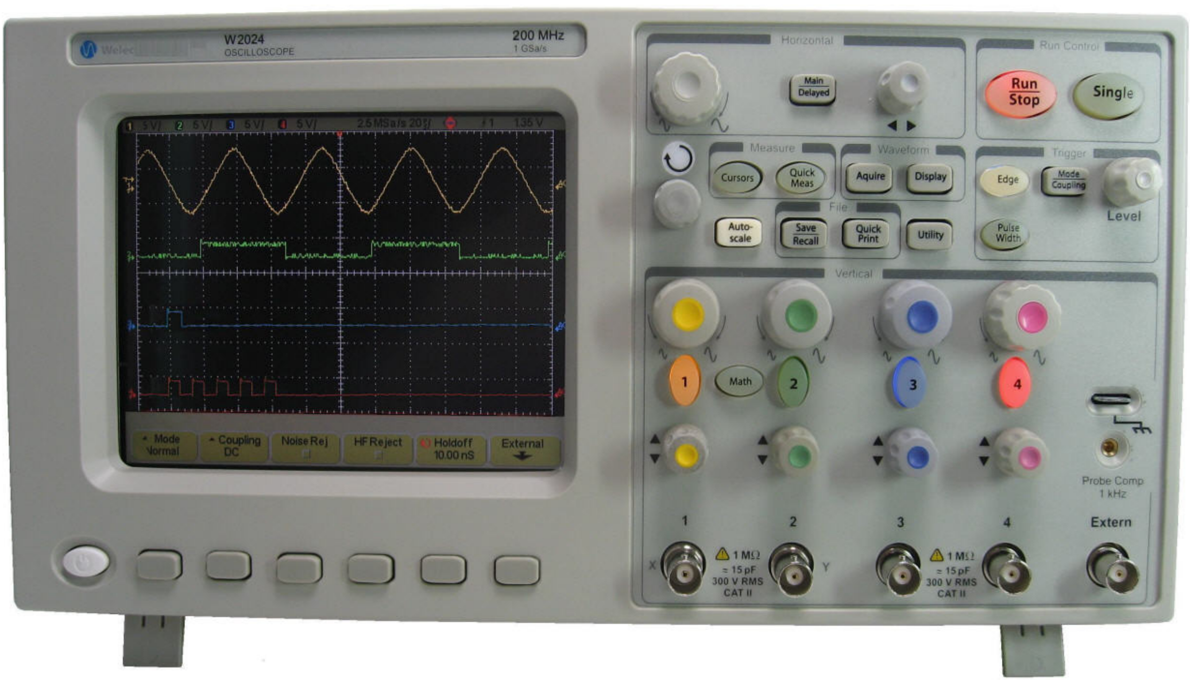
W2000A

External Trigger Mod



22.11.2014
BlueFlash

Table of contents

Introduction

The external trigger input of the W2000A models was always one of the trouble spots. Improved drivers in the open source firmware did not solve the problem.

The main cause of the malfunction is the false dimensioning of the external synchronisation circuit. But the good news is that we can improve it by only changing a few cheap components. This document is a summary of the posts in the hardware thread of the technician forum www.mikrocontroller.net made in January 2012. First improvements by Jürgen, final solution developed by Jörg.

The Problems in Detail

The Input Stage

Right behind the protection of the input stage is an OPA656 working as an impedance converter. In some devices this component is not what it seems to be. In the 100MHz version (W2012A/W2014A) and also in some 200MHz devices this OPA is a faked component with limited bandwidth (< 100MHz). It can be identified by a green point on the case. This part should be exchanged by an original OPA656 to enable the triggering of high frequency signals.

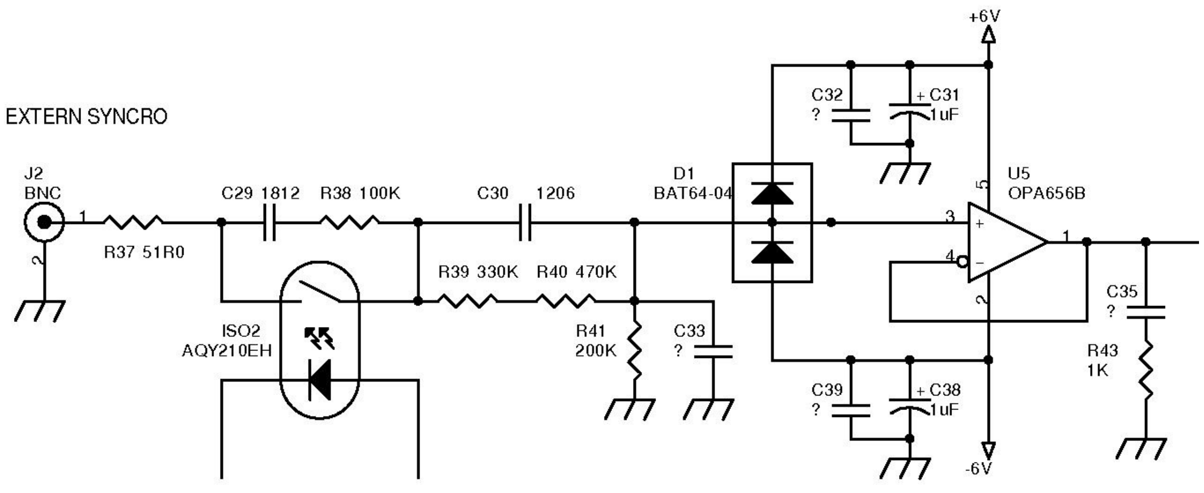


Fig 1: Input stage with OPA656

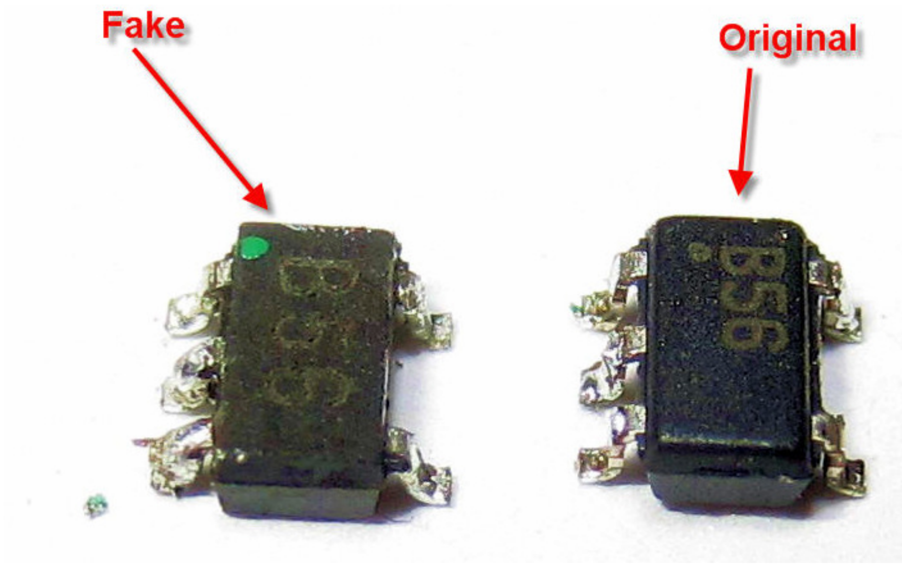


Fig 2: Fake and original OPA656

The Main Trigger Circuit

The core of the circuit is the comparator LMV7219M (marked C15, component U6). One of the inputs [pin 3] is connected to the input stage (output of OPA656). The other input [pin 4] is fed with a controlled DC voltage which is generated by the FPGA with a PWM signal.

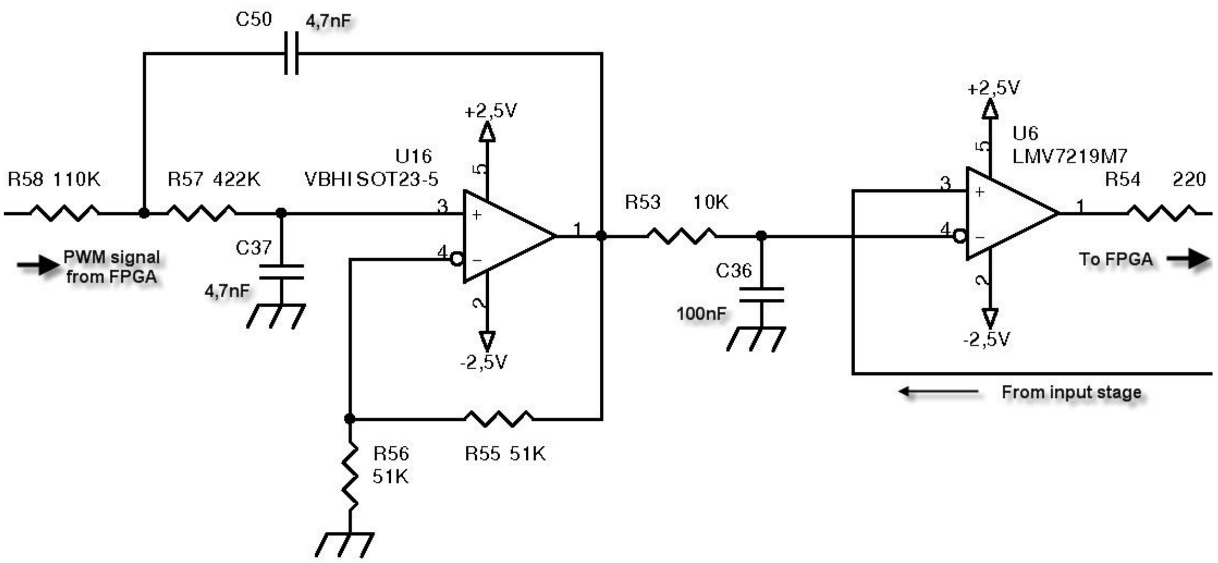


Fig 3: Lowpass filter and comparator U6

The circuit around U16 is a lowpass filter for the PWM signal demodulation. Measurements at this circuit have shown that the PWM signal has a bad ripple voltage which leads to a jitter at the comparator and in worst case to a completely wrong comparator output.

So what we can do is to change the lowpass filter dimensioning to suppress the ripple voltage. With the help of a simulation program following new values have been figured out:

- C50 → 100nF
- C37 → 100nF
- C36 → 2,2µF

The result is an attenuation of -104dB (original -25dB) which leads to a clean signal at the comparator input (measurements, simulation and values by Jörg).

The Line Trigger

Synchronization with the frequency of the power grid is often needed for measurements in power supplies or other AC driven circuits. Unfortunately the line trigger of our W2000A scope isn't working at all.

The reason is the voltage which is branched from the power supply. The level of this voltage is reduced so much by voltage dividers that the comparator is not able to recognize the amplitude of the sinus signal. What we have to do is to change the voltage dividing.

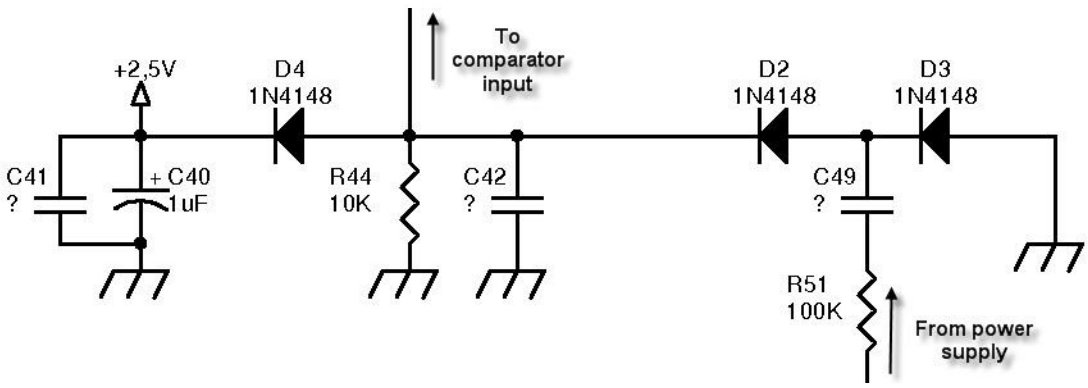


Fig 4: Line trigger voltage divider

New values for the voltage divider:

- R44 → 100KΩ (exchange with R51)
- R51 → 10KΩ (exchange with R44)
- D2 → bypass with wire

This correction leads to a signal with higher voltage level which can certainly be detected by the comparator.

Disassembling the DSO

Opening the backside is very easy. There are three screws that have to be removed. A little bit more difficult is the removing of the knobs on the front side. Pulling hardly may destroy the rotary encoder. Better is to lever off the knob with a small screwdriver.

The shaft of the rotary encoder has a flattened part which can be seen in the small gap between knob and front panel.

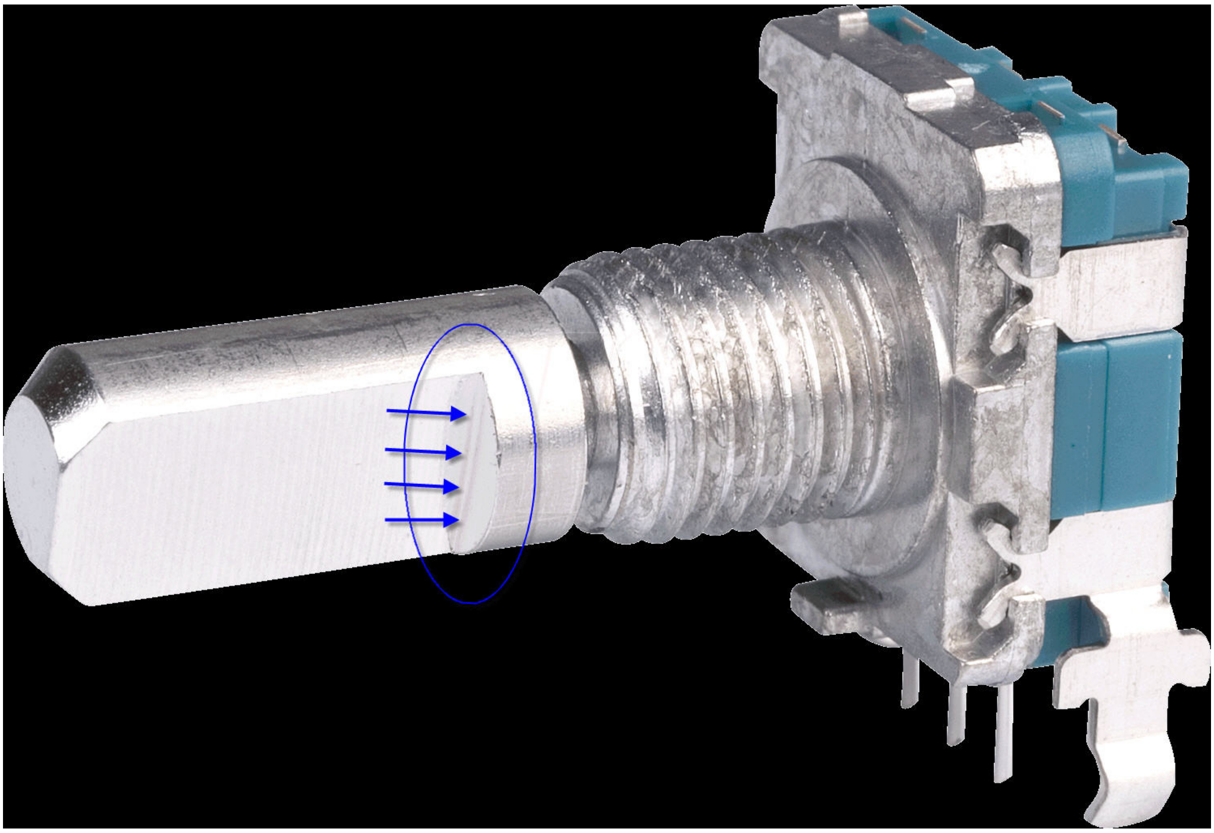


Fig 5: Shaft of the rotary encoder

Turn the flattened part up and insert the screwdriver into the gap. Now we can lever the knob off, using the edge of the flattened part (fig 2 and fig 3).

Fig 6: Lever off the knob

1. Remove power supply unit (4 screws). Pull off the two plugs coming from the display
2. Pull off the main display plug from the mainboard and unloose the screw which holds the mainboard. Also unloose the screwing of the BNC connectors. The mainboard now can be levered up with a little screwdriver against the metal frame at the same position as the little screw has been.

What do we need?

- Soldering iron with fine tip (a regulated station is recommended)
- Soldering paste (like CR44)
- Magnifying glass or microscope
- Pincette

Bill of Material

Part Number	**Value**	**Form factor**
C50	100nF	SMD 0603
C37	100nF (replace with C36)	SMD 0603
C36	2,2µF	SMD 0603
R44/R51	Exchange against each other	SMD 0603
D2	Piece of wire for bridging	
OPA656 (if needed)	NB	SOT23-5

The OPA656 can be ordered for about 6€. If your device is a 100MHz version it may be a good idea to upgrade your DSO to 200MHz or more in the same flow of work. For further informations read the documents W2000A Low Budget Mod and W2000A OPA653 Mod.

The other components can be desoldered from old PC boards or something like that if you don't want to buy them.

Modification

The trigger input stage with OPA656 and the main trigger circuit can be found on the backside of the mainboard beside the USB connector. The parts are reachable without disassembling the mainboard directly after removing the backside of the case.

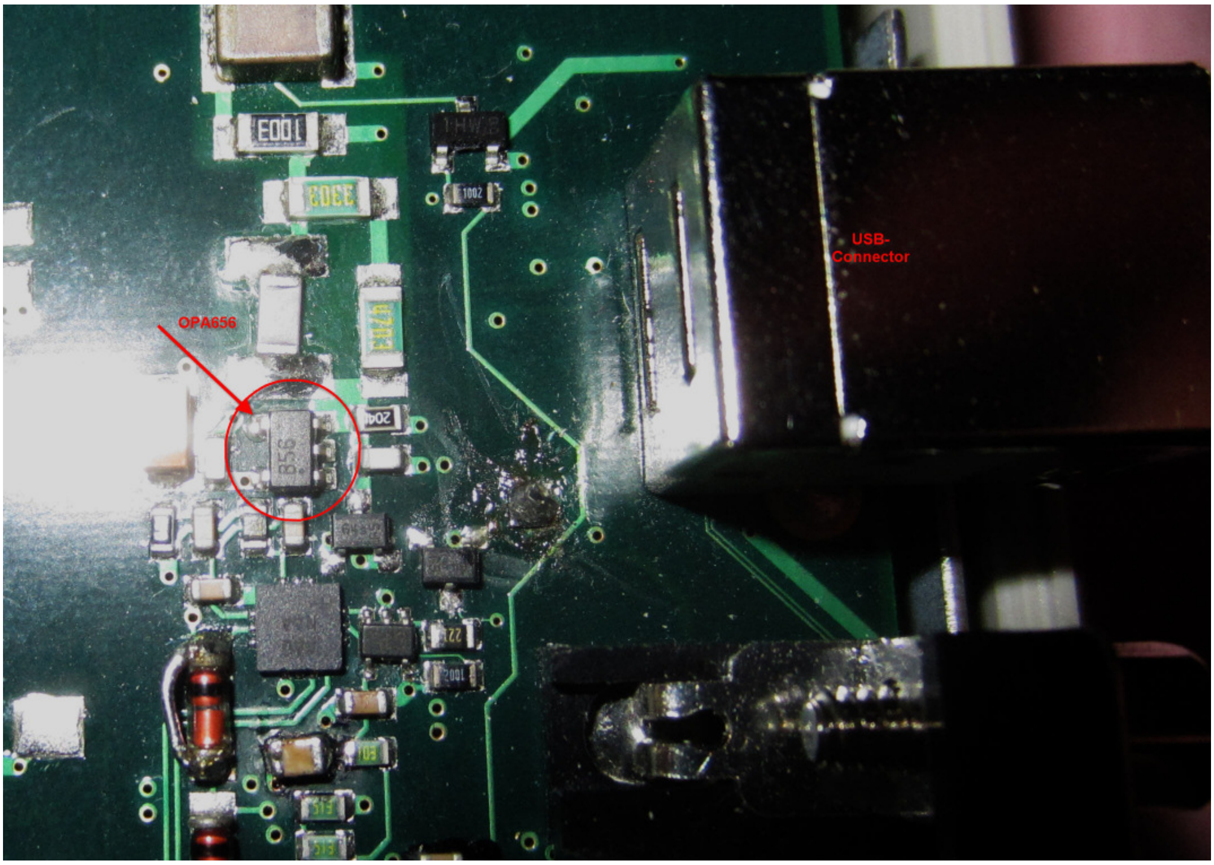
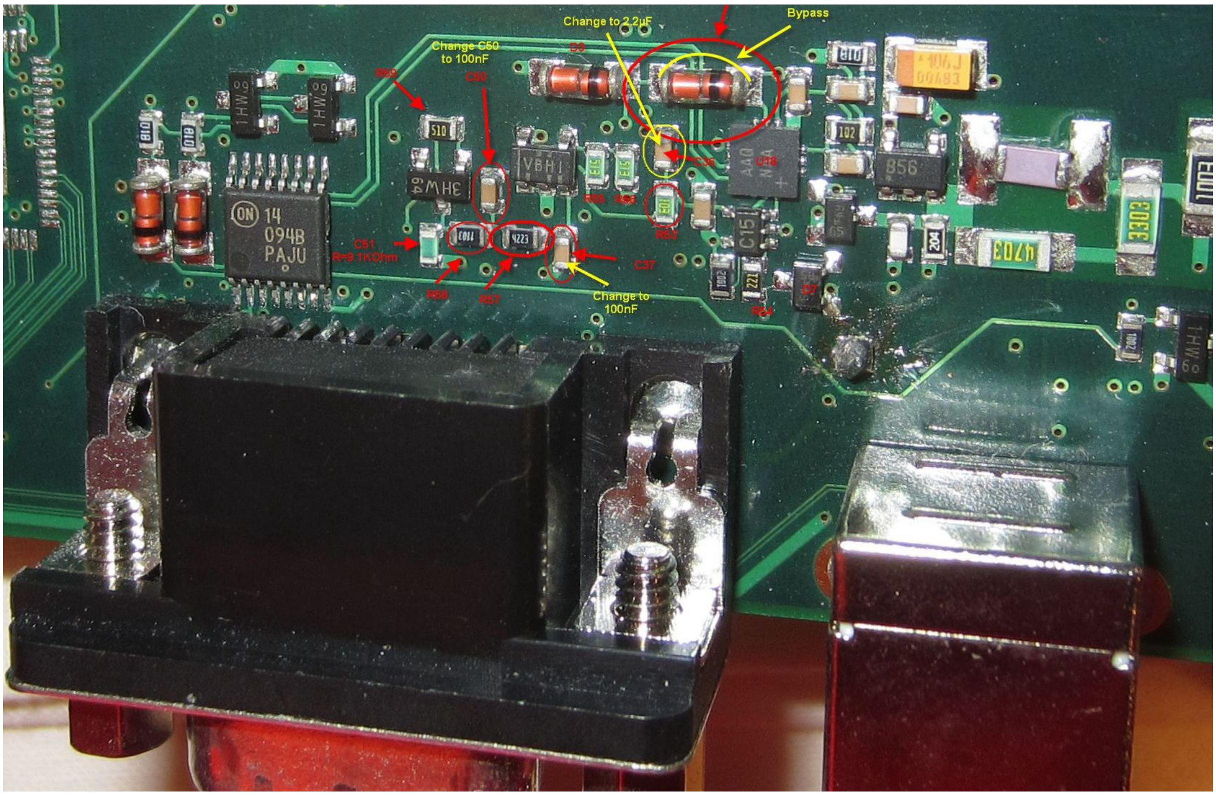


Fig 7: Input stage with original OPA656 (B56)

If the OPA656 is a fake version replace it against an original part for a better selectivity of the input stage. The MELF diode which can be seen a bit below the OPA656 is D2 with a piece of wire soldered from pad to pad.



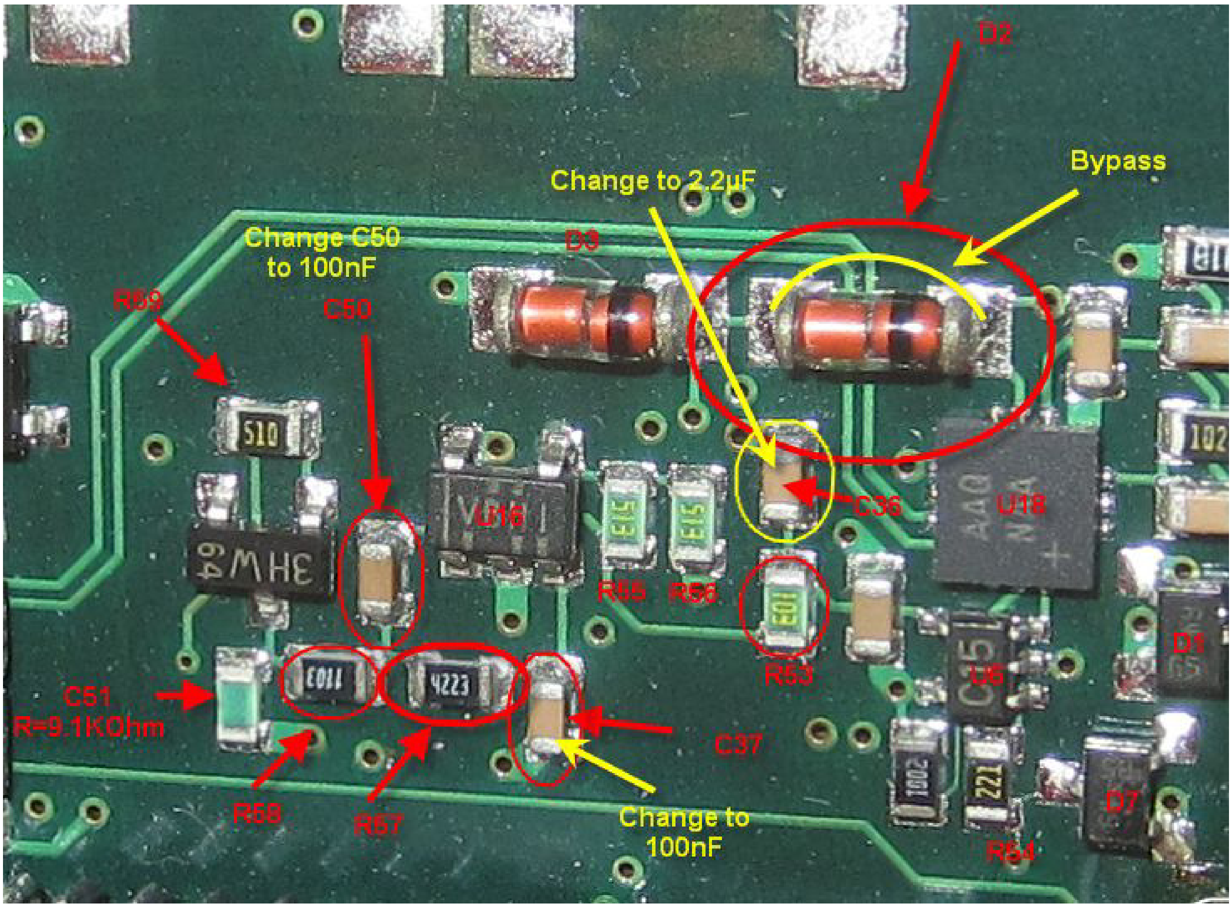


Fig 8+9: Main trigger circuit

The line trigger can be found on the front side of the mainboard which is reachable after disassembling.

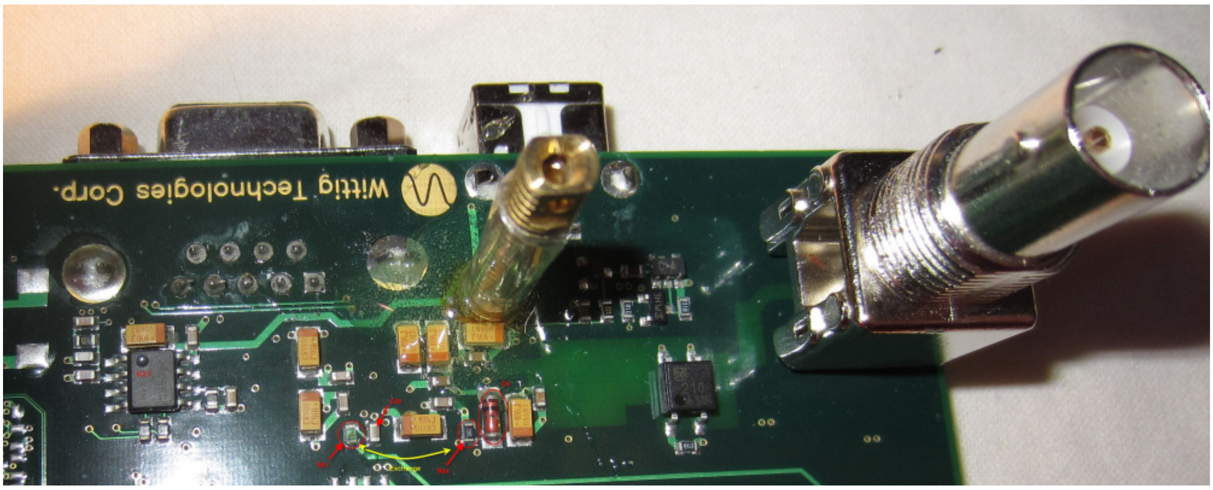


Fig 10: Mainboard front side and external trigger BNC connector

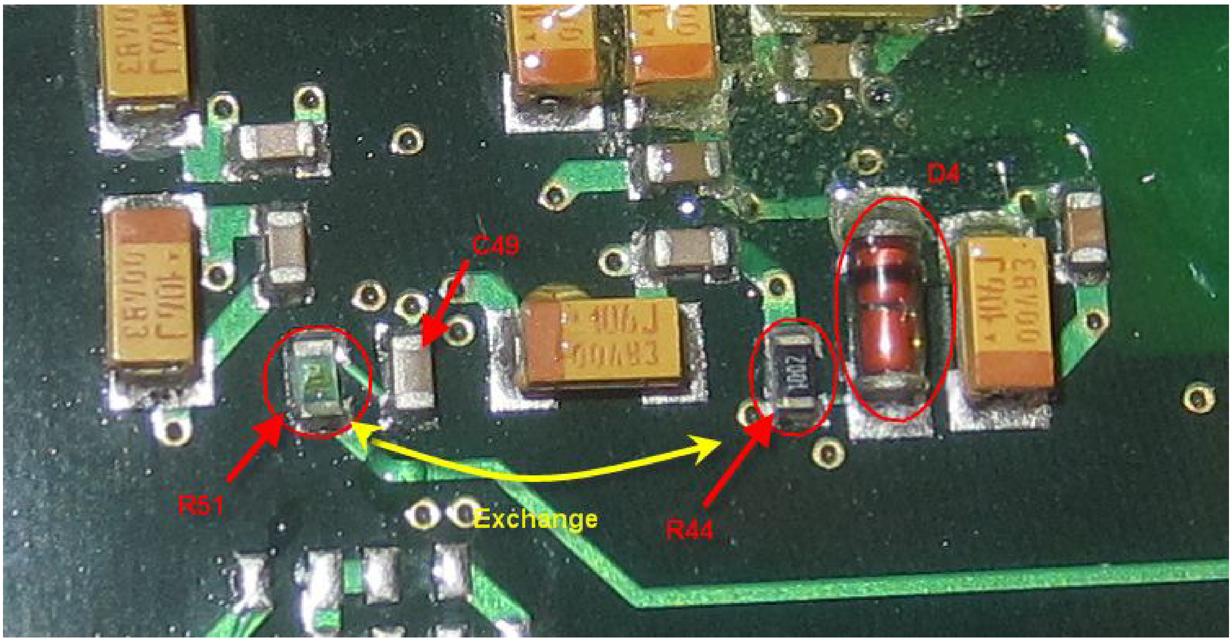
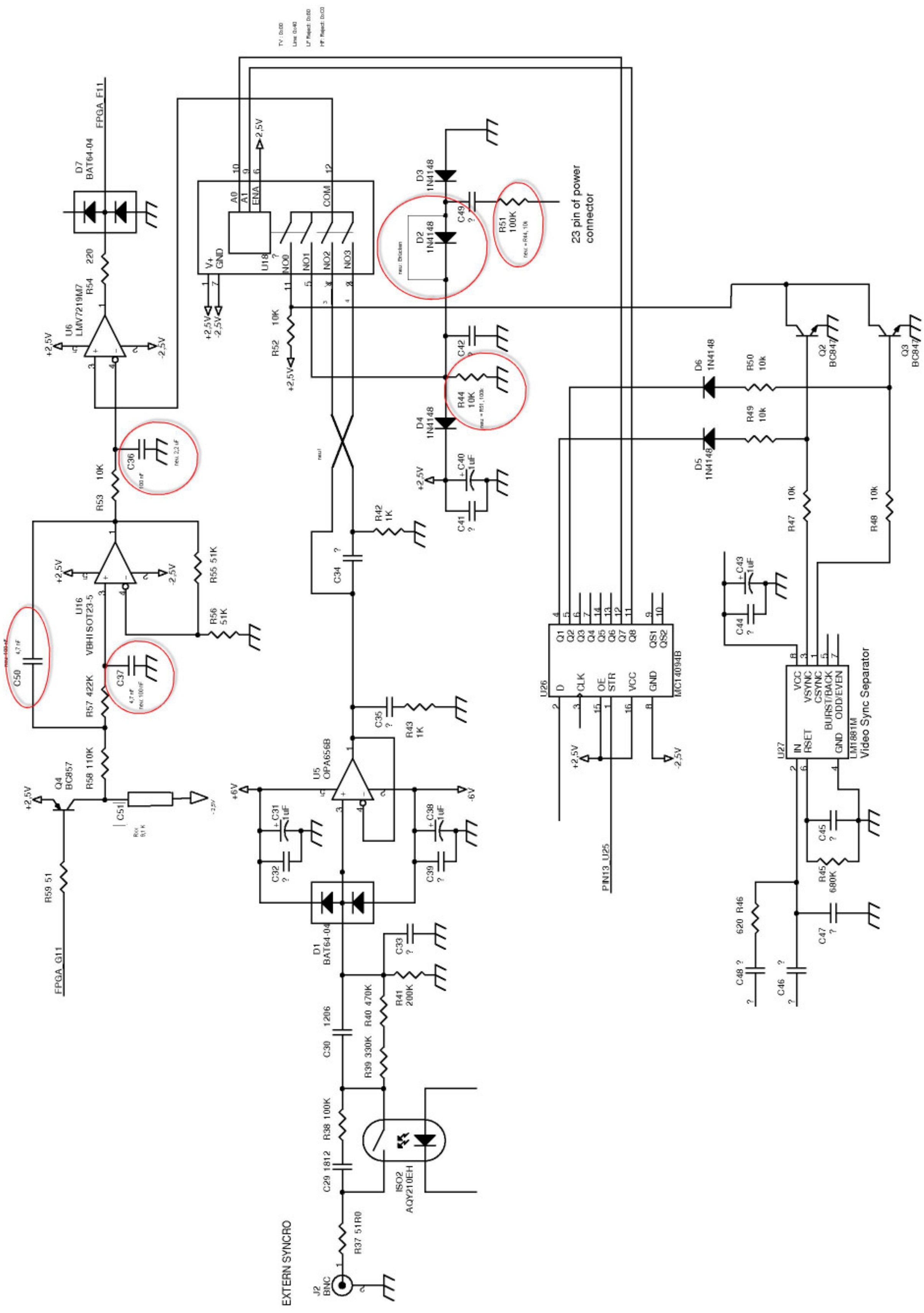


Fig 11: Line trigger voltage divider

Appendix


23 pin of power connector
EXTERN SYNCRO
PIN13_U25
MC14094B
LM1881M
Video Sync Separator