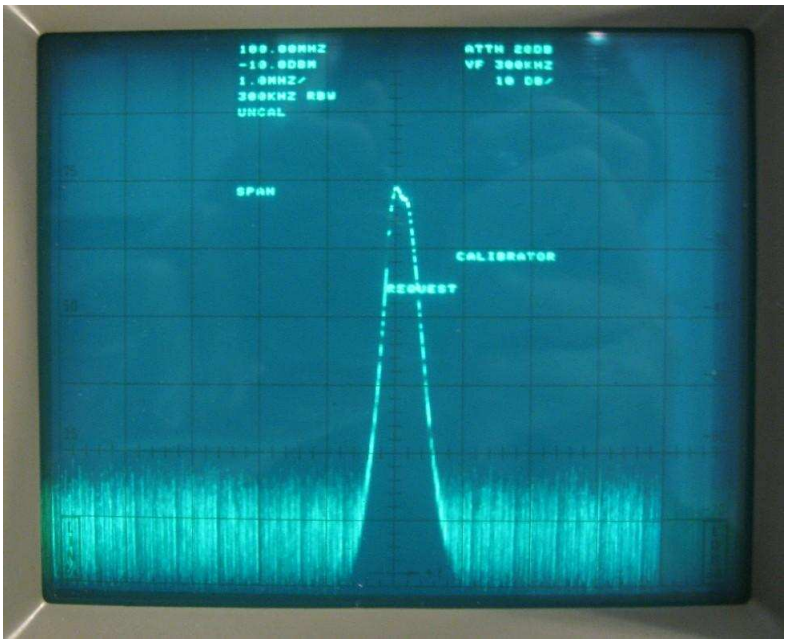
Tek2712 repair

January 2015, Koos Bouwknegt

Since 2009, I have a Tek2712 spectrum analyser, made in 1994 by Tektronix Beaverton.
The analyser was used incidentally the first 15 years without problems.

First repair December 2009

When I got the analyser, the first problem was a gradually shrinking of the display, including the on-screen display (OSD). The display in direct view mode (non storage, button "D" pushed) was normal, so it was not the CRT or HV supply.



The OSD data did shrink to half the normal size in this mixed display. The size reduction fluctuates between 20 and 80% od the normal size.

The problem is in the display storage board A9. This board did not correspond with the 2712 service manual (1992?) but was the A9 board as in the service manual of the Tek2715.

The problem was clear: the reference (VR=5V) which is the only component in common for both the X and Y DAC at the output of the display storage board was too low and fluctuated.

After replacing several components, the culprit was a leaky elco near 0.1uF SMD capacitor (C9) across the reference IC. The fluid caused between 200 ohm and 2k leakage. Troubleshooting was hard without an extenderboard at that time.

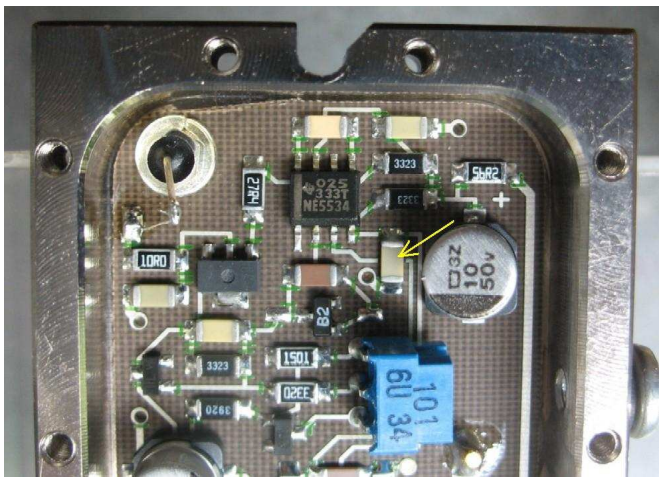
Second repair, september 2011

The second problem was a sudden 25dB decrease of the sensitivity at any frequency. The 100Mhz calibration signal was -56dBm instead of -30dBm. For troubleshooting, I used only the internal 100MHz calibration signal, so I could use the input N connector with rigid coax as testlead to measure signals in the RF modules.
The signal on the input of the LOG board (J160) was also 25 dB too low
The signal on the input of the VR board was 0.03Vpp in stead of 0.5Vpp , so these boards were OK, and the fault is upstream in the boxed RF modules of the analyser.
Further trouble shooting required a second spectrum analyser and I was very lucky to borrow one, an Advantest R3361C.
The attenuator has an auxiliary, unused output. The signal level here was -49dB as expected. The output of the first IF amplifier and filter at 2110MHz was -48.5 dB, 17 dB too low.
So the input mixer was bad, or the local oscillator signal was low.
I crossed my fingers that the mixer was OK, and started to measure the output of the local oscillator, a YIG oscillator plus a buffer stage. The output of the buffer is - 8 dBm , about 21.8dB below the expected value of +13 dBm @ 2210 MHz.
The buffer stage has an unused output (J300) for an external tracking generator (option 15) . This output is directly from the YIG oscillator, and should be +5.9 dBm, which it was, so the YIG oscillator is OK, quite a relief.

Well the input of the LO buffer was correct, and the output was far too low.
So I dismantled about any RF module and opened the LO buffer module. See the picture below. The input of the buffer module is still connected to the YIG oscillator, hanging on the right side outboard. The LO buffer stage is still powered by its flat cable from the Tek2712 mainframe.

The buffer is a single stage GaasFet, with stabilized output power. Stabilisation is done by rectifying the RF output, an opamp compares this with a blue potmeter reference. The opamp drives the drainvoltage of the Gaas FET via a transistor.
Both opamp inputs and the opamp output are at -7V, so the transistor was off, and the FET got no drain voltage, explaining the very low output of the buffer stage. Connecting the drain to +8V via 100 ohm produced the normal +13 dBm RF output, so the FET itself was OK.

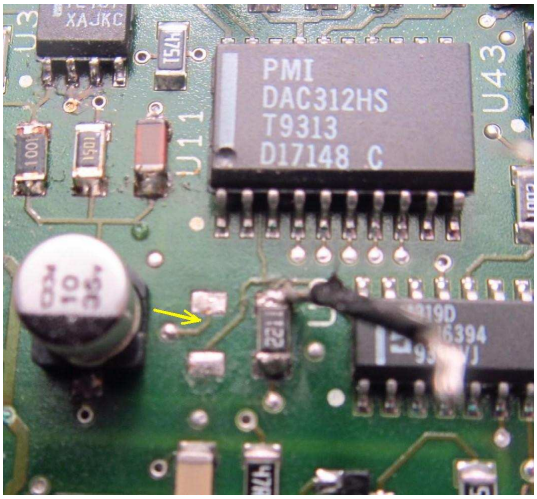
Swapping the opamp had no effect, but it seemed that some external source injected current into the plus input of the opamp.



The culprit was another leaking electrolytic cap, the fluid creeps under the blue pot and the 0.1uF smd capacitor (C 292) (see yellow arrow). This track went to the plus input of the opamp, pulling the + input to -7V, and the – input to -6.6V via a diode.
After cleaning, reassembling and adjusting the LO level to +13 dBm (with the blue pot), everything was OK.
I hope the detector diode is not damaged by the 7V reverse voltage. This type of schottky diodes has a maximum reverse voltage of 4V, but there are no signs even after 2 years, only a higher 0Hz peak.

Third repair, December 2013

The third problem came as a horizontal jiitering of the actual curve. The OSD was normal, yesterday's stored curves were normal, and the direct curve was OK as well. It seemed that the actual curve which should be written in addresses 0 to 512 of the display storage was only written in addresses approx. 100 thru 400.



Clearly, the analog sweep was not converted correctly into digital numbers that address the memory. Conversion is done with a 9 bit up/down counter, driving a current output DAC. Its 0…4mA output current is fed thru a 1.25k resistor and compared with the 0…5V analog sweep sawtooth.
Deviation of more than 50mV give up or down pulses to the counter.

The jitter was rather symmetrical, looking more as a gain error than an offset error. This could be the reference part of the DAC, the value of the 1.25k resistor, or some noise source that made extra up/down pulses to the counter.

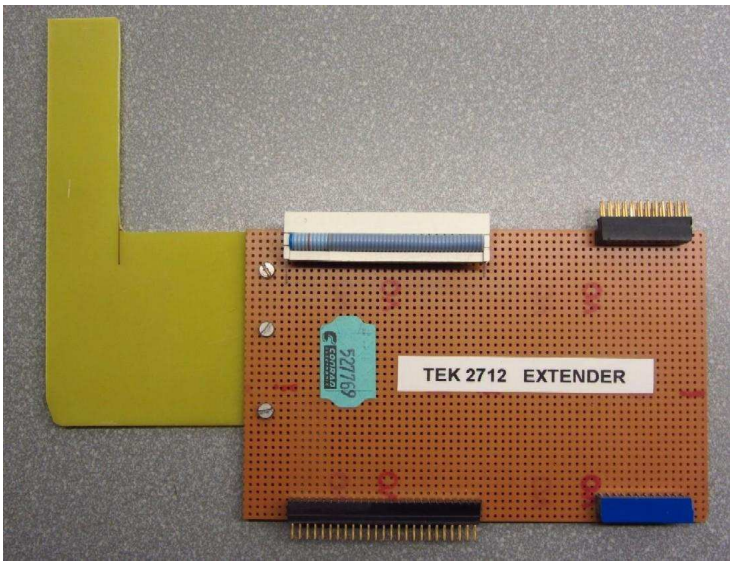
There were no signs of excessive noise on the up/down signals. Remains the 1.25k resistor, made of a 1k smd resistor in series with a 500 ohm potmeter for Horizontal Input Gain (HIG).
After removal of the 1k resistor, a nearly interrupted trace showed up beneath it (yellow arrow) that had 200 ohm to 10kOhm resistance ! The trace was probably corroded away by the nearby leaking electrolytic capacitor (elco). After bypassing this tiny trace, everything was normal.

4th Repair , Sept 2014

The traces jumped up and down, but saved plots and OSD are steady. The culprit on the display storage board this time was the 33uF electrolytic capacitor across the 2V ref input of the ADC, which was open and made the 2Vref buffer circuit to oscillate at 300kHz.

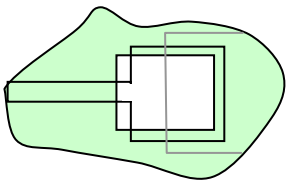
These faults could only be found with an extended display storage board. With connectors and flat cable from the junk box, I made a very useful extender.
The 50-pole flat cable and connectors are quite common, but the 24-pole connectors for the power supply lines is not. I have cut these from long connectors.

After all, repairing a tek2712 could be done for very little money, but finding the trouble took weeks every year.

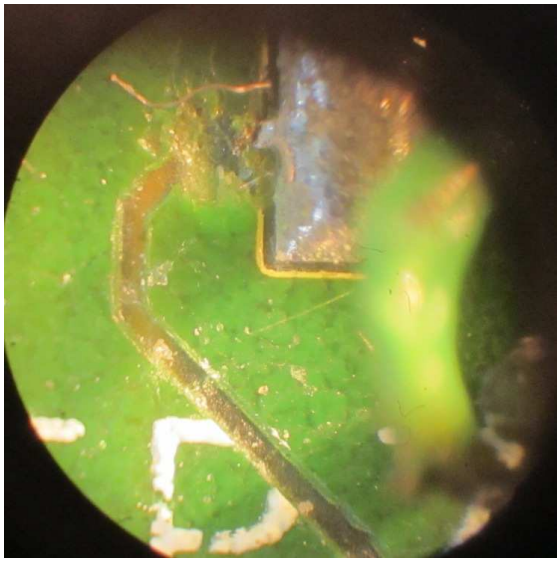


5th repairs, January 2019
After a few years of service vertical problems appeared again. Again, these were located on the display storage board (tek 2715), and related to leaking electrolytic capacitors.
1) No trace visible, OSD and stored traces are OK. The reason was that the opamp preceding the ADC in front of the storage bank got no -11V. One pad of the 47 ohm resistor R8 was no longer connected to the -11A bus.
2) Random vertical jumps of trace and OSD was the second problem. These jumps appeared also on the -VR bus. The culprit was similar: One pad of the 47 ohm resistor R101 was no longer connected to the -11A bus.

The common problem seems to be a tiny misalignment between a solder pad and the solder mask. The mask protects the trace from corroding by acid from a nearby leaky electrolytic capacitor. But the connection of the trace to the solderpad is unprotected, and corroded until full interruption. See the microscope photo .



6th repairs 28 aug 2019
Complete display incl OSD is shifted half screen upwards during the first 10 minutes after turn-on. And sometimes the 100MHz cal signal is -55dBm in stead of -30 dBm. Also the 10MHz signal at the input of the VR board is 25dB too low (1mV in stead of 60mV peak-peak)



7th repair 21 october 2019 Several open traces around C12 on the display storage board.
Repaired, and C12 exchanged by a tantalium cap.

8th repair 5 februari 2020 The 2 elco's on the YIF buffer module replaced by tantalium C's. This brought the 100MHz calibration back to -30dBm.