Troubleshooting an HP 54503A oscilloscope.

The convenience store down ... Here is my favorite oscilloscope does not work (November 2010) after a few months without use!

Symptoms: Lights but still not access any menu or any normal image, just displays an error message. Sometimes the internal buzzer sounds when the ignition.

My first fear in finding the fault was that the EPROM are defective, because these components may lose their contents after 15 to 20 years. And this unit has a certain age. Fortunately, after removing the cover, I mean the power to make funny noises (tchik-tchik-tchik. ..)!

"This should be repaired without too much trouble"-I thought ... If I had known!

Click on the photos to see a larger version in another window ...

Once the top cover removed, complex electronics are discovered. The power supply is in the air flow of the fan, which is its place. Against the left wall is the control and power of the CRT, and the bottom of the deck housing management occupies the entire space.

We distinguish better inside the device once removed the power supply ...

View from above: the main board is visible. On the left, all the microprocessor and its peripheral part (memory, I / O, ...). On the right of the input attenuators and A / D converters D This unit has 4 channels 500MHz.

A view of the microprocessor: it is 68000. Logical choice for the time when this device was

designed in the late 80s. User data is stored in non-volatile RAM Dallas Semiconductor: these horrors circuits comprising a molded into the battery case! 20 years later, they became obviously bad!

The power extracted from the inner cabinet. I thought the simple troubleshooting, but ... This card (built by Boschert) is particularly complex! It is indeed a switching power supply but also with conventional regulations ... In addition, the technical control of the power transistor does not appear in the first glance: we do not find here the classic circuits. Ouch!

The failure is a "pumping" power starts and stops, then resumes ... Generally there is a short circuit in one of the side (diode, capacitor) or a failure of the protection circuit or the PWM oscillator. Not always easy to diagnose in these supplies because everything is connected: in case of trouble on the secondary, it has an impact on the primary and vice versa.

Visual Tour: This step is necessary to identify the different parts and understand the operation of this power.

It seems impossible to find patterns that gear on the internet, this company seems to not even exist anymore. After some initial research failures "classic", we must look further! And the complexity without drawing it will be difficult ... We'll have to reverse-engineer!

For primary side. We distinguish very well (two blue and two capacitors pricipalement self shaped small transformer) line filter, rectifier and two filter capacitors (560µF). The power transistor is a TIPL755 mounted on heatsink. The other components are mounted nearby. There is a TIP41, a 2N2222 and 2N2647 unijunction. Not easy to understand how at first glance ...

For secondary side. Not bad capacitors, large cooled chokes and diodes: this gives more power voltages for different parts of the device. But it is also, curiously, classic LM350 regulators and MOS transistors on a heatsink. Only the statement of the scheme will help to understand ...

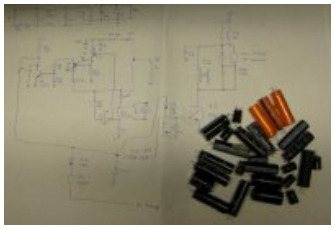
The platinum tension control. A LM339 (Integrated Circuit tabs 14) provides a voltage comparator, a LM317 (TO220 right casing) gives the reference voltage for the comparators. A circuit "crowbar" thyristor (TO220 left box) bypasses one of the outputs in the event of voltage overshoot, so as not to "kill" uses when power failure.

View output connectors and pads tests. I added a red LED on the 12V output to see the operation. The output voltages are numerous: 5.15 V digital, analog 3.5 V, -5.2 V analog, analog +12 V,-12V analog, display 12 V, 15.5 V fan. All masses (0 volt) are common. There are also a lot of pots everywhere.

First steps in the troubleshooting (November 2010): static testing of all power semiconductors, circuit off "crowbar" (to see if it is not he who causes the pump) ... Some side decoupling capacitors and replaced ...

Reading scheme. It is indeed a power supply, but some outputs (12, -12 particular) are stabilized by conventional regulators. Capacitors are very generously sized.

It is testing the power supply through a variac and slowly increasing voltage AC power I see this: it starts and is stable around 150V AC, 180V up about. Between 180 and 230, it starts to wobble! My research then focuses on the primary side, and I discovered a small ceramic capacitor 100nF defective! The 470µF this side was bad too.



For safety reasons, I decided to replace all electrolytic capacitors, some with a little cast.

Here are all the capacitors replaced on my notepaper ... You can now download my notes from reading the pattern of this power is available: see end of this page.

But despite the breakdown of food, the machine will not start more than before, and even worse, now there is at all an error message! And yet, all the supply voltages are present, stable and well ...

The fight was not finished yet! Then I received an interesting former engineer at HP information. If starting the diet is not correct (offset appearance of different voltages), the motherboard can not work at all. This gentleman sent me for test, complete nutrition and tested! You can find visit his eBay store: "watronics92."

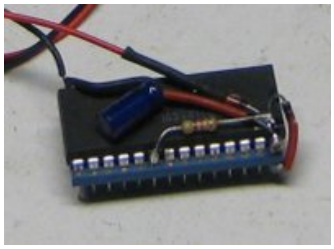
Restart with food tested ... And still the same problem, no start! That's when I decided to check the signals to pins 68000. All data lines and address are fixed, while power supplies, clock and other signals are OK. Bizarre! Checking the power of the 4 circuits EPROM, it happens "something". A reboot, and ... It works again! I probably made a move EPROM into the socket while working in the scope.

I also know now that the repair of my food is OK and restart the absence is not due to my troubleshooting. Phew!

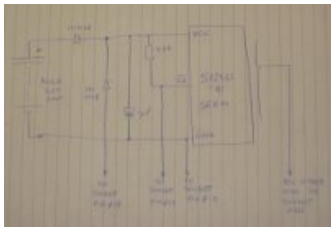
Now the total. The device can work again, so it's time to make it a good maintenance. And to start, replace the NVRAM (with integrated battery). In fact, it no longer remembers nothing, and the calibration is lost after each cut. To do this, extract the large motherboard ... In this photo, the NVRAM is already de-soldered and replaced with a 28 pin socket. (Sorry for the blurry photo ...)

The system NVRAM Dallas Semiconductor kind DS1235YW, widely used by HP in this series oscilloscopes. Date code 8912 (12th week of 1989), the internal battery will still be held up well! This tour is no longer available and is replaced by the reference DS1230Y.

To work on such a circuit, anti-static precautions are in order: ground of the plate and the soldering iron, bracelet, ...



With no new Dallas NVRAM on hand, I built one with my stock components to test. RAM 51256L is pin compatible with the DS1235Y. Do up a few components, and a 3.6V battery. Diagram below ...



The pattern of my editing. The diodes provide a logical "or" between the voltage supply or battery. 47k resistor maintains EC pin high when the power is off, so the RAM consumes almost nothing about the backup battery. But here, in this tilt, "something" keeps this pin to low level when the power is off. Too bad, I will give an NVRAM! But this allowed me to test the storage of the calibration, and it works!

31 March 2011: Continuation and end! Here it is repaired! After restoring power and replacing the Dallas memory backup EPROM and recalibration. It took time, but I am very happy to have saved. This saves money (by avoiding the purchase of another), and it is ultimately a good

experience!

At the end of the calibration, the messages are reassuring: everything is ok! That this good device for the service again.

Documents:

My reading of the scheme "Boschert" food (also valid for HP54051A, HP54502A, HP54503A, Hp54504A) is available HERE (PDF file 480ko).

NOTE (not present in the drawings): the voltage Vref must be adjusted with R41 to 2.75V (Exit A1, the LM317).

Copying 4 27C101 EPROM can be downloaded HERE (ZIP 280ko containing four binary file).

Back repairs

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