

Altitude measurement - calibration - ultrasonic

Problem

As already mentioned in [Height measurement](#)

(<https://canvas.vub.be/courses/20138/pages/hoogtemeting>), the RX signal consists not only of reflections on the ping pong ball, but also of reflections on the Plexiglas tube.

This can be clearly seen in Figure 1: the first pulse is due to the reflections in the tube, the second to the ping-pong ball.

However, when the ping-pong ball is at the bottom of the tube, we get the situation in Figure 2: the pulses overlap and it is no longer possible to distinguish between the reflections coming from the tube or the ball.

In order to determine the height of the ping pong ball, this reflection must therefore be taken into account.

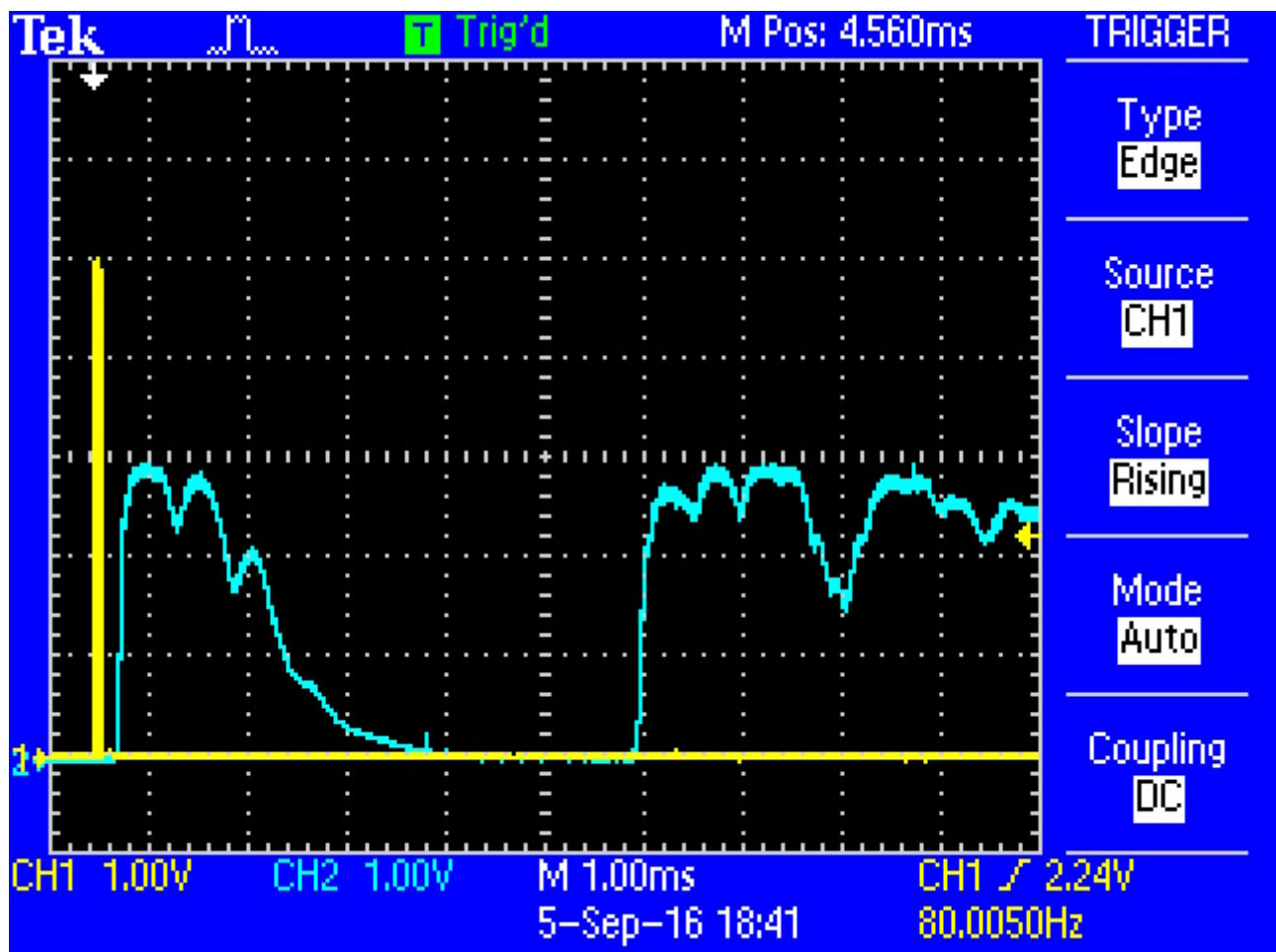


Figure 1: The two received pulses (blue). The first pulse is due to the reflections in the

tube, the second to the ping-pong ball .

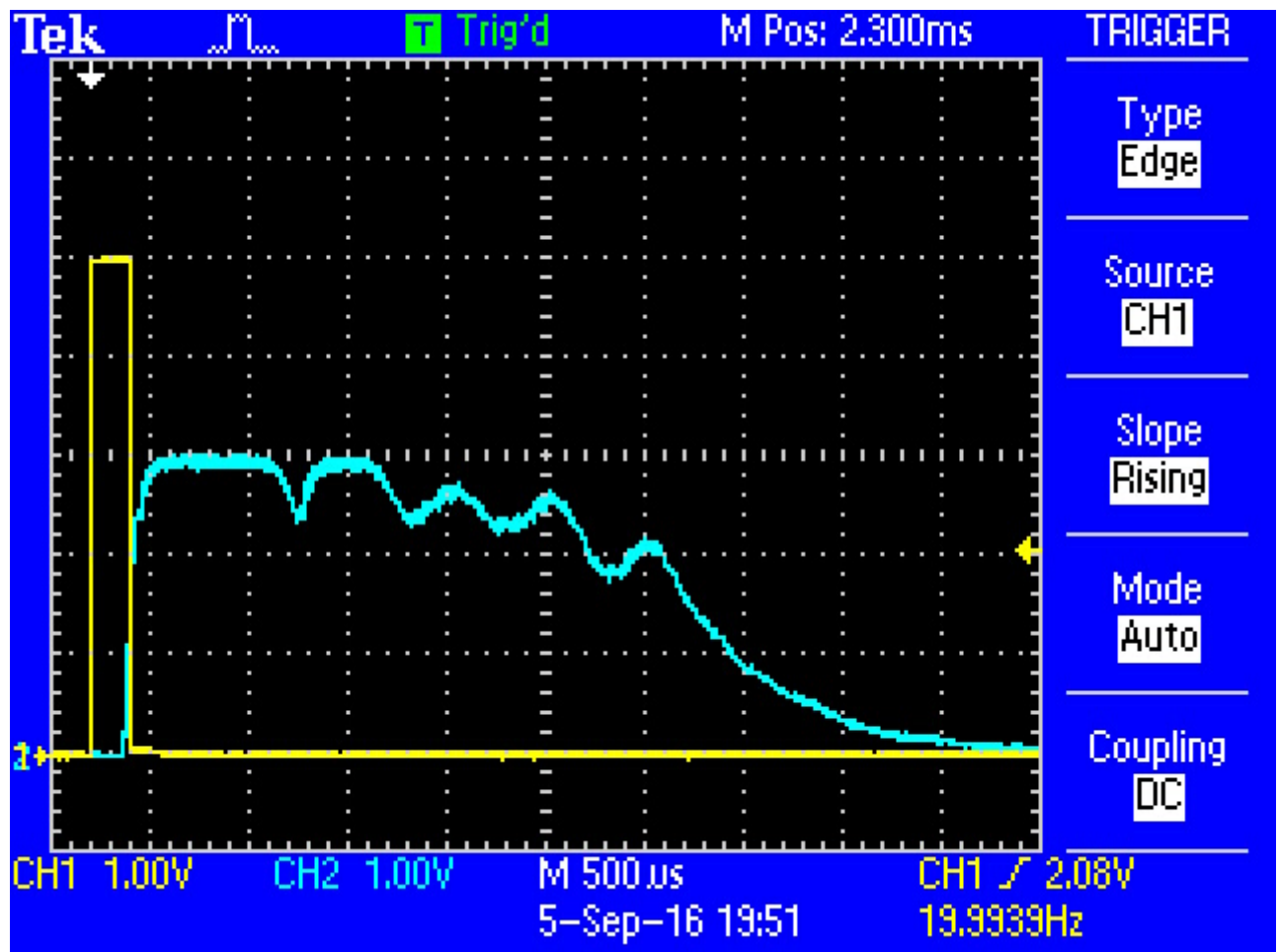


Figure 2: In the received signal (blue), it is no longer possible to distinguish between the reflections in the tube and the reflection on the ping-pong ball .

Solution

In order to solve the problem of the undesirable reflections, a calibration is performed. This calibration measures the reflections from the tube (the reflections during the first 3 ms, or better: the first half meter of the tube; check this calculation), and then subtracts them from the measured signal . In this way we are left with only the reflections of the ping pong ball (see Figure 3). It is important here that the ping pong ball is at the top of the tube, so that its reflections do not overlap with those of the tube (Figure 2). When starting the calibration , so the ball is blown upwards first.

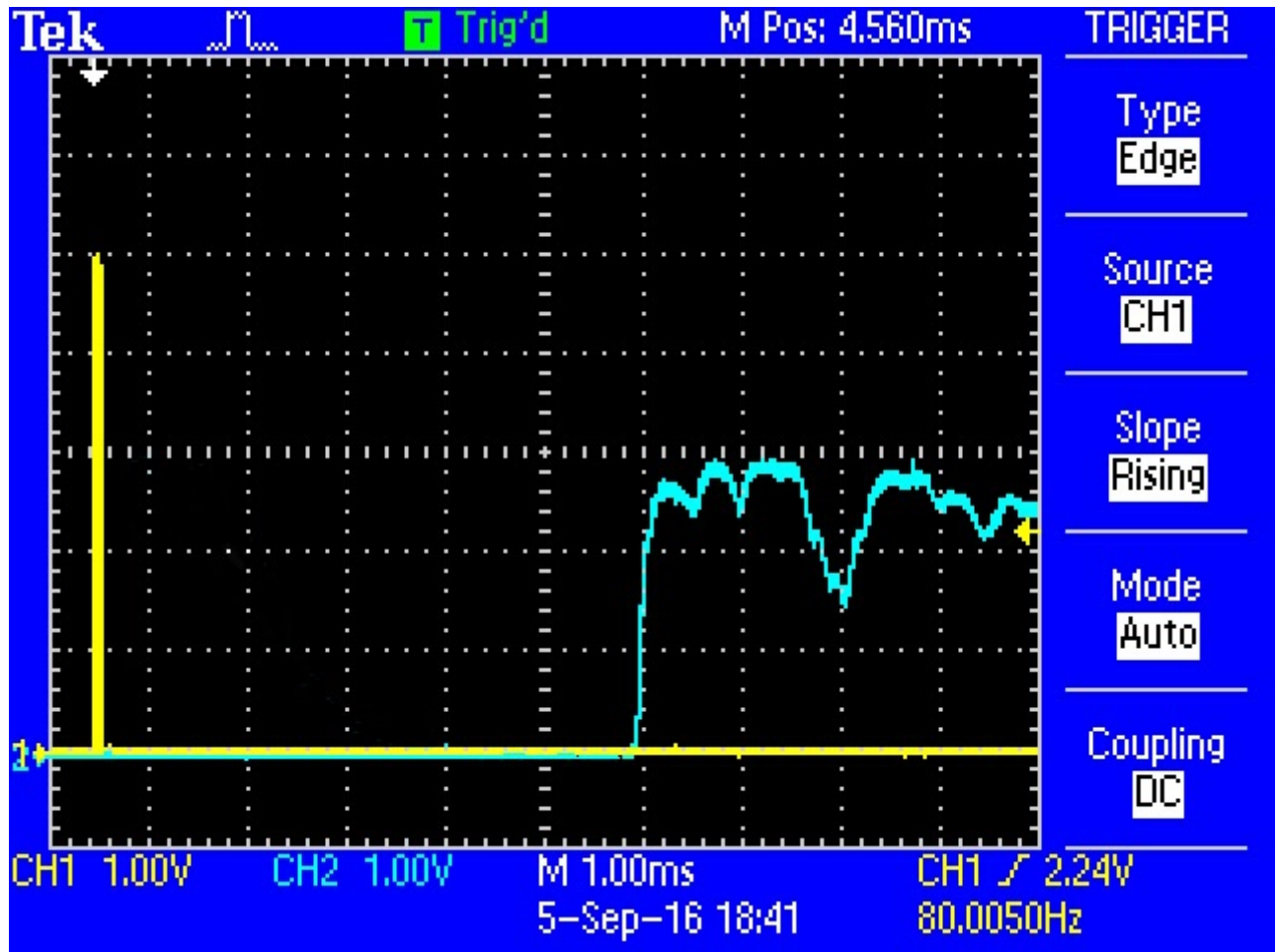


Figure 3: After calibration, only the pulse of the ping pong ball remains (blue).

Note: this figure is only available on an oscilloscope with memory function.

The time pulse (PULSE) output now only triggers on the reflection of the pig-pong ball, as can be seen in Figure 4.

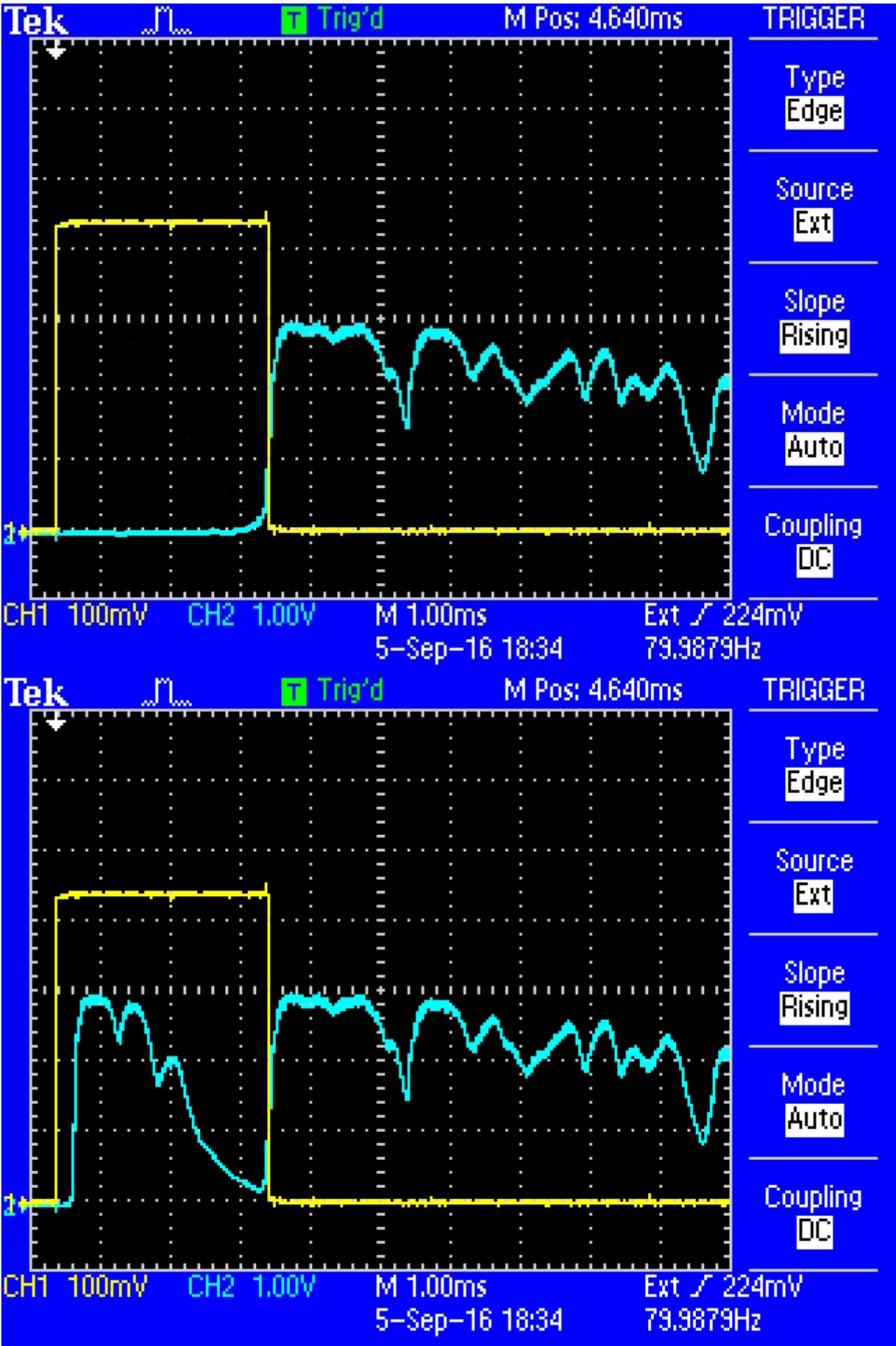


Figure 4: (left) the received signal, with reflections from the tube filtered out (right) the

received signal as seen on the oscilloscope: both reflections visible

The time pulse (yellow) ignores the first reflection from the tube, and only measures the reflections of up the ping pong ball!

The calibration

To calibrate the system , the fan must be connected to the ping pong tower and then the reset button must be pressed for a few seconds .

The ball will be blown upwards and the reflections of the tube will be measured. Then it will float a little lower; this indicates that the calibration was successful.

DO THIS EVERY TIME AFTER STARTING UP THE ALTITUDE SENSOR (after applying voltage)!

Setting the Threshold

To determine the height of the ball, the height sensor measures when the reflection exceeds a certain value. This value is set with the potentiometer.

If the ball does not float stably after calibration, this threshold has been set incorrectly.

If the threshold is too low, the height will be estimated much too low (Figure 5 left).

If the threshold is too high, the ball will sometimes not be detected (Figure 5 right).

To adjust the threshold, turn the potentiometer in the correct direction and recalibrate.

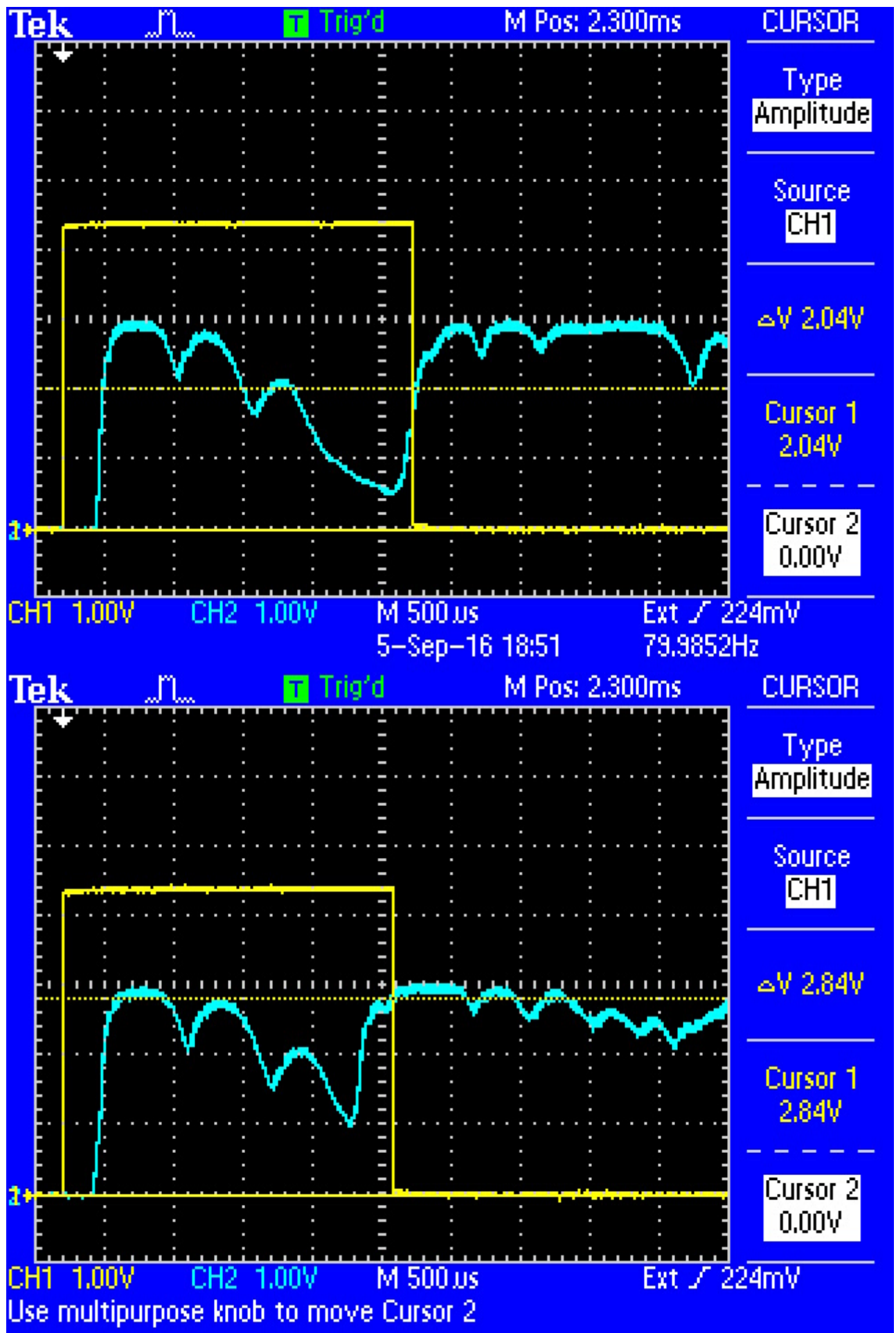


Figure 5: (left) A low threshold (point of intersection yellow and blue graph) (right) A high threshold (point of intersection yellow and blue graph)

Conclusion

