I have removed the possibly damaged IC from the PCB and made measurements between SW-GND, Vin-GND and Vout-GND. The results were as follows; SW-GND=2 Mega ohm, Vin-GND= ~500k ohm and Vout-GND=Short. I replaced the IC with new TPS61252 IC and the output of the circuit was 5.08V as expected and everything was working ok.

To find the cause of the problem, as you mentioned I took some waveforms under no load and under load. With two motors connected (for load condition), I implemented go forward, go backward, go left and go right commands (each of them for 10 secs) in consecutive way without any pause between commands so that I can put the 5V part under full test to see the output change. Below are the result. During no load and load test, firstly, no tvs or tantal capacitor was connected to 5V, after some tests I put some tantal caps near TB6612 motor drive IC 5V line.

When motors are not connected

When motors were not connected the waveform was as follows.

Figure 1: 5V output when motors are not connected. Vpp of ripple was 100mV, Vmax 5.08V and Vmin=4.98V

When both motors connected, both motors are at 80% full speed

I powered off pcb, connected the motors and powered on, when the motors starts to work at the very beginning following waveform was captured.

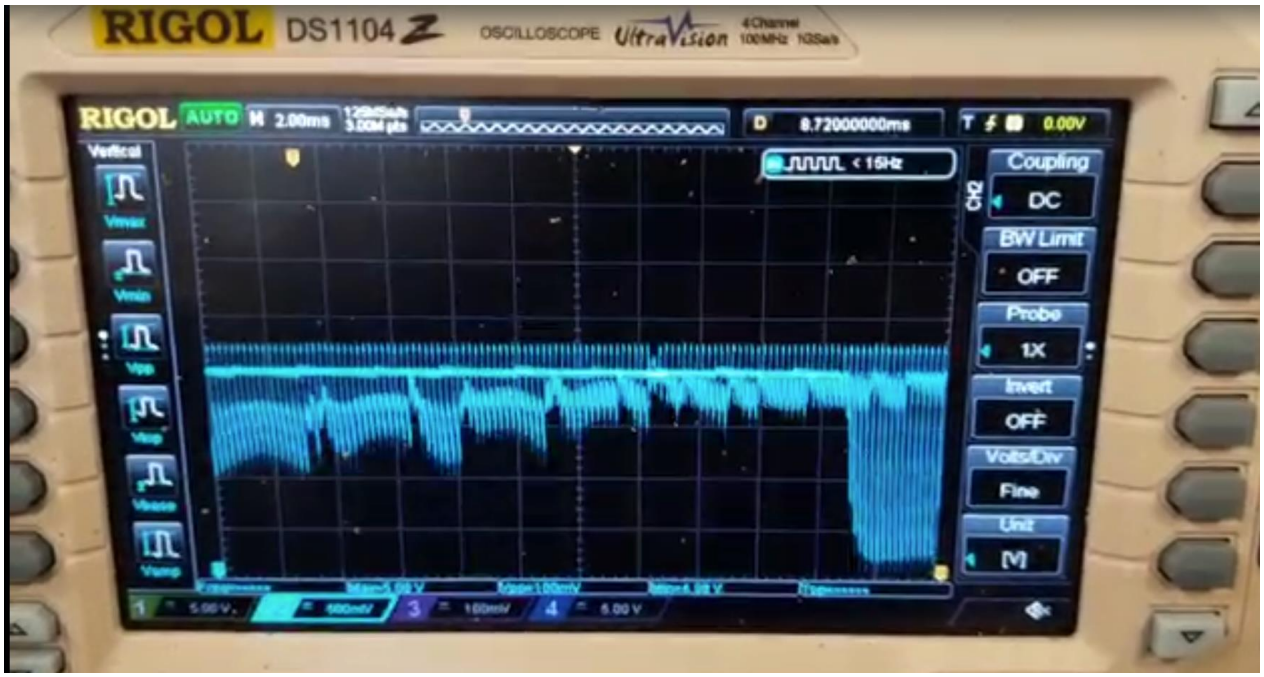

Figure 2: Waveform captured during first startup of the PCB with two motors connected

This waveform shows up then 5V line becomes as in Figure 3.

During go forward operation following waveform was observed.

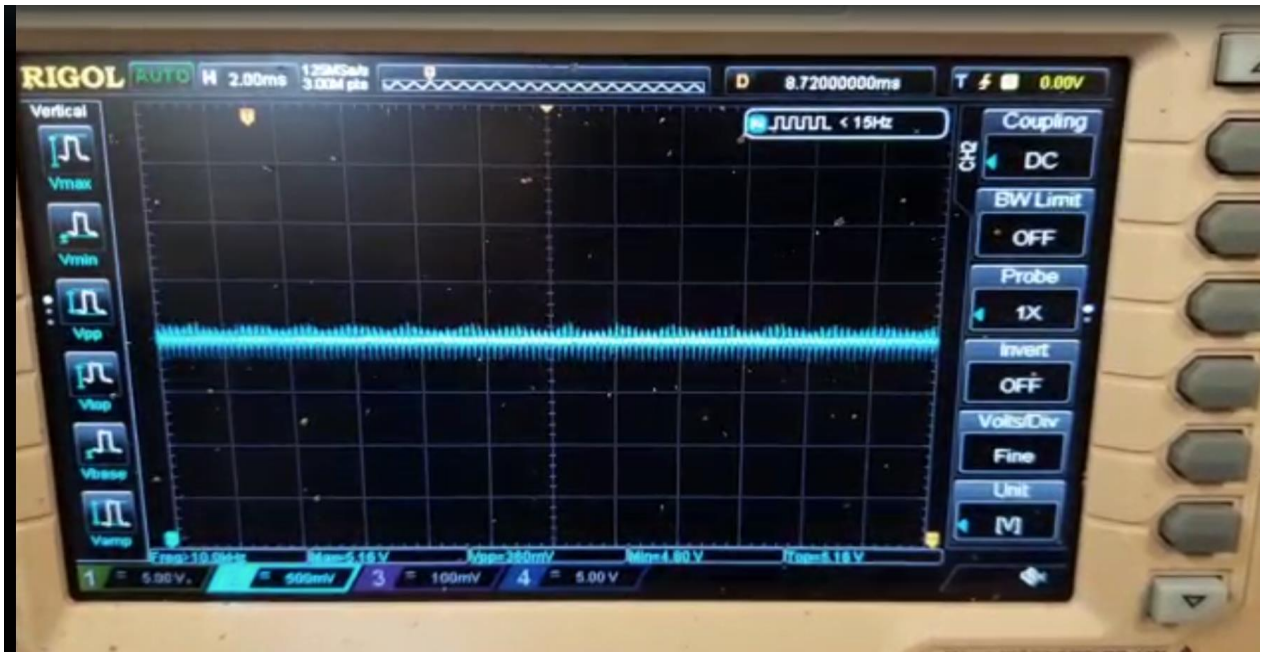

Figure 3: 5V output during go forward command. Both motors are working (at 80% of full speed). Vpp of ripple = 360mV, Vmin = 4.80V and Vmax=5.16V

During transition from go forward to go right command (go right = one of the motors (M1) is on and the other (M2) is off), following waveform captured.

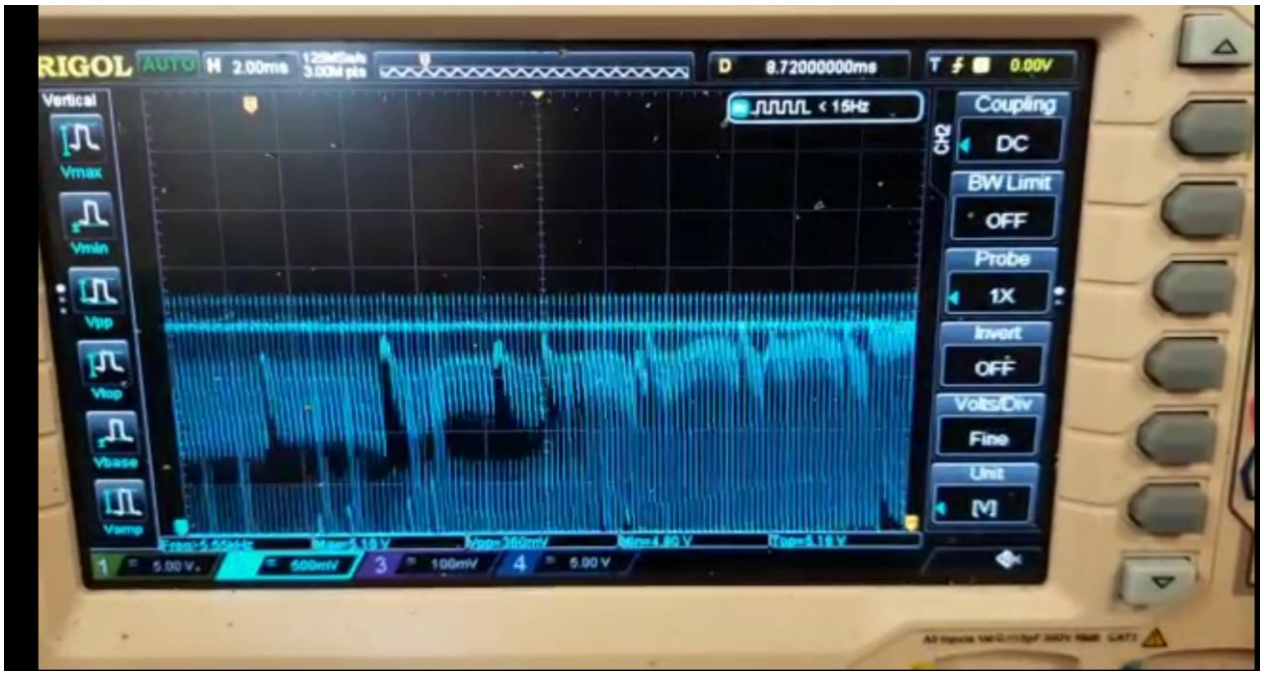

Figure 4: Waveform captured during transition from go forward to go right command.

Again after transition the 5V line becomes somehow stable and following waveform captured.

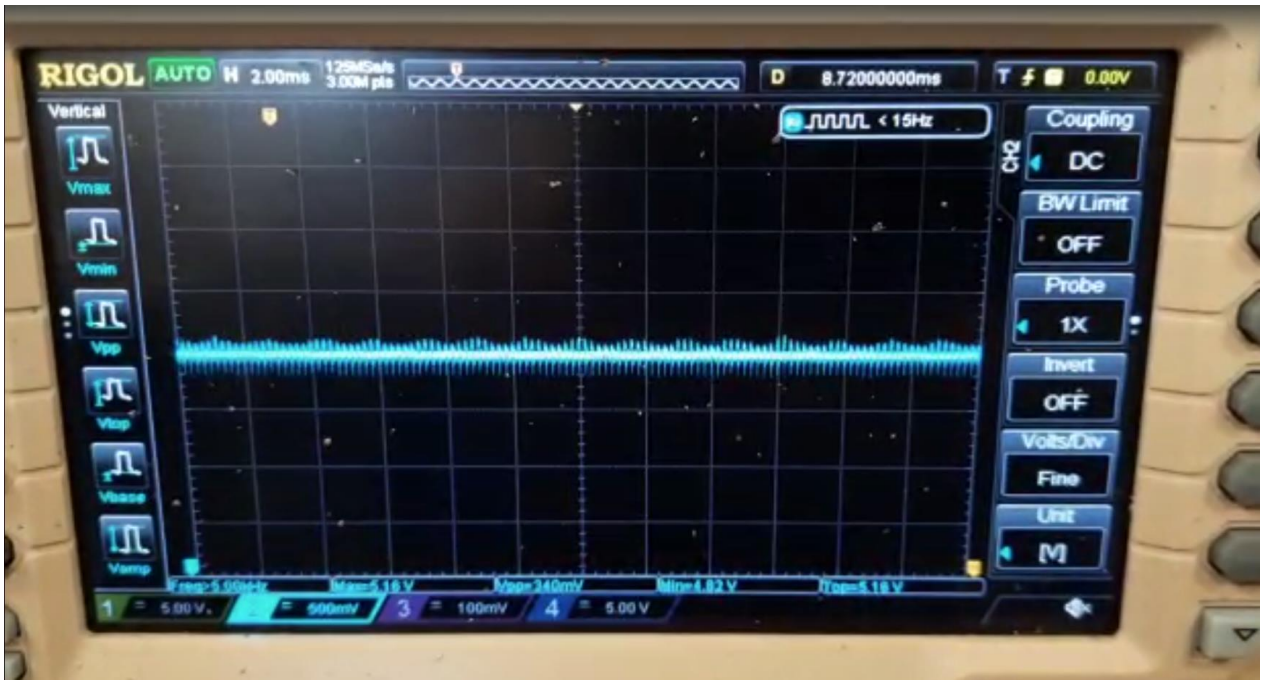

Figure 5: Waveform captured during go right command. Vpp=340mV, Vmin=4.82V and V max = 5.16V.

During transition from go right to go left command (M1 off and M2 on), following waveform was captured.

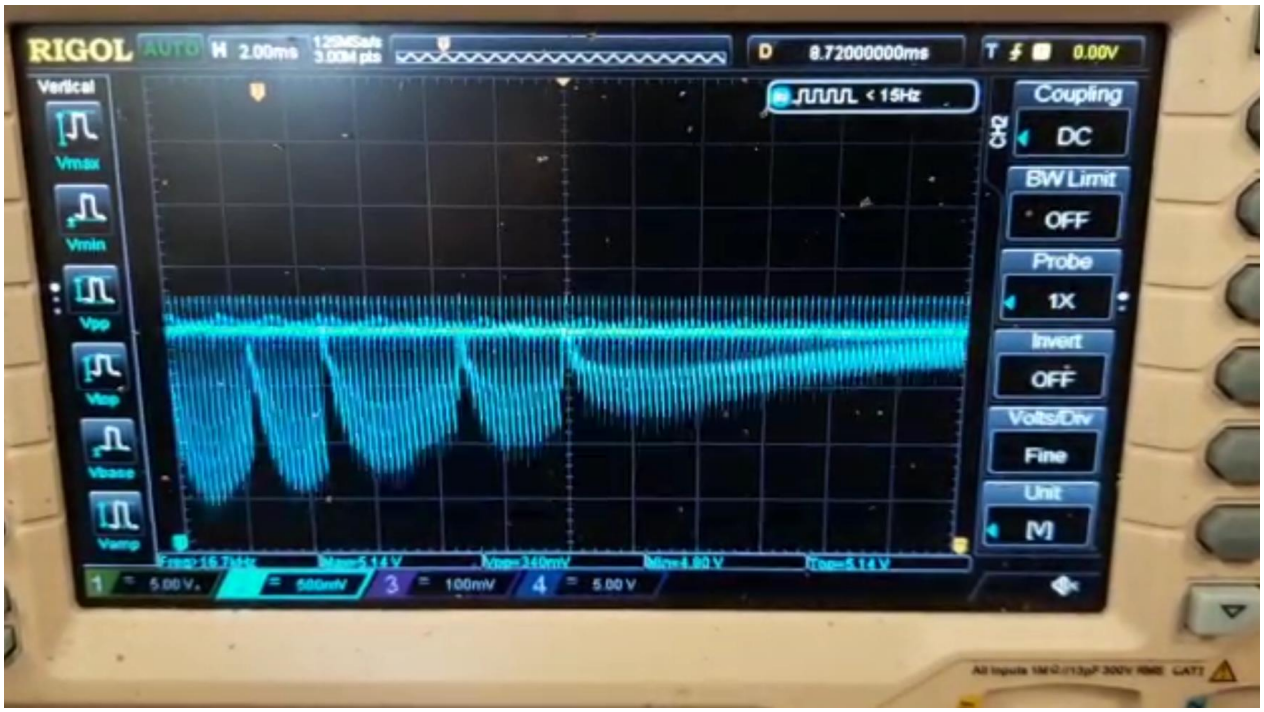

Figure 6: Waveform captured during transition from go right to go left command.

Again after transition, the 5V line became somehow stable and following waveform was captured.

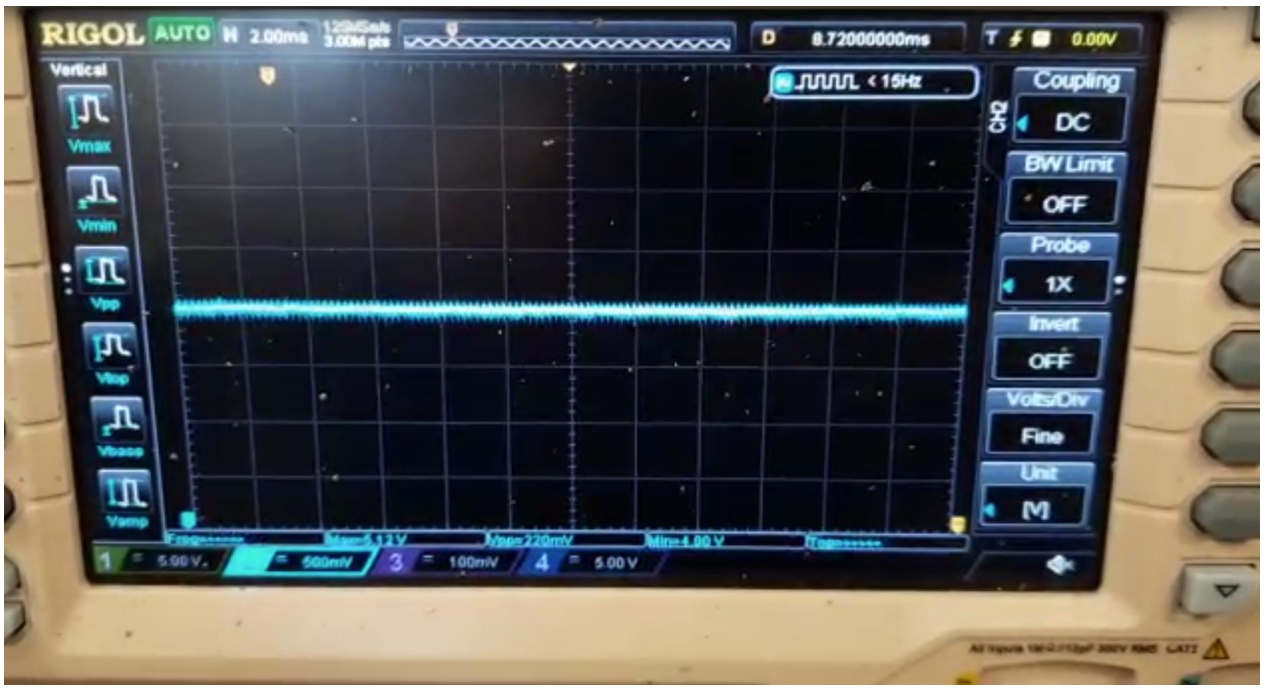

Figure 7: Waveform captured during go left command. Vpp=220mV, Vmin=4.9V and V max = 5.12V.

During transition from go left to move backward I captured following waveform.

Figure 8: Transition from move left to move backward

Before transition the motor 2 was in CW direction, when move backward command comes, motor 2 changes the direction to CCW and as you mentioned, maybe the charging occurs as in the above picture.

After transition, 5V line again becomes somehow stable and following waveform was captured.

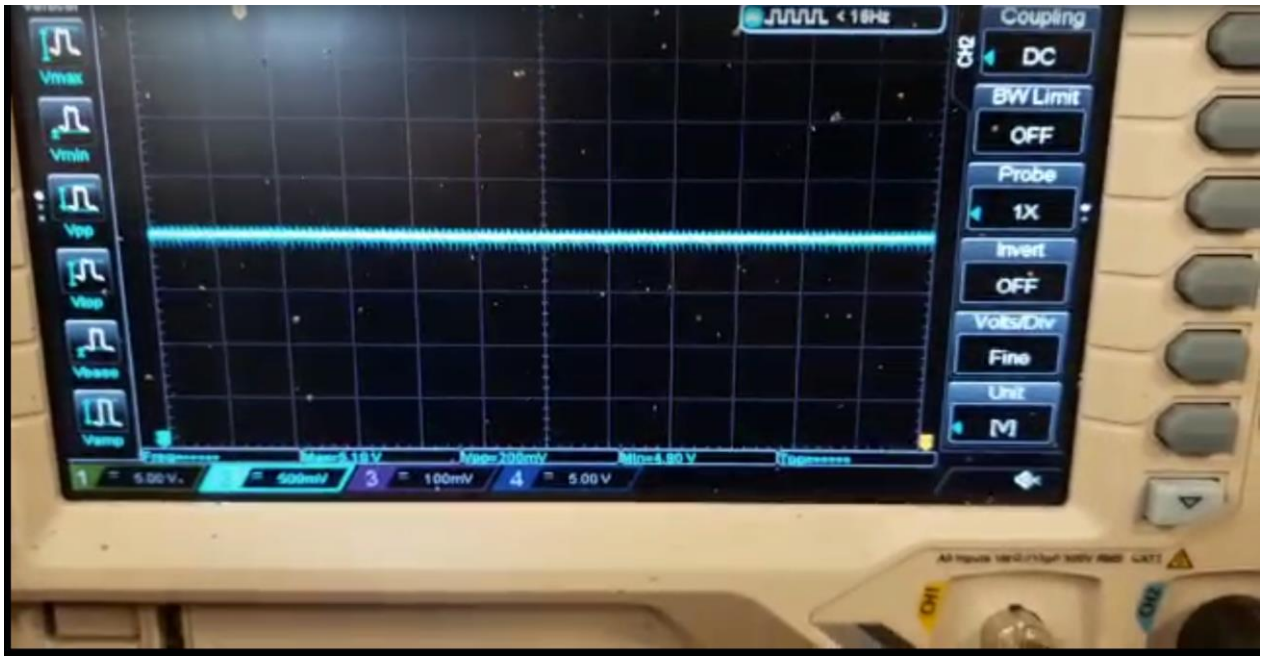

Figure 9: Waveform during move backward command, both motors are on; Vmax = 5.1V, Vpp of ripple=0.2V and Vmin=4.9V

What I saw is when PCB is first started and motors are connected, (or during transiitons) the voltage drop occurs, the 5V line drops to around 4.7V for very small amount of time then jumps to normal level (around 5V).

I made another test with same board, this time I increased motor speed to 100% and implemented go forward for 3 seconds and go backward for 3 seconds. During transitions motors were changing direction suddenly and in transition state, the Vmin sometimes was as low as 2.5V. At 100% speed, the Vpp of the ripple was around 600mV (not in transition). Below are some waveforms.

Figure 10: Waveform during transition from move forward to move backward. Vmax=5.3 Vmin=2.92V (although the screen shows around 4.7V, The 2.92 V appears for very short time)

After transition, the 5V line becomes somehow stable, with Vmax=5.3, Vmin=4.7 and Vpp of ripple = ~700mV.

Figure 11: Waveform captured on 5V line, (normal operation move backward or move forward, both motor are on with full speed). Vpp=600mV, Vmin=4.7V and Vmax=5.3V

In most of the cases, I noticed the when there is transition and/or when motor starts to work, there is some voltage drop (5V line drop as low as 2.5V sometimes). During my tests, the PCB was power with power supply, (Vin=3.7V and power supply current limit was set to 1.5A). In above tests there was not any tantalum capacitor or TVS diode between 5V and GND. When I put Tantalum capacitor between 5V and GND (100uF 10V) near motor driver IC 5V pin just to see what happens, the ripple was again around 600mV, Vmax was around 5.3 and Vmin was around 4.7V.

I have following question. I have noticed another thing. When I set power supply current limit to 1A, and implemented go forward 3 sec then go backward for 3 seconds, one of the motors was behaving as expected the other was not, it was trying to change direction and was failing. When I further decrease the current limit (around 0.5A), both of them were behaving strangely, not changing the directions. In my PCB, there are two power inputs, USB and single cell 18650 2200mAh 1C battery. The battery is always present, if usb is connected (for example to upload some code) PCB uses usb to charge battery and also priority is given to usb to power my PCB. There is some current limit on PC usb port (0.5A – 0.9A) or if battery capacity decreases, the battery will not be able to supply enough current. Can these things (not enough power/ current input) damage the IC?