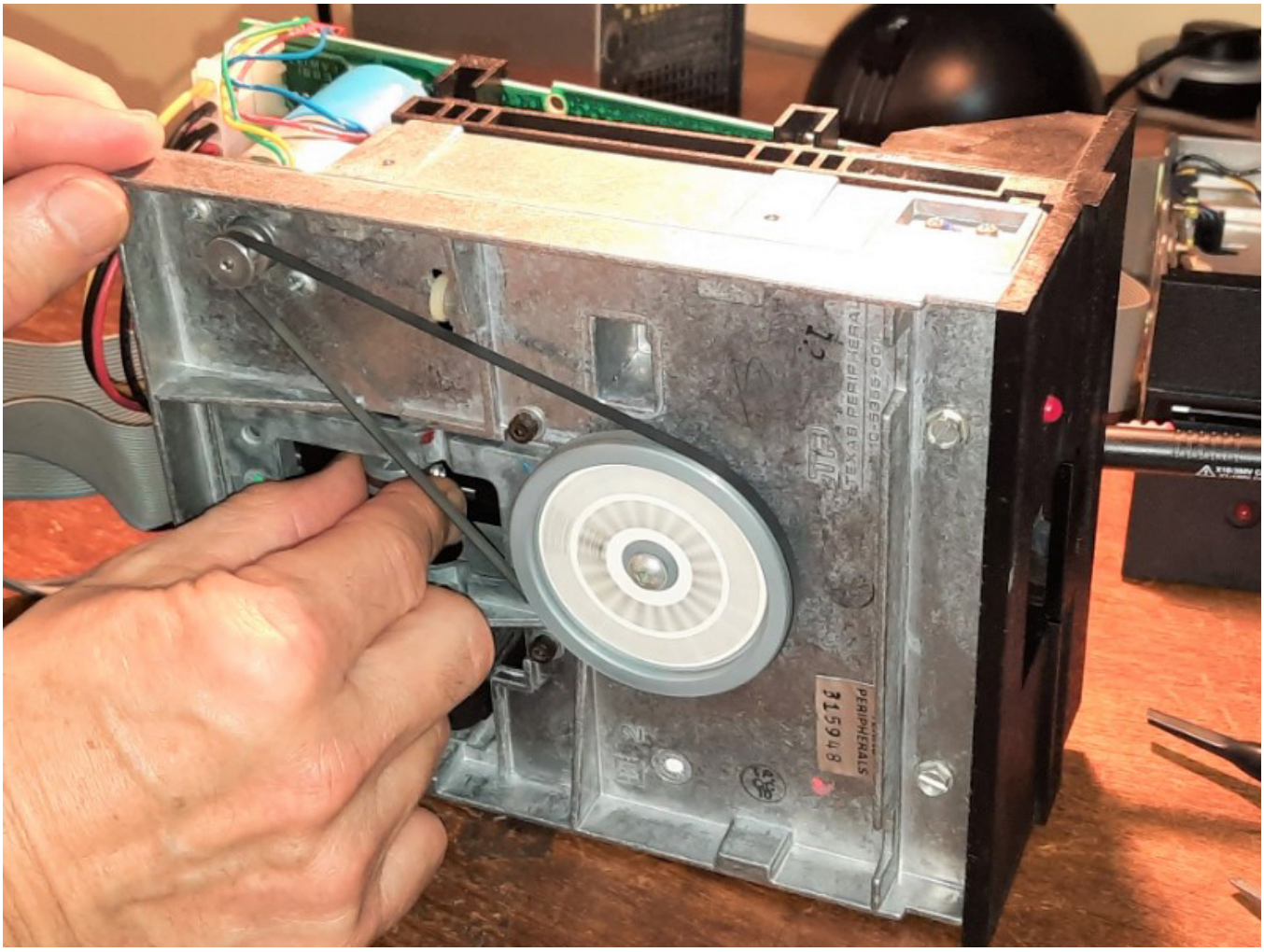

Figure 6. Turning the Stepper Motor Coupling

He merely turned the coupling making sure ImageDisk still displayed the track id that matched the selected track, then adjusted the coupling it until the signal on the scope was as strong as it could be.

After retightening the stepper coupling screw, we then fine-tuned with the adjustment screw cam to ensure we were getting the best signal we could. (Figure 7)

Figure 7. A strong signal after "coarse tuning" with the stepper coupling (note: each division in this case is 100mv)

Finally, we tightened everything up, connected our drive to the TRS-80 and exercised it thoroughly with floppy doctor. The drive now worked perfectly and with complete interoperability! (Figure 8).

Figure 8. The drive passes all tests with flying colours including interoperability

Concluding thoughts

Maintaining these old drives without the specialist tools and training of the technicians of old, is somewhat of a black art! The importance of the correct placement of the stepper coupling in disk alignment, was bought home to me in this repair job. Check both screws (head band screw and clamp screw) on the stepper coupling are tight and if alignment seems impossible by the alignment screw alone, perhaps a loose stepper coupling is the culprit?

Terry Stewart (Tez) (and Philip Avery)
3rd September, 2022

Fixing a Tandon TM100 drive on a Kaypro II

It's nice to get gifts! A month or so ago I received a tidy Kaypro II computer from a donor who had noted I was looking for such a beast. However, the computer came with no software. The owner had tossed all he had, thinking the disks were damaged due to de-magnetising from bad storage.

No software was no barrier. The Internet means that getting hold of 8-bit software is seldom a problem. Sure enough, after enquiring on the Vintage Computer Forums I was pointed to Dave Dunfield's archive site where I managed to download disk images. In no time at all I'd produced a 5 ¼ inch Kaypro CP/M 2.2 disk on my PC using his MS-DOS imaging software.

It was then I discovered the Kaypro donor may have misdiagnosed the problem. There was probably nothing wrong with his disks. The problem seemed to lay with the A: drive, which simply refused to boot!

Was it the drive though or the new CP/M disks I'd produced on my PC? Swapping over drive A for B showed that it was indeed the drive as once done, the machine booted perfectly! However, the faulty drive (which was now B) showed the following symptoms:

Photo 1. Kaypro hooked up to another one of my full-height drives to verify the disk controller was ok.

Apart from giving floppy drives a clean, I had little experience of fixing faults. Consequently I asked for help from my folks on the VC forum which resulted in this lengthy thread, full of helpful suggestions. Over a week or so, armed with some literature on these Tandon drives, I carried out the following tests to try to narrow the possible cause;

By this time I reached a few conclusions. Forum wisdom was that the two problems described above (Non-transferability of disks formatted in the faulty drive and failure of the higher tracks) were unrelated. The first problem was most likely due to radial mis-alignment. The other was less clear. It could be that the heads were damaged, a condition from which there is no easy cure!

I had reached an impasse. To radially-align the heads on a drive required an oscilloscope and a special alignment disk. I had neither. Besides that, even if I did manage an alignment, there was still a possibility that the heads were damaged.

Maybe it was just better to toss this drive and seek a replacement on the auction sites?

Enter Philip Avery. Philip is a fellow vintage computer enthusiast with some experience in fixing full-height Tandon drives. What's more, he was only 50 minutes away by car. During a visit, Philip volunteered to take the drive away and check it out. He had an oscilloscope and although not owning a special alignment disk, he did have some techniques available which might help.

The photo opposite shows Philip with his TRS80 Model III which was crucial to the repair. I'll let him carry on the story....

Thanks Terry. I should point out that my experience with these drives is really only from keeping those in my TRS-80 Model III serviceable.

I connected Terry's drive to my TRS-80 Model III and ran Floppy Doctor, a drive diagnostic program. Immediately I noticed the drive was noisy & rough during disk rotation (despite Terry's lube job), though track stepping was fine. Floppy Doctor's digital speed read-out confirmed that Terry had adjusted the speed bang on.

I applied a drop of 3-in-1 oil to either side of the hub spindle (I didn't know if Terry had lubed these parts) and also onto the Clamp bearing. Not much improvement there. I then noticed when releasing the disk latch a little (taking the load off the Clamp bearing, but not lifting the head off the disk) - the noise practically disappeared. Holding the latch in this position I was able to format & verify the disk error free.

At about this time I had a 'brain recall event' - a posting from Chuck(G) on the Vintage Computer Forum highlighted a problem caused by a worn/bad Disk Clamp. On studying this Clamp, I noticed a ring of diecast metal around it where it appeared to have been 'working' in the hub (see opposite). On looking at other Tandons in my spares bin, no such ring was apparent. I elected to swap out the Clamp with one of my spares. A drop of oil was applied to the Clamp bearing during fitment and when spun up - the drive was beautifully quiet & smooth with the latch shut. I was then able to successfully write & read MFM worst-case data all over the drive with Floppy Doctor.

However the disk wasn't readable when read by my TRS-80's other drive. I suspected that the radial alignment was out, but I don't possess an Alignment disk to do the check by. Instead, I just adjust for peak signal when reading a disk formatted by a good drive, preferably the 'other' drive from the system under test. It's imperative in this case to bulk erase the floppy before formatting. This avoids aligning to old, possibly mal-aligned tracks and also verifies all 40 tracks are readable, ie the drive is not 'one track out'. To bulk erase, I simply pass a strong magnet within about 20mm of the floppy & do several passes to cover the entire surface.

I connected my scope up to Terry's drive, inserted the formatted disk (as above) and found a lousy signal. A good signal on my scope is about 0.3V peak to peak from TP1 or TP2 when reading over any given track. This I determined from measurements during past service 'sessions' with my Model III. Adjusting the Adjustment Cam, after loosening the retaining screws (as detailed in the TM100 manual) brought up a nice big signal. At this point I lock the retaining screws (only mildly tight) then step over the disk to ensure all tracks produce a decent signal. It's worth noting that with the higher tracks (above say track 30), it is normal that there is a substantial drop-off in signal (by as much as 30%) as there is less media in those inner tracks (smaller circumference). Sometimes it takes several adjustment attempts to get an overall good signal. I then lock down those

retaining screws.

The next step is to verify the drive is aligned to the given correct track. It is possible to adjust the cam to the next track, so for example you could be set-up to read track 1 to 40, not track 0-39. Using Floppy Doctor's stepping function, I start at track 40 (one beyond the proper track count of 0-39) and ensure there is no signal (hence the need to bulk erase). I then step back to 39 which is where the first sign of signal should occur. Then continue stepping & eventually reaching track 0, ensuring there is a good signal there and that the track 0 sensor activates also.

With these steps completed on the drive under test, I could now read/write across to my other TRS-80's drive.

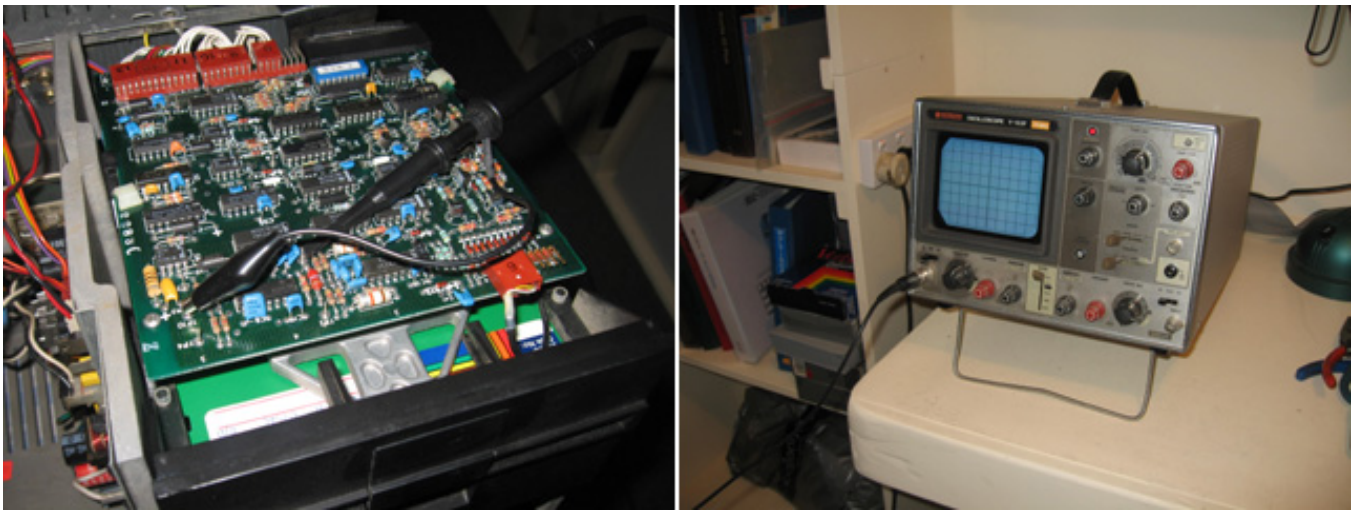

Photo 4. Probing the drive for radial alignment

All good so far. But will it work in the Kaypro II?

Terry duly swung on by & we fitted the drive back in to the Kaypro. On power up, both drives were quiet & smooth running. Disk read/writes went fine on the drive in question (drive B). We then copied the CP/M System disk to B & were able to boot from this disk in drive A. Ye ha! All fixed.

[As Terry continuously unearths more & more vintage computer

equipment, I expect it only a matter of time before he comes across a 40 track alignment disk. At which time we might re-visit some of our drives & use the correct approach to alignment.]

Philip Avery

In conclusion then, the problems appear to have been:

This exercise has shown me that most of these problems are fixable, given the right equipment and some tenacity. All kudos to Philip, and the guys on the VC Forum. Thanks to them the Kaypro II is now a complete working unit!

Tez (Terry)

Original article - 18th January, 2009
More detail on Philip Avery's methodolgy added - 28th August, 2009