11 November 2018 - Maintenance Bulletin - PCBA 5010-4 Battery Analyzer

Applies to units purchased prior to September 2018 - Hardware Versions 1, 2, 3

Part 1 - The Repair – Pages 1-3 – Please follow carefully and implement on all units purchased prior to September 2018.

Part 2 - Description of Problem – Pages 4-6 – For Your Interest - With before and after oscilloscope captures.

Part 1 - The Repair - Charge Pump Voltage Spike:

A small capacitor needs to be added between the +38V auxiliary and the +50V supply to suppress a voltage spike that occurs upon initiation of service due to an unforeseen problem since 2008. Luckily both contact points are easy to access from the back side of the bus PCB as shown in figure 1.

A capacitor with voltage rating of **16V or higher** and a value of **3.3uF to as high as 47uf** will work fine. The capacitor I had on hand for this example was an electrolytic 18uf, 63V, 105 degrees Celsius rating but a standard 85 degree Celsius rated cap would be ok. (A non-polarized ceramic type capacitor with voltage and capacitance ratings in the above range would also work fine)

Step 1 - Unplug and disconnect all cables from the analyzer and let stand for minimum 30 minutes to allow all the supply voltages within the analyzer to dissipate. Remove cover.

Step 2 – Using a small knife, scrape the green solder mask off a small spot on the bus PCB and tin with a spot of solder as shown in Figure 1. Use a rosin type solder flux or similar to ensure a clean contact and wetting.

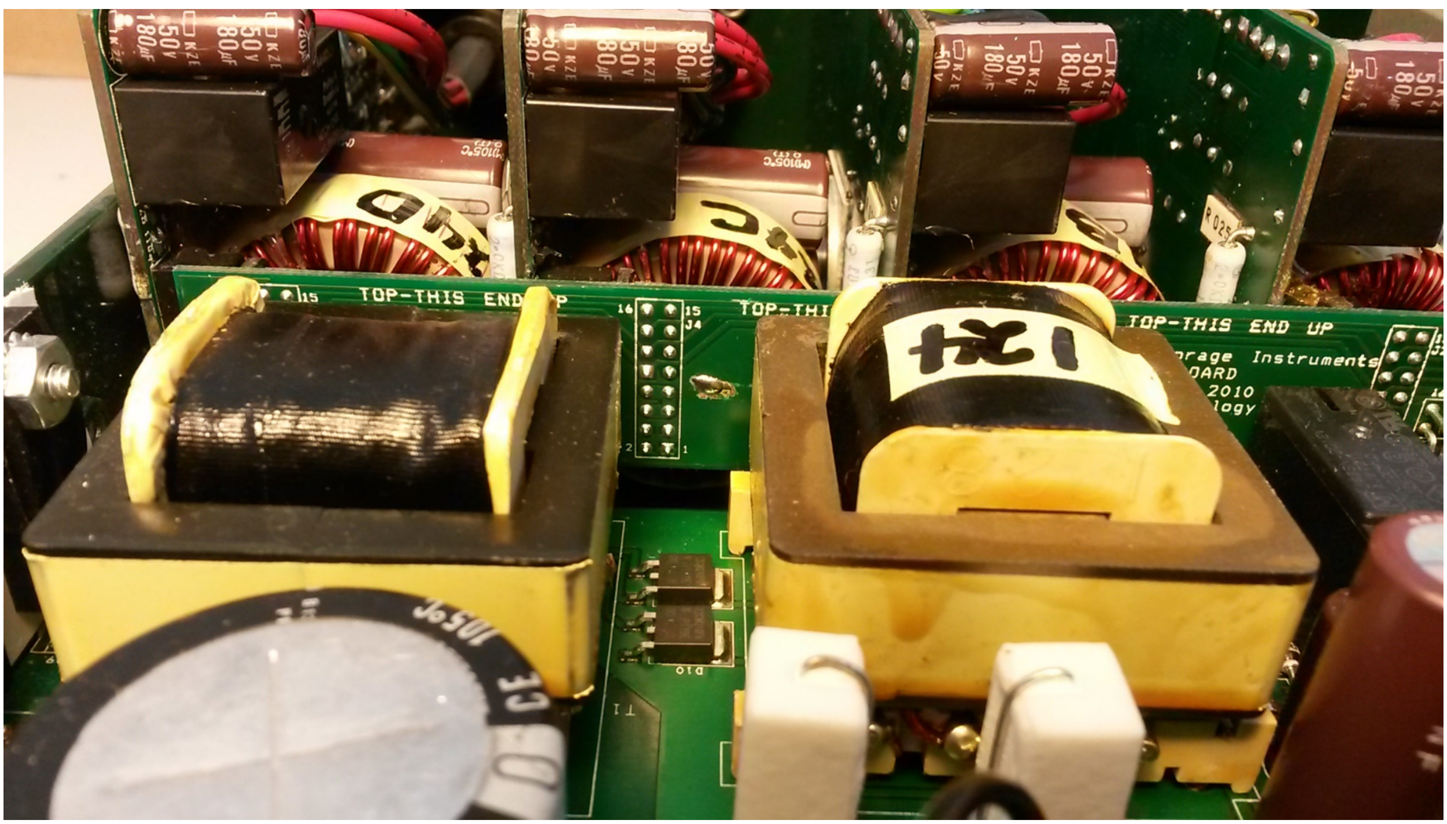

Figure 1.

Figure 2.

Step 3 - Prepare a capacitor to be added by cutting and bending the leads as shown in Figure 2. Cut the leads approximately 1.5cm in length and **bend the positive lead** with a 2-3mm foot, then trim the straight negative lead to match it in length.

An electrolytic capacitor value in the range of **3.3uf to 47uf** is fine, rated **16V or higher** will do the job.

Step 4 – Solder the **bent positive lead** of the capacitor to the +50V bus as shown in Figure 3. (The whole large surface area of the PCB copper on this side of the board is the +50V supply bus) Use flux when soldering and clean with small cotton swap (Q-Tip) and acetone when done. Bend the newly soldered lead to position the unsoldered negative lead so that it is adjacent to the third pin down from the top on the left side as shown in Figure 3. This pin is the +38V auxiliary supply.

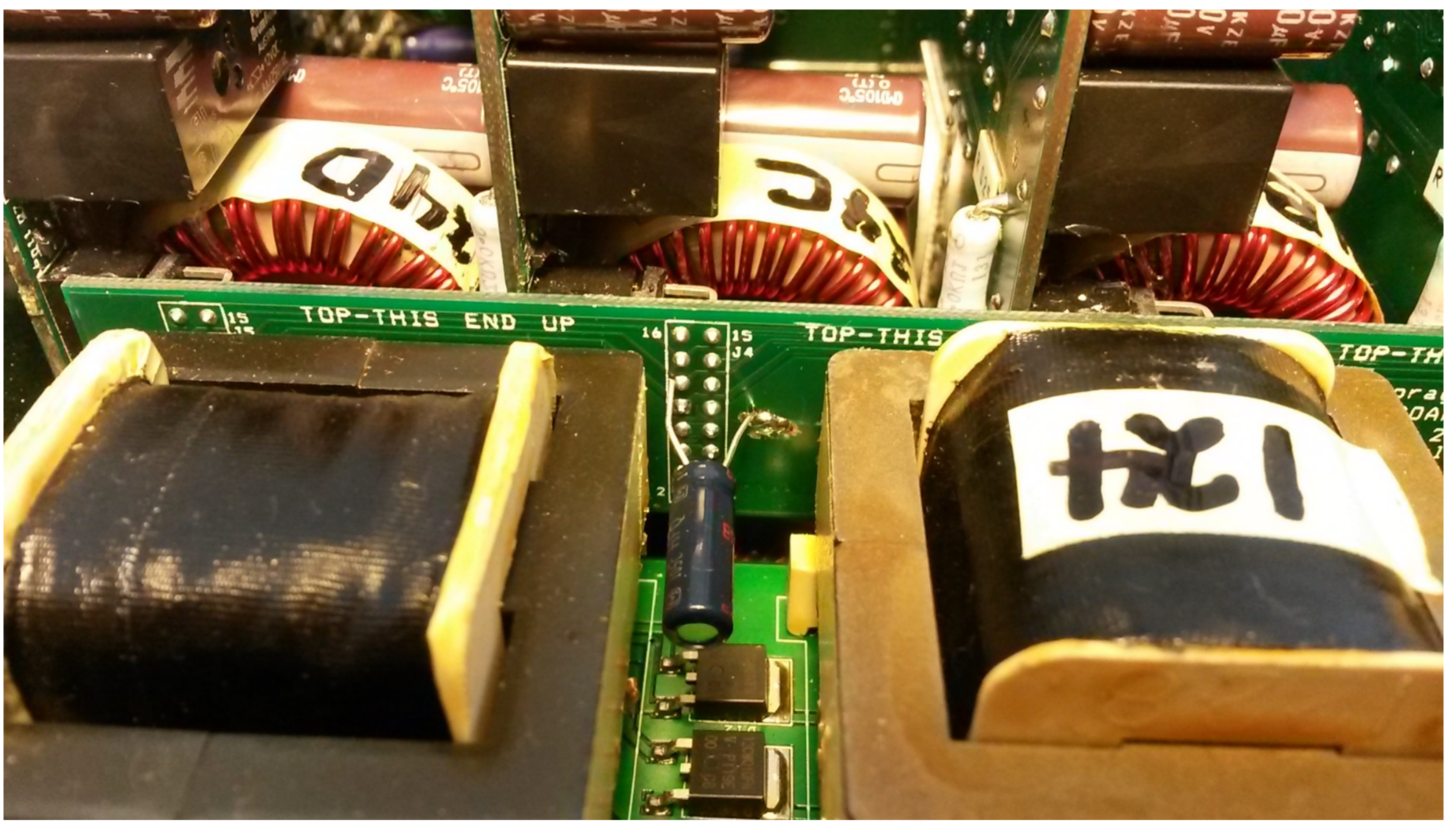

Figure 3.

Step 5 – Use flux and solder to tin the negative lead and solder it to the 3rd pin down on the left side of the bus PCB. (Pin 12) Be careful not to short to other pins nearby with the soldering iron or solder.

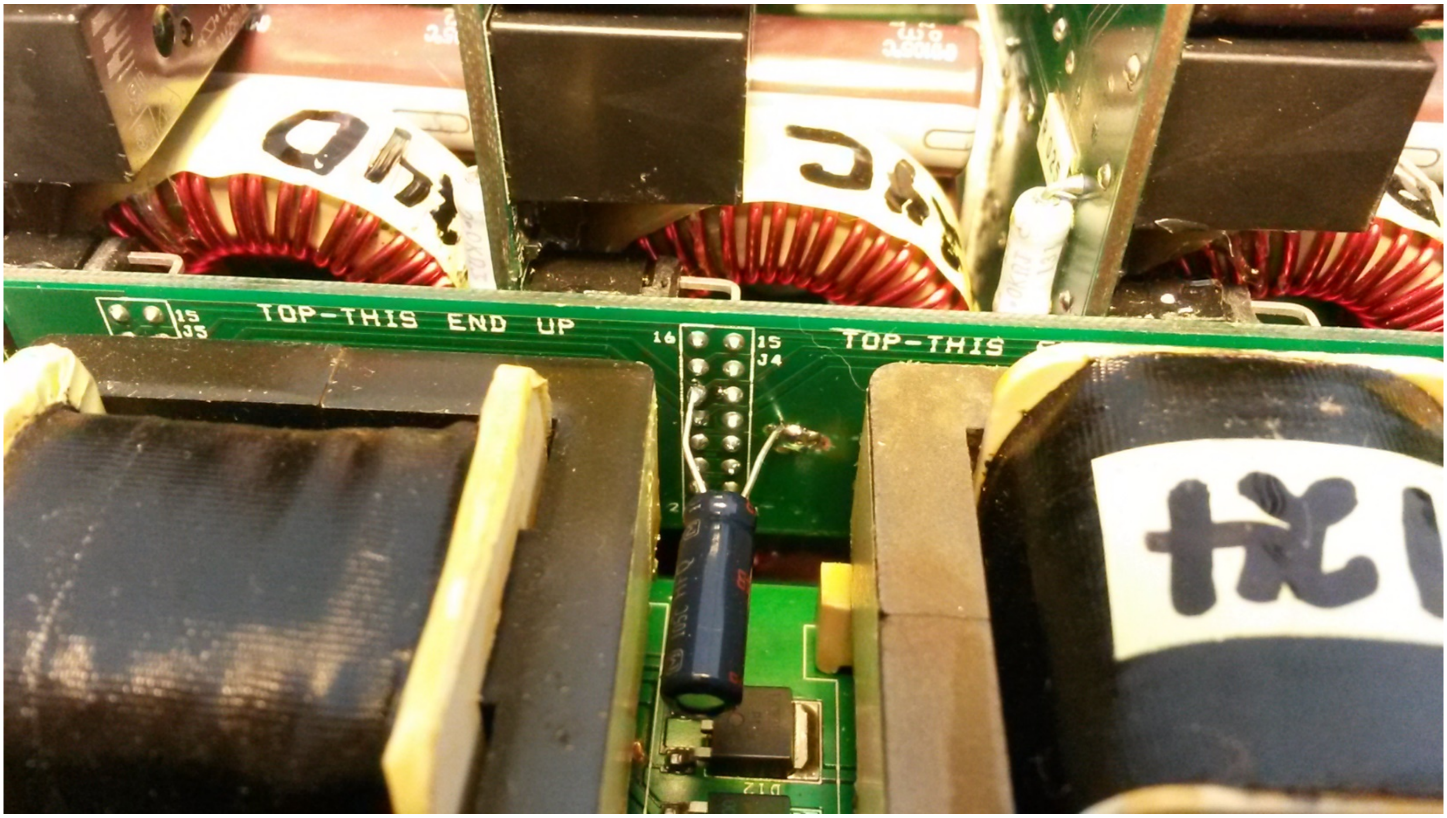

Figure 4.

Step 6 - Clean with acetone and small cotton swap (Q-Tip) and inspect that both sides are well soldered and connections are sturdy and nothing is shorted or bridged with solder by accident. That’s it! Replace the cover and use as normal.

Part 2 - Description of Problem:

On any given channel, the reverse bias leakage current of D12A and D12B (25-75nA) creates a voltage divider at NODE A causing C33 to charge up to approximately 25 Volts over a 5-15 minute period such that sometime later, upon pressing of the START button to initiate service, PFET Q12 SUM55P06 turns on driving NODE B to rise from zero to 50V in-turn generating a 75V spike into NODE C of the +53V auxiliary which then divides by the capacitance ratio of C31 and C35 resulting in a 4-5V spike at NODE D on the +38V auxiliary at C35. With C35 being only 0.1uF x 4 channels = 0.4uF total, it is too small to absorb the current spike without a spike in voltage on the +38V bus which in turn acts like a false ON signal to all the other PFETS of the other channels as the +38V auxiliary is a common connection in the system bus. So the initial spike of one channel can then trigger the other channels to also turn on which creates a cascading effect of voltage spikes at the same time all adding together causing the total spike voltage to reach as high as 10V as seen on the scope captures included on next page.

The problem arises if by chance another channel is already in service and running with its lower NFET ON at the time of the voltage spike into the +38V auxiliary that causes the PFET to also turn ON at the same time. This is when the channel can blow when both the NFET and PFET are ON at the same time as it creates a short circuit across the +50V main supply. A deadly situation that need only happen once and the channel will blow, short circuit, making the whole analyzer thereafter inoperable.

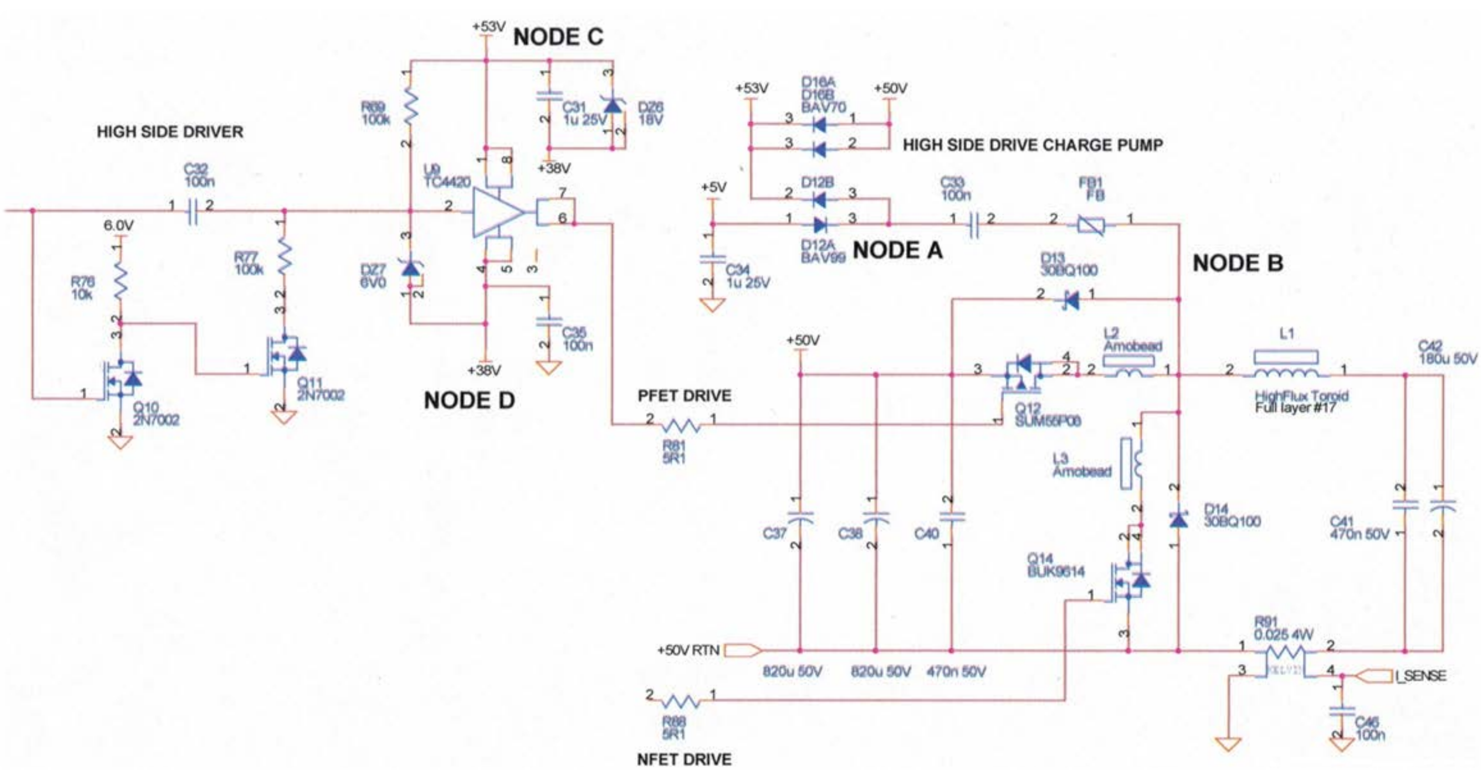

Figure 5. – Channel schematic of high side driver, charge pump and power section.

Figures 6,7,8,9 below:

Figure 6 shows the scope connections, Figure 7 shows the voltage spike on the +38V auxiliary **prior to repair.**

Figure 8 shows the scope connections, Figure 9 shows the voltage spike on the +38V auxiliary **after the repair.**

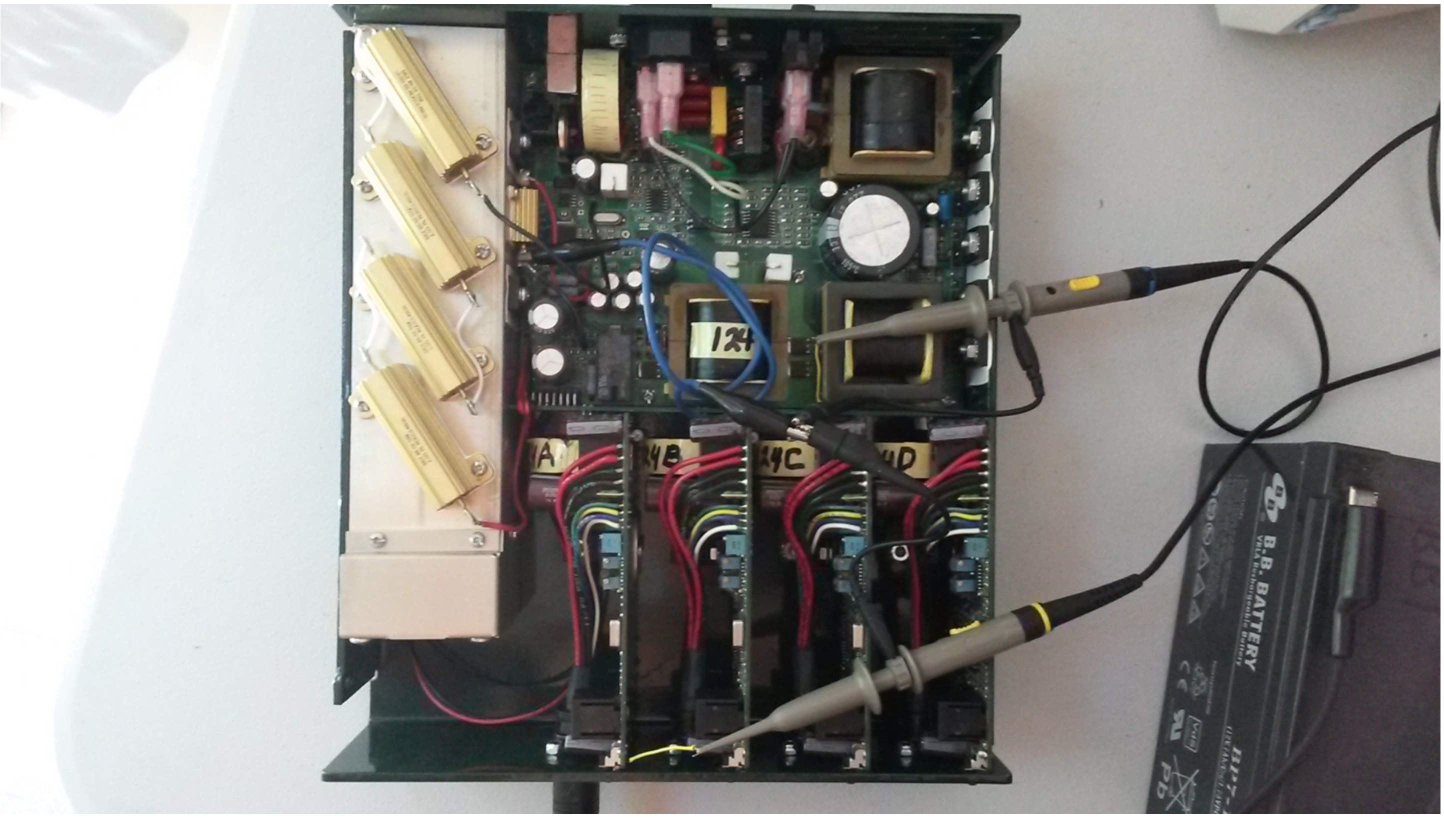

Figure 6. – Scope triggered off channel 1 rising edge, large 10V spike occurs approximately 12ms later.

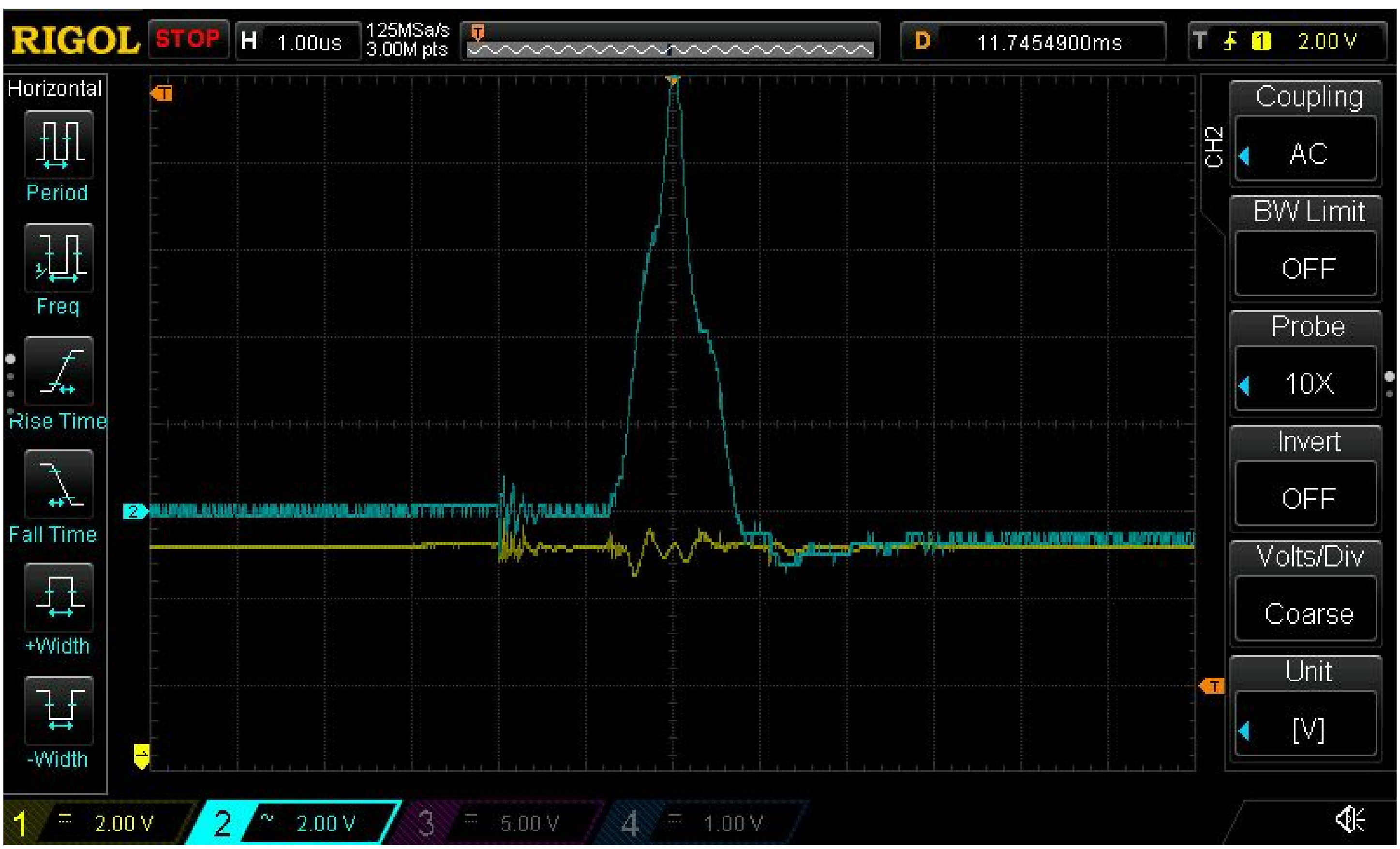

Figure 7. - Voltage spike on +38V auxiliary before repair, 10V peak.

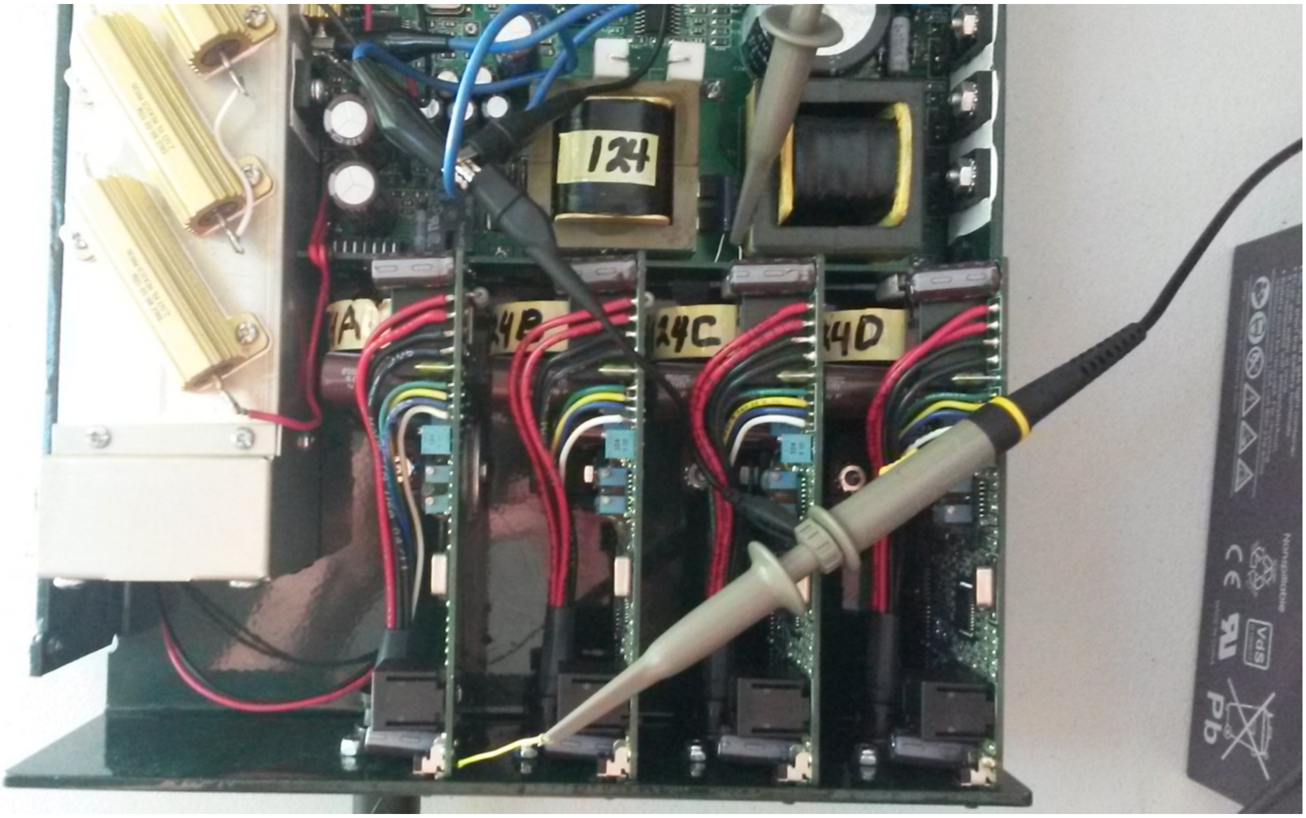

Figure 8. – Scope triggered off channel 1 rising edge, much smaller 2V spike occurs approximately 12ms later.

Figure 9. – Voltage spike on +38V auxiliary after repair, 2Vpeak.