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EB5AGV's Workbench: HP-8753C repair

The restoration of a legendary VNA

This page is devoted to the repair of my **HP-8753C** Network Analyzer. I hope you enjoy it!

HP-8753C NETWORK ANALYZER

- *300 kHz to 6 GHz*
- *Integrated 1 Hz resolution synthesized source*
- *Direct save/recall to an external disk drive*
- *Execute complex test procedures with the test sequence function*
- *100 dB of dynamic range*
- *Group delay and deviation from linear phase*
- *0.001 dB, 0.01 deg, 0.01 nanosec marker resolution*
- *Built-in accuracy enhancement*
- *Time domain analysis (optional)*
- *Swept harmonic measurements (optional)*

The HP 8753C network analyzer provides excellent RF network measurements for lab and production test areas. When combined with a test set, it provides a complete solution for characterizing linear behaviour of either active or passive networks, devices, or components from 300 kHz to 6 GHz. With two independent display channels available, you can simultaneously measure and view the reflection and transmission characteristics of the device under test in overlay or split-screen format on the crisp color display. The easy-to-use softkey selection of measurement functions allows you to measure the magnitude, phase, or group delay characteristics of your device under test.

Unit as received

I got the unit knowing it had several faults, so there was not surprise when I got the first display from it:

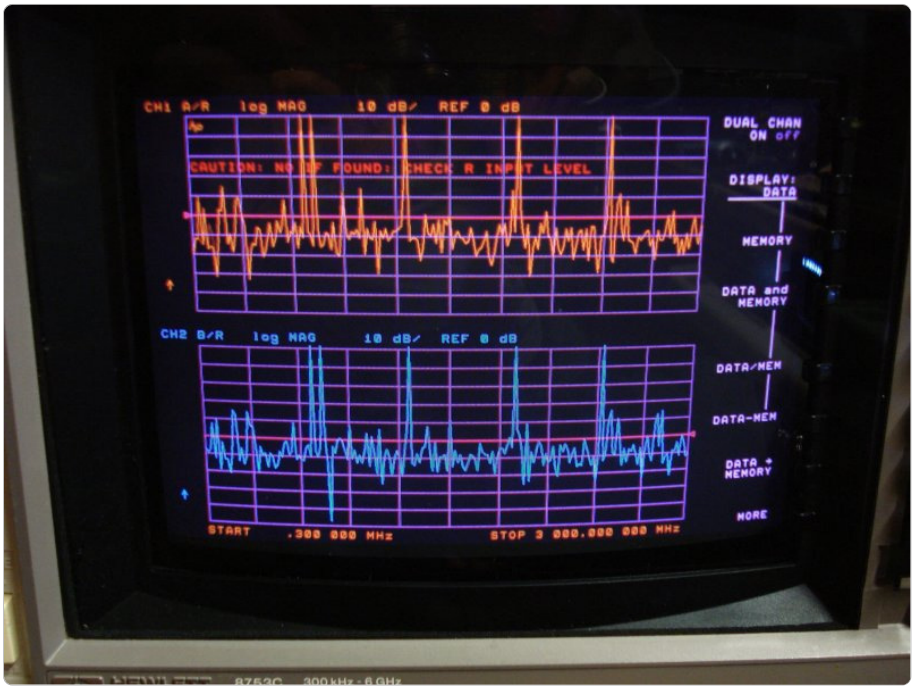
As you can see, it shows a **PHASE LOCK CAL** error. So that was a good starting point!

Other smaller problem was that the power switch was semi-stuck, wth a gummy touch, making it very hard to power up and down the unit. I looked at the mechanism and there was lot of old grease on it. But as it runs on one side, internally to the frame, I needed to remove the display section to access it, so I left that for later work.

Basically, the unit was mechanically sound, except for the missing display buttons cover (an spare is already on its way :-)). It was complete inside (I had no way to know before getting the unit, so that was a very welcomed thing) and some parts were obviously working, as power supply, fan, CPU, keyboard, display and so on.

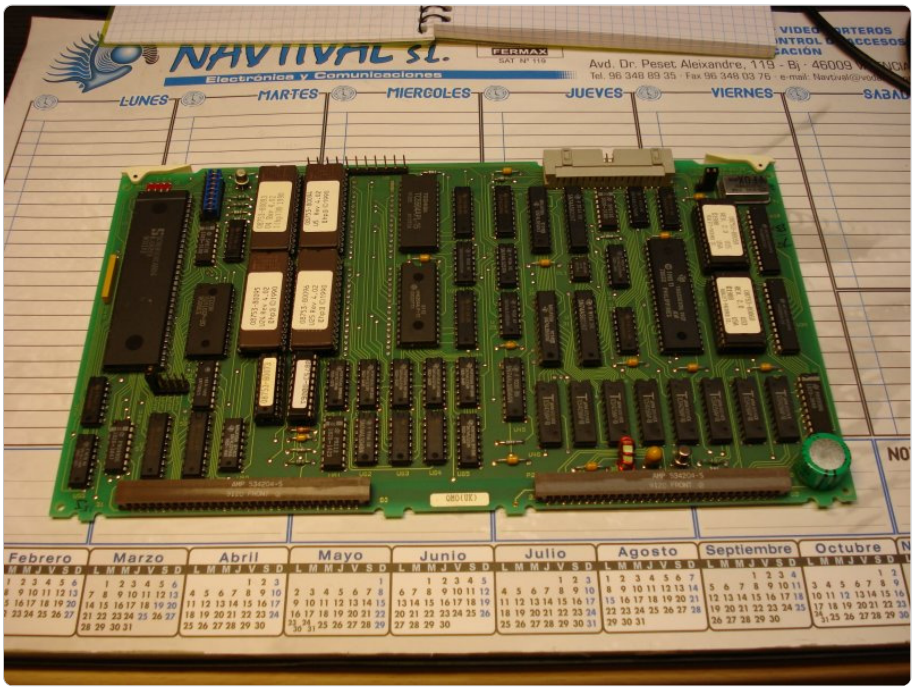
Here you have a test pattern displayed on the Sony monitor subassembly (yes, it is a Sony Trinitron tube!)

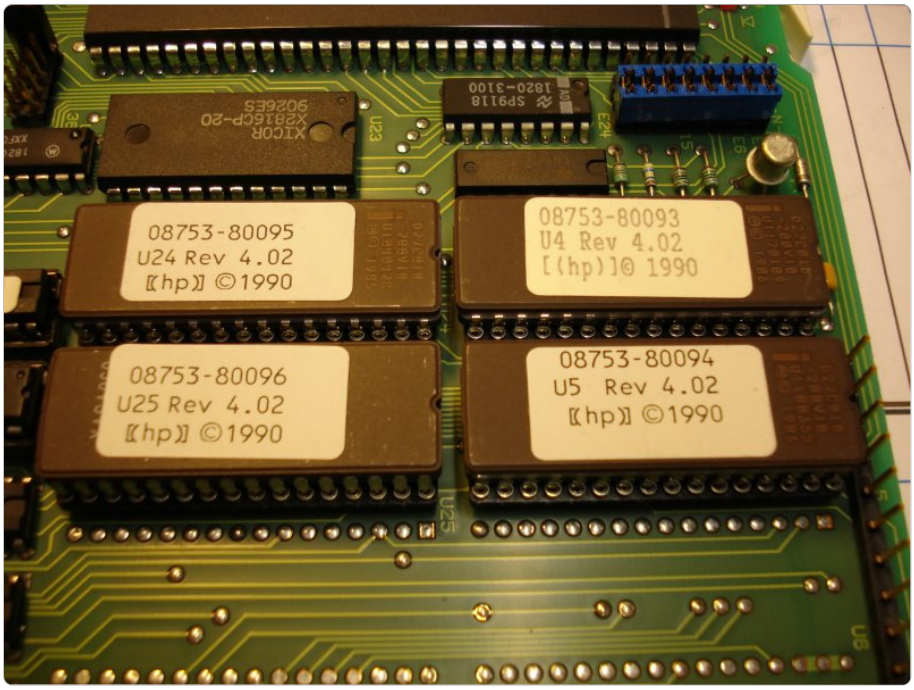
The display looks really nice, which is a plus for a 20 year old instrument



Locating the faulty assembly

I got the CPU board out of the unit, trying to locate a jumper which is named in the Service Manual, but no joy. Anyway, here you have the CPU with close views of the EPROMs





This 8753C seems to be the 4th version, being a **3039 series**

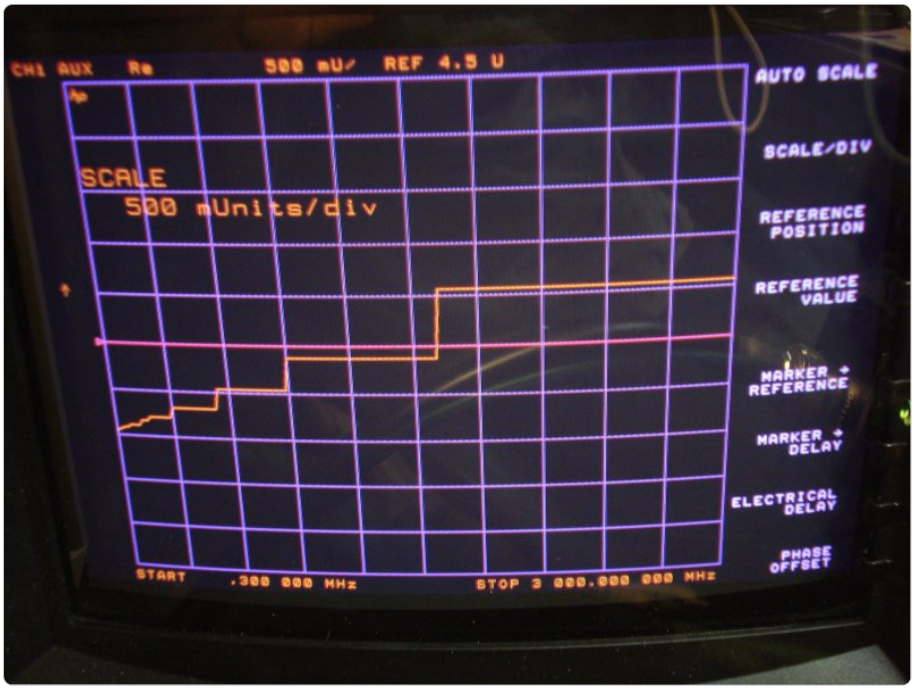
I followed the Service Manual procedure to find that power supply was OK, digital control was OK and source was faulty. But I stopped early, as it suggested to do a recalibration and I was afraid that would only make things worse; I checked the RF OUT in CW mode with an spectrum analyzer and an oscilloscope, at different frequencies. It seemed to have a good level (and it was variable as it should), but frequency was way out and only changed in large steps (this could be a hint on the problem, I guessed).

I found that the **A3 SOURCE** assembly was bad by doing the **A3 SOURCE AND A11 PHASE LOCK CHECK** (page 6 of Source Group section or page 297 of the HP-8753C Service Manual PDF file) and got these results:

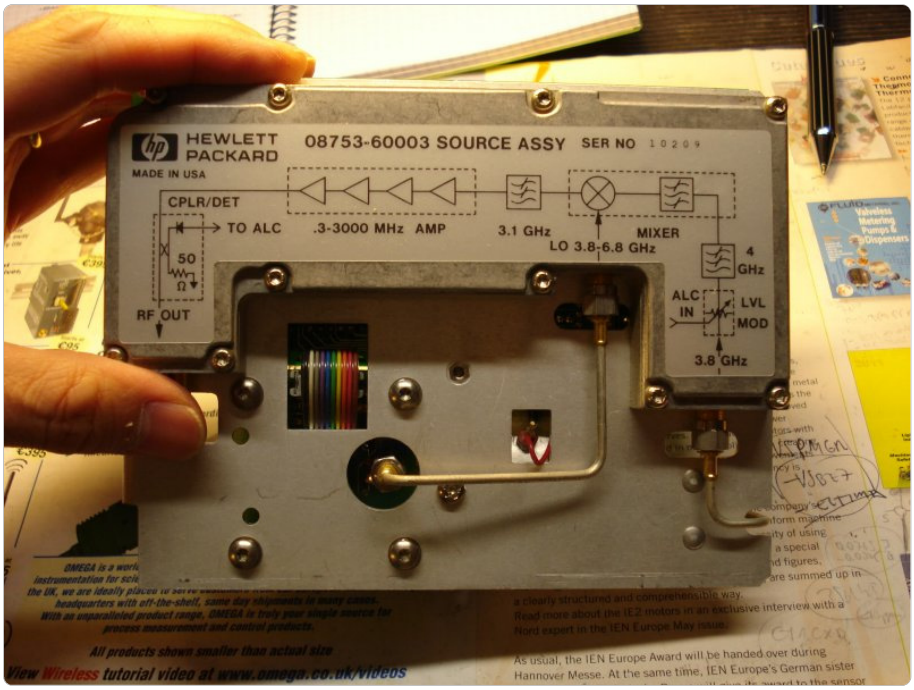
Setting	Observed frequency	Error (approx)
300kHz	83.17MHz	80MHz
30MHz	114.53MHz	84MHz
40MHz	124.55MHz	84MHz

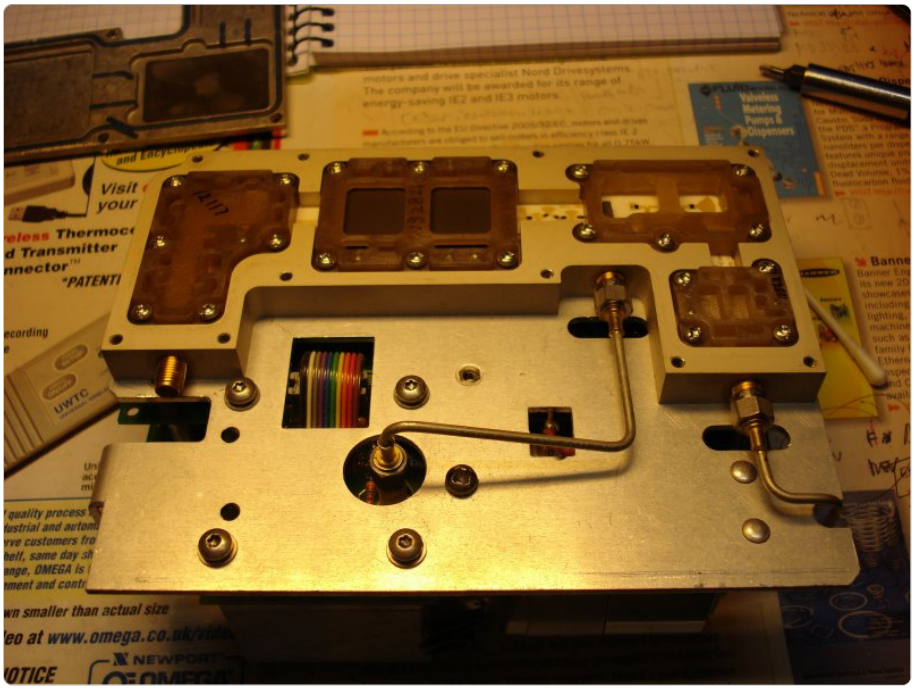
So something was not going fine. Then I did the **YO COIL DRIVE CHECK WITH ANALOG BUS** test (page 8 of Source Group section or page 299 of the PDF file) and apparently it was fine, so the manual concluded that failure was on the dreaded **A3 SOURCE** assembly. I got it out of the unit and, as expected, there were no external signs of problems.

Here you have the apparently good check of the YO coil drive:



And this is the **A3 SOURCE** assembly:

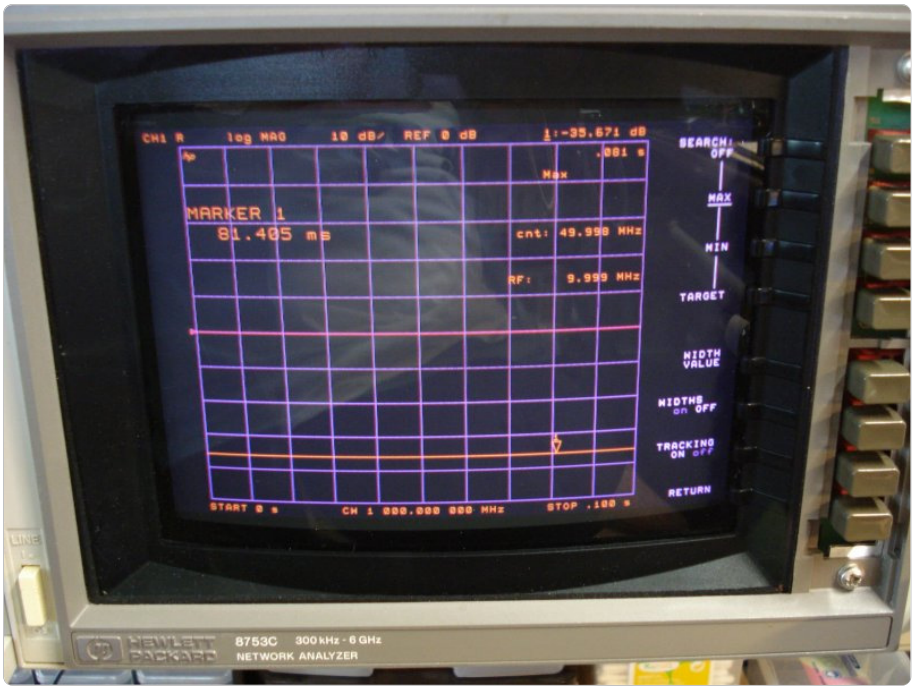




So I went bed at about 3AM local time... but brain never stops working ;-) and, next morning, I checked the trace I got, which should be similar to the one showed in Figure 6 (page 300 of the PDF)... and, YES! there was a difference which could prove significative: there was a **negative offset**!!!. That figure is labelled as 500mV/GHz so the about 0.35V offset could be very significative and could explain why frequency was always higher than expected.

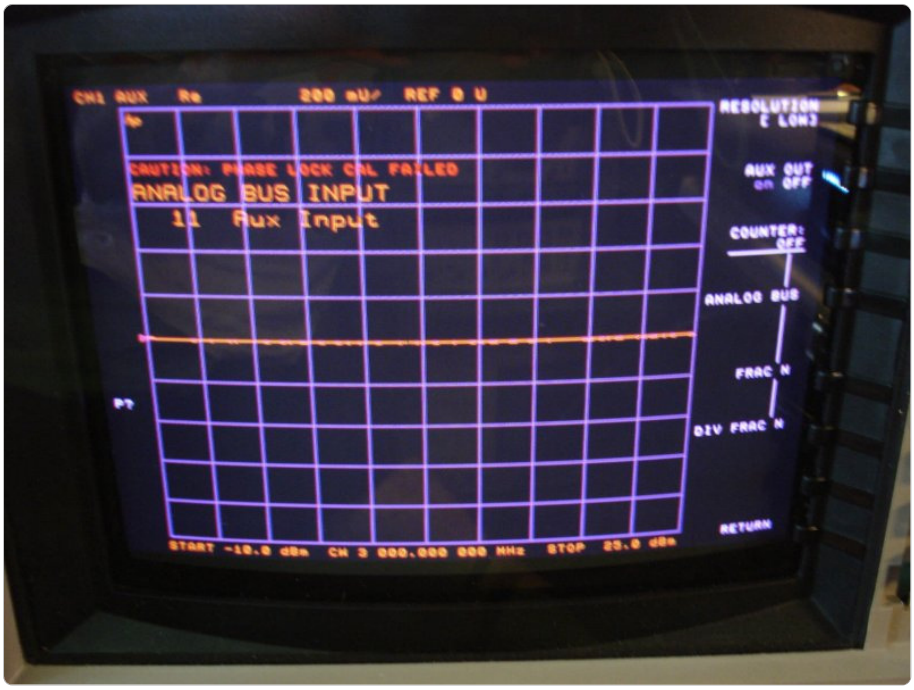
Doing some extra checkings

This kind of microprocessor controlled systems, even being 20 years old (in 2011), have usually a large quantity of self checks which save a lot of time measuring here and there. So I took the Service Manual and found the tests which had to do with the **A3 SOURCE** assembly. But before doing them, I thought that a good way to know if the rest of the system was OK, was to check the unit with an external reference. So I did the **MINIMUM R LEVEL FOR EXTERNAL SOURCE PERFORMANCE TEST** procedure (page 125 of the PDF) and got good results at 10MHz, 20MHz, 100MHz and 1GHz (I didn't check at higher frequencies). Here you have a sample display:



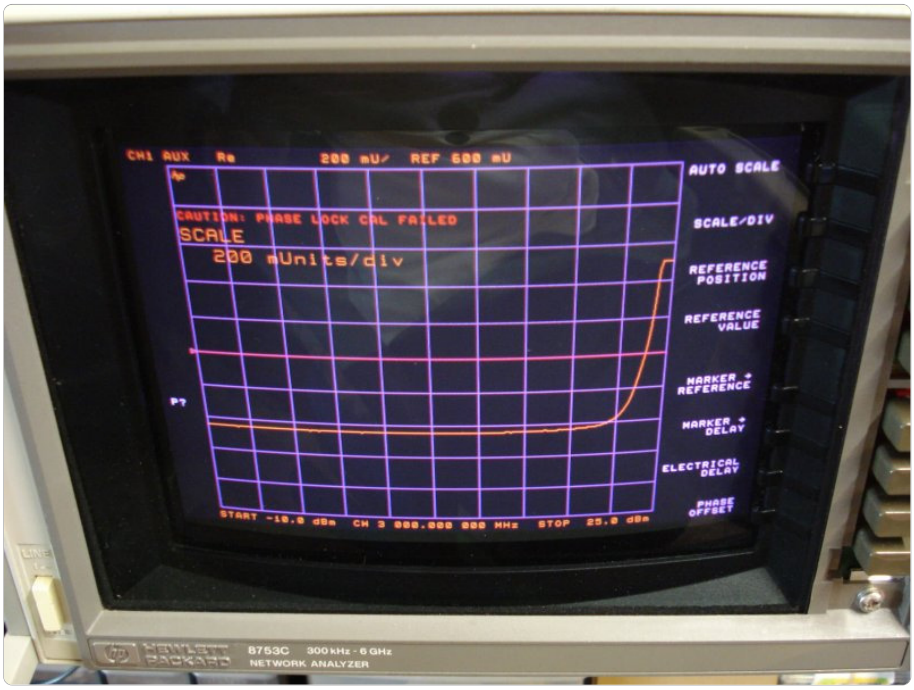
Knowing that the analyzer seemed to run fine with an external reference was a good thing, as it really pinpointed the **A3 SOURCE** as the real culprit. So I run all the tests which were related to it. And the results were, as you can imagine, bad (at least for the first one; the other ones seem to be similar to what the manual says, but with some offsets). You can see from page 361 of the PDF what the different displays should be in a working unit. Here you have what I got:

LmIn TEST



LmOut TEST

AmpIn TEST



Det TEST

Then I did some apparently successful tests: **Temp TEST**, **Integ TEST** and **Log TEST**

Analyzing the tests, from the manual I got this result: **CAVITY OSCILLATOR NOT OUTPUTING ANY POWER**.That oscillator is a 3.8GHz unit and I am looking for it...

Cleaning works

I have done also some cosmetic work on the unit and have also fixed the gummy power button system. To do that, I have got out the display assembly, have carefully cleaned it, and then have cleaned and greased the power button mechanism:

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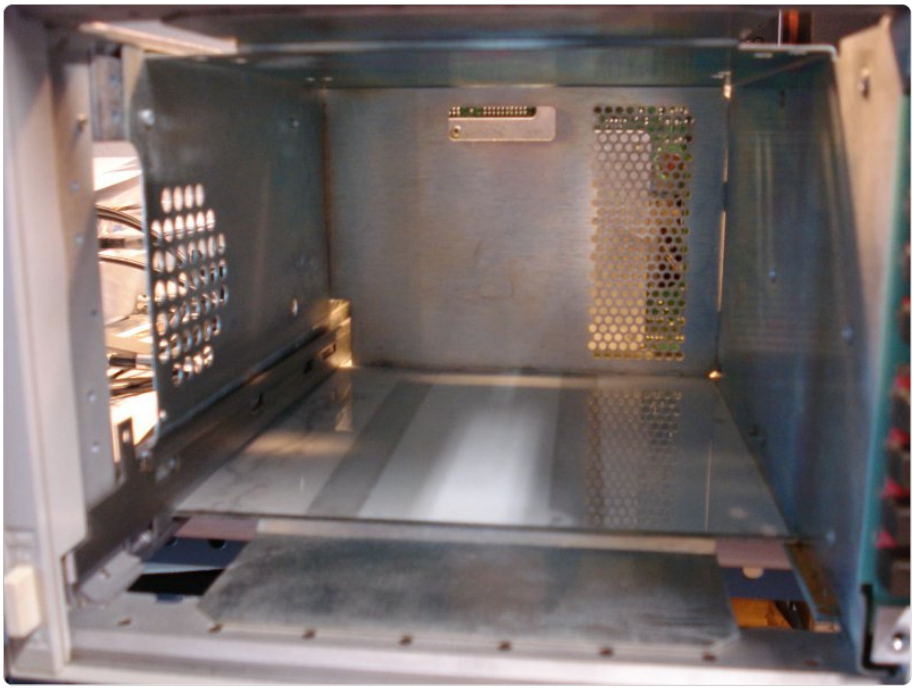

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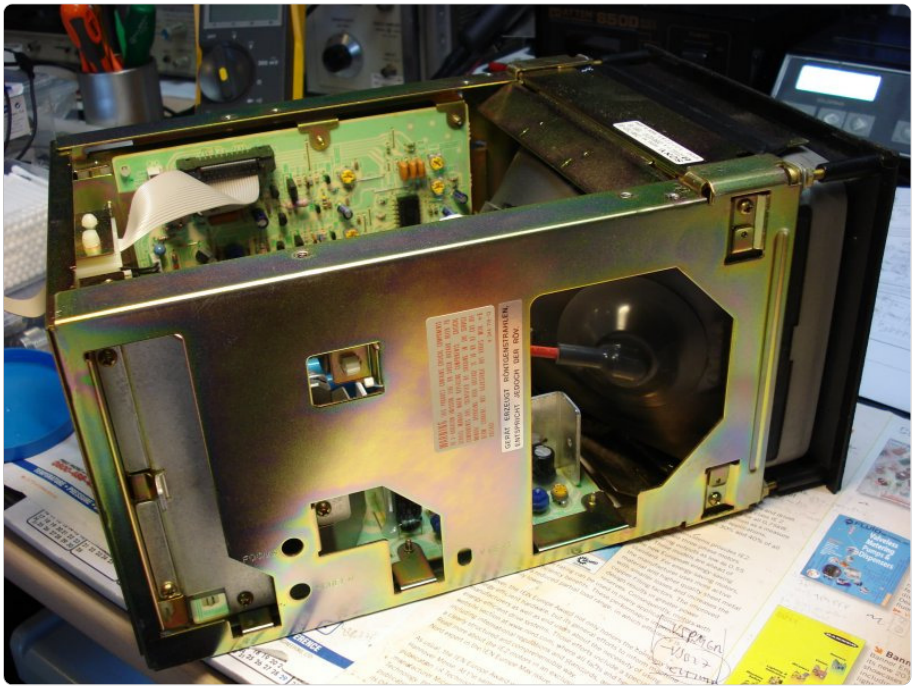
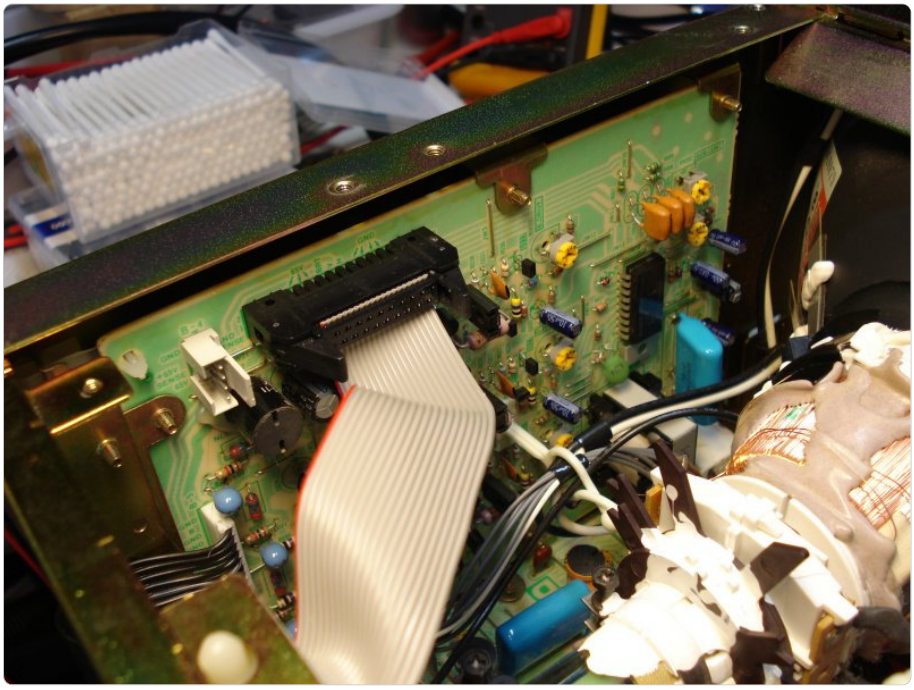
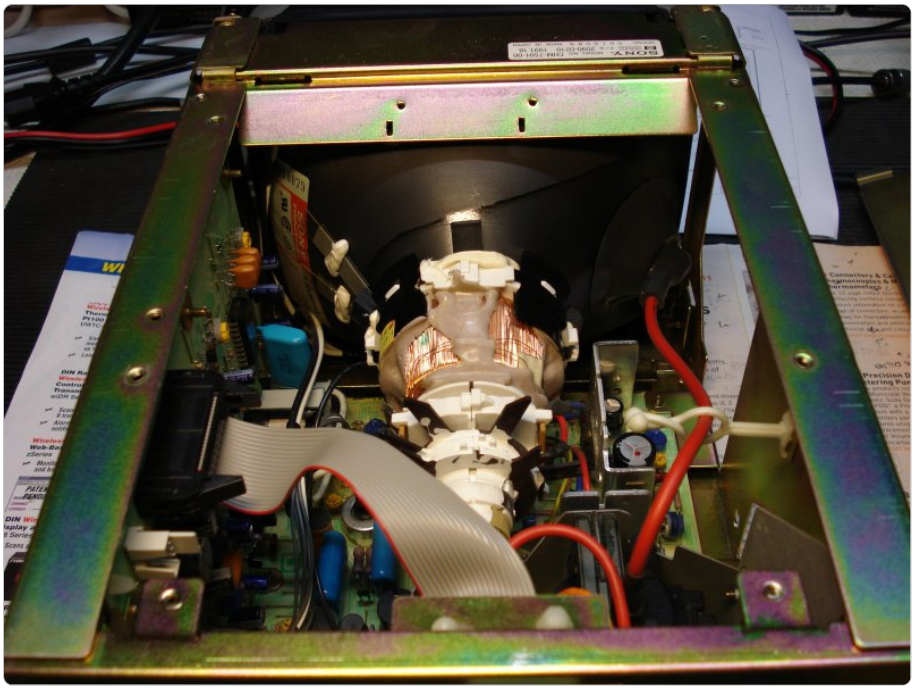


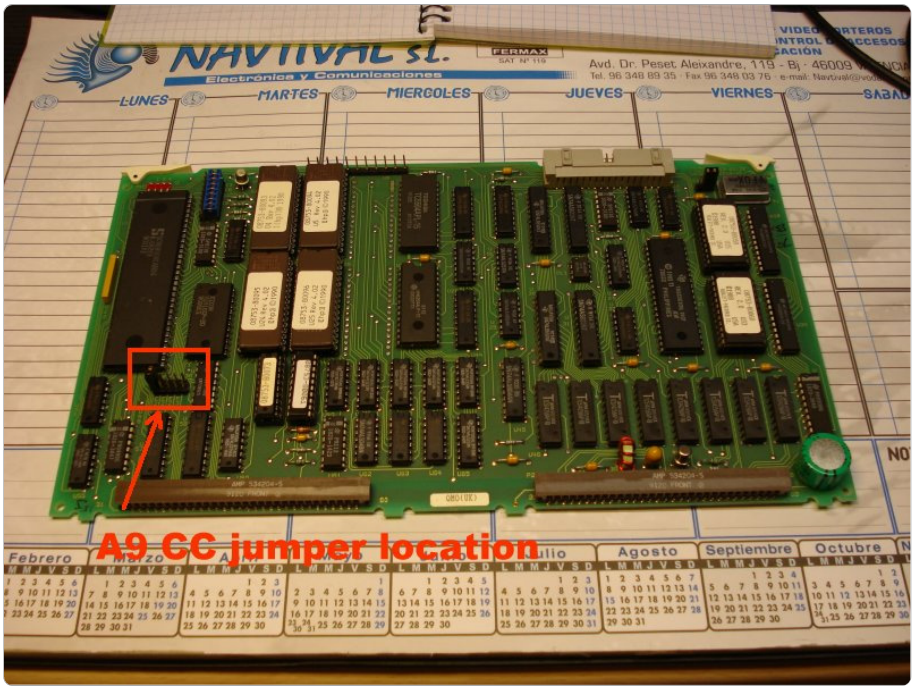




Source adjustments

As I said before, I was afraid of trying any test which would write on the configuration EEPROM, as I had no way to restore the previous configuration if things got worse... but thanks to Dr Joel, at the Agilent Forum, I decided I had nothing to lose and, being Dr Joel the designer of the **A3 SOURCE** assembly, he for sure knew better than me!

So I searched the Service Manual and on the **ADJUSTMENTS AND CORRECTION CONSTANTS** section, I found, on page 180, the **SOURCE PRETUNE TEST** (test #45) and the **SOURCE PHASE LOCK TEST** (test #48) and decided to execute them... but then I found a problem: manual calls for a jumper to be set on the **A9 CPU** board, called **A9 CC**. But I could not find it for a while, until I got the info from another manual of an 8752C, where it was pictured. This is the hidden jumper, shown in **NORMAL** position. Put it to the **RIGHTMOST** location to enable storage of calibration constants (CC):

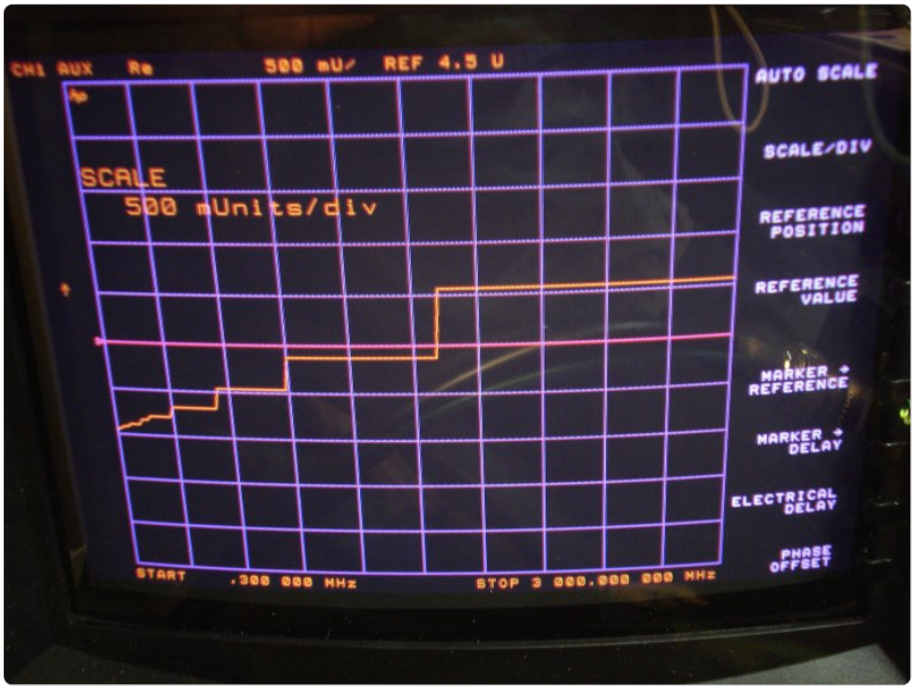


So I proceeded with some hesitation and hoping for the best... and, yes, it happened!!!

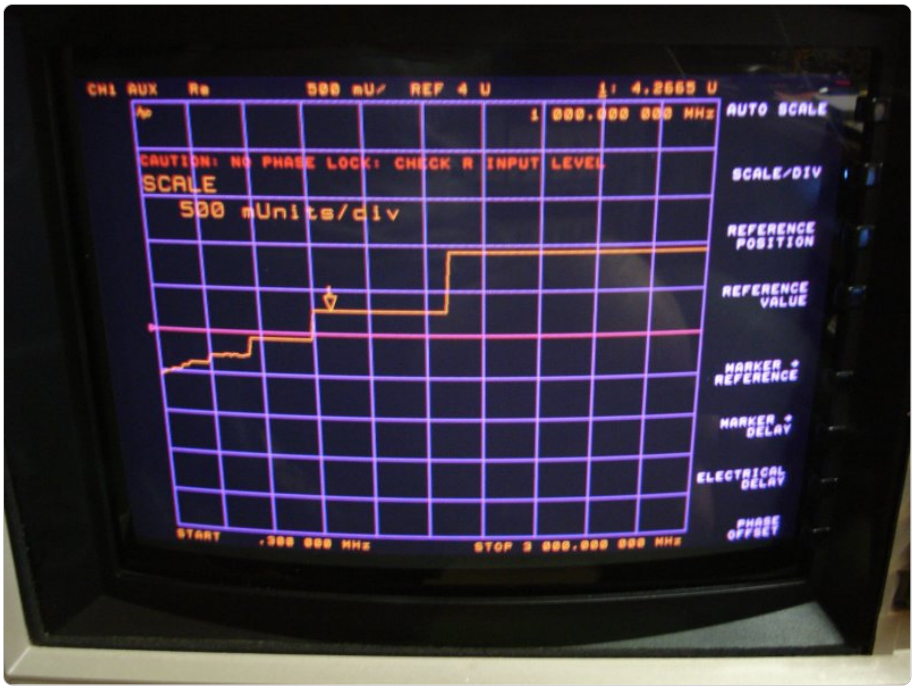
Now the **LmIn TEST** showed something different than a flat line:

I run all the other SOURCE tests and everything seemed OK and the **PHASE LOCK CAL** error was gone for good!!!

Here you have the previous (apparently good) check of the YO coil drive, which showed some offset:

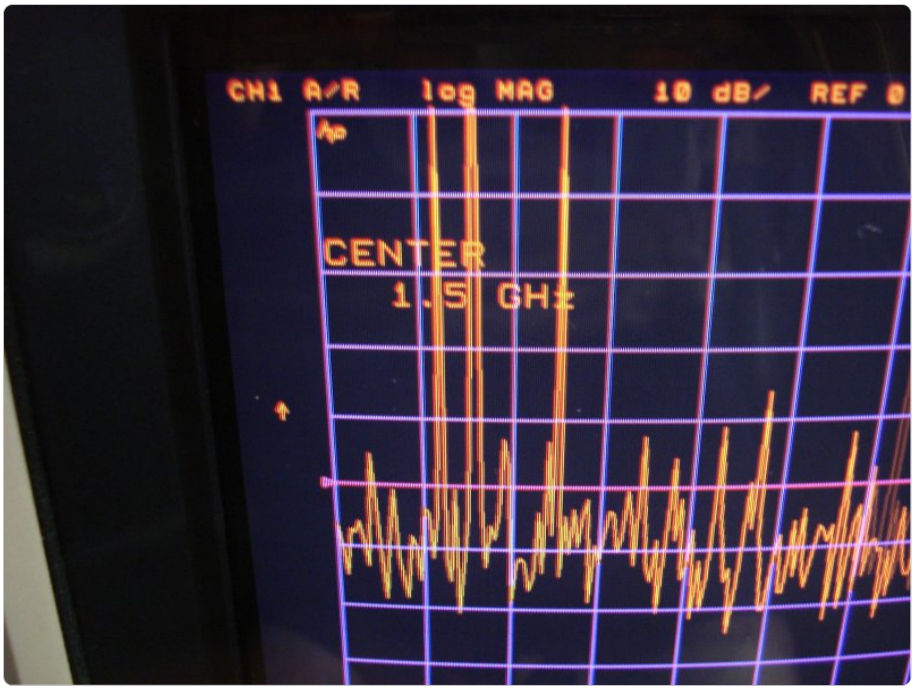


And now this is the same signal after the pretune changes:



As you can see, I was right about the offset being an anomaly.

I did also some CW tests and, as a sample, a 1.5GHz signal was nicely displayed with my **Tektronix 496** spectrum analyzer:



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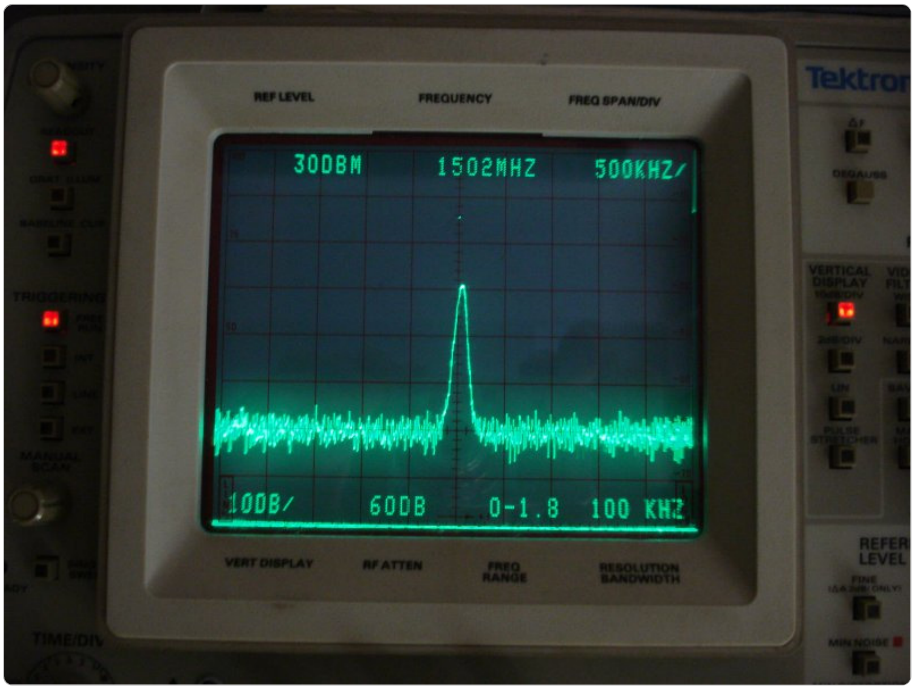
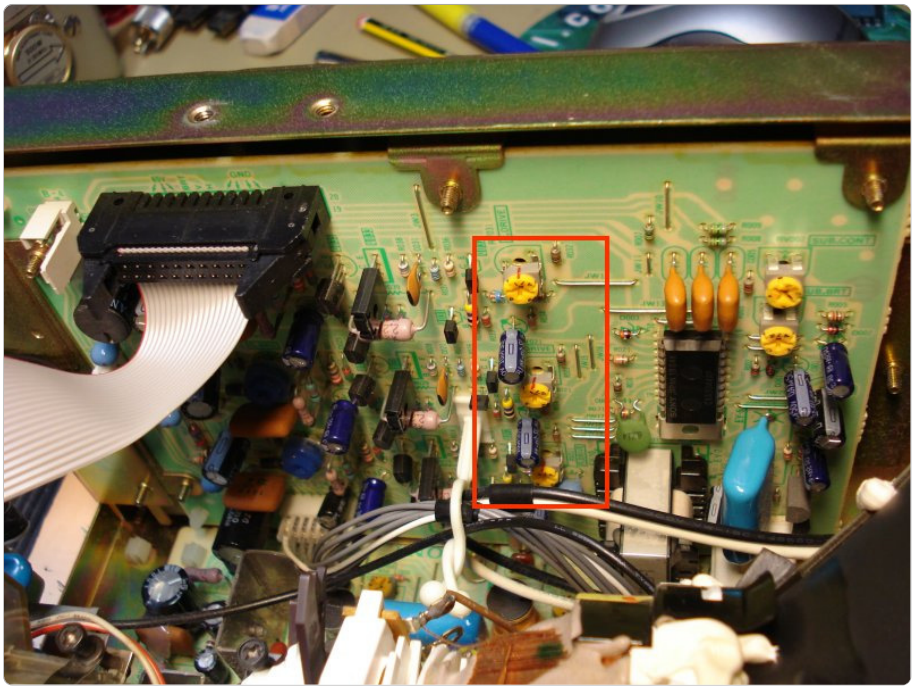


So, yes, it seemed like the VNA was working fine!!!

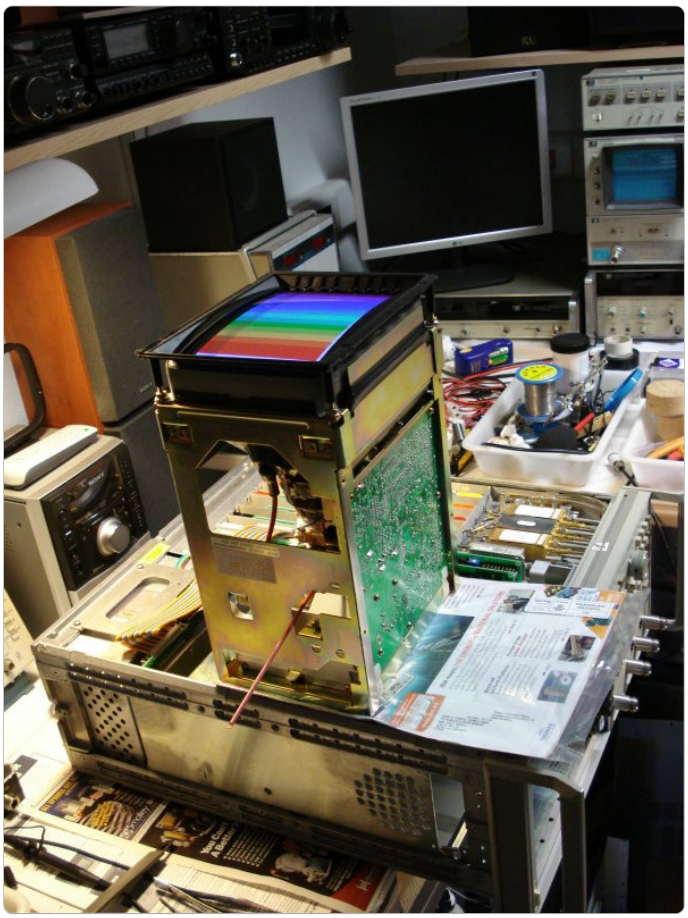
Display color adjustment

I had some info about the colors not being accurate on this unit. But as I had never used an 8753C before, I was not aware that the **Channel 1** should be **yellow** instead of **orange**... so I decided to fix that. These units use a SONY display module, which is a **Sony CHM-7501-00** or, by HP numbers, a **2090-0210**, as you can see on the label:

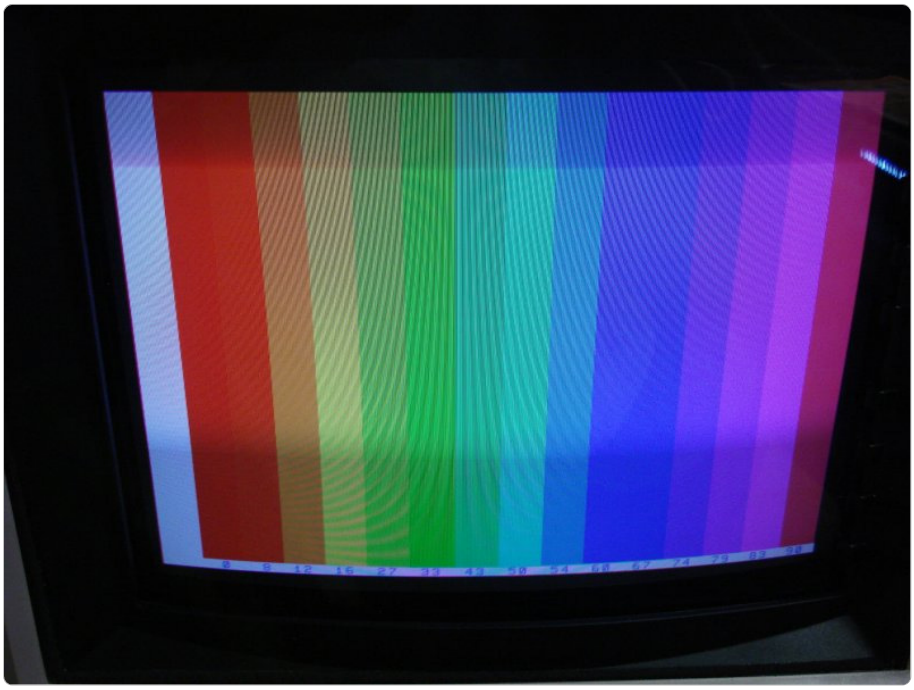
In order to get the proper colors displayed, I got the display module out and looked for the R-G-B gain pots. I marked with a permanent pen the actual position, so I had a reference to come back if I goofed the adjustment too much ;-). Here you have the pots:



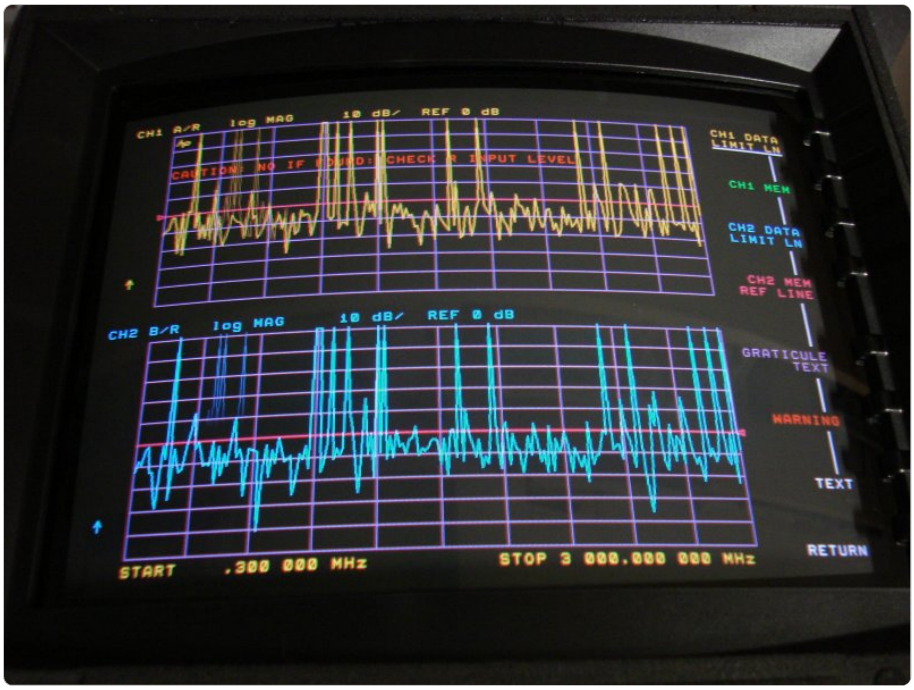
I put the assembly over the analyzer, in vertical position so the control cable could be plugged while adjusting it by means of a long plastic trimming tool:



It was not hard, using the extensive display charts tests, to get the colors more natural, as chart #13 shows:



And now Channel 1 was, as intended by HP, **yellow**!



Next step is to add an external storage unit to the VNA.

More to come soon... keep tuned!

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