DDS generator test FNIRSI

Original blog post: July 12, 2023

I don't always want to take out my large generator which weighs about 20kg, it does have very good performance but I don't always need a 10MHz sine wave with a distortion factor of less than 1%. Sometimes I need a simple sine wave with a stable frequency. Sitting on an allegro the other day I spotted such a simple DDS FNIRSI generator, tiny, lightweight and powered from a power supply, I thought why not. I know that if there is an obstacle standing between me and doing a new project then I won't start working on a new project. And that is how I became the owner of this tiny generator. In this material I will try to see if such a generator will be useful in an electronics technician's workshop.

Appearance:

The generator is sold together with a black non-transparent acrylic case, in my opinion more aesthetically pleasing than all those transparent cases for other such devices. The housing is self-assembled, assembly is simple although it took me a while to find out where I should put the spacers.

Interface:

The designers have allocated 5 buttons and 2 potentiometers to use the generator. The potentiometers are used to adjust the amplitude of the waveform and the DC component. The buttons are used to switch the waveform type, switch the output on/off and change the frequency.

Perceptive readers have probably figured it out. But why are there knobs for component and amplitude adjustment? The reason is that this generator is a kind of analogue-digital hybrid, with

digital signal generation and frequency control, while the component and amplitude are regulated by two simple operational amplifier circuits at the output.

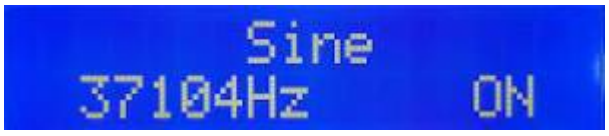
Parameters:

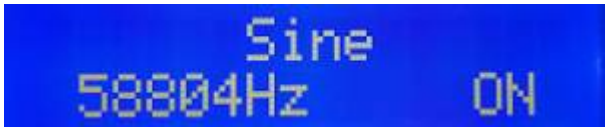
Below are the parameters declared by the manufacturer:

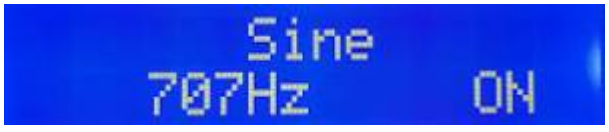
1. Channels: 2
2. DDS frequency range (channel 1): 1 Hz to 65534 Hz
3. High Speed frequency (channel 2): 1 MHz, 2 MHz, 4 MHz and 8 MHz
4. Offset adjustment: potentiometer 0.5pp - 5Vpp
5. Amplitude adjustment: potentiometer 0.5Vpp - 14Vpp
6. DDS signals:
7. Sinusoidal
8. Rectangular signal
9. Triangular signal
10. Ball wave
11. Inverse sawtooth wave
12. ECG
13. Random noise
14. Interface: 2 potentiometers and 5 buttons
15. LCD display 1602, 2 lines with backlighting
16. Frequency adjustment: 1 Hz, 10 Hz, 10 0Hz, 1000 Hz and 10000 Hz
17. Output impedance 20 to 200 Ohm

I know, I know, the bandwidth is a bit weak and the waveforms strange EKG !?!???

Well okay but let's move on to more serious issues of how to use this generator. To be honest I am surprised how accurate the frequency indicated by this generator is. Here are some measurements with a frequency meter. The blue display is the generator display the red display is the meter display.







The following calculates the relative error by taking the value given by the frequency meter as the reference value.

ΔX - Różnica pomiędzy wielkością mierzoną oraz wielkością odniesienia
X - Wielkość odniesienia
X_0 - Wielkość wskazania
δ - Błąd względny

$$\delta = \frac{\Delta X}{X} \cdot 100\% = \frac{|X - X_0|}{X} \cdot 100\%$$

1 POMIAR

$X = 37105,326$ Hz
$X_0 = 37104$ Hz

$$\Delta X = |37105,326 - 37104| = 1,326$$

$$\frac{\Delta X}{X} = \frac{1,326}{37105,326} = 0,000035736$$

$$\frac{\Delta X}{X} \cdot 100\% = 0,00357361\%$$

$\delta_1 \approx 0,004\%$

2 POMIAR

$X = 58806,144$ Hz
$X_0 = 58804$ Hz

$$\delta = \frac{\Delta X}{X} \cdot 100\% = \frac{2,144}{58806,144} \cdot 100\%$$

$\delta_2 = 0,003645877\%$
$\delta_2 \approx 0,004\%$

3 POMIAR

$X = 706,98534$ Hz
$X_0 = 707$ Hz

$$\delta = \frac{\Delta X}{X} \cdot 100\% = \frac{0,01466}{706,98534} \cdot 100\%$$

$\delta_3 = 0,020735\,93\%$
$\delta_3 \approx 0,02\%$

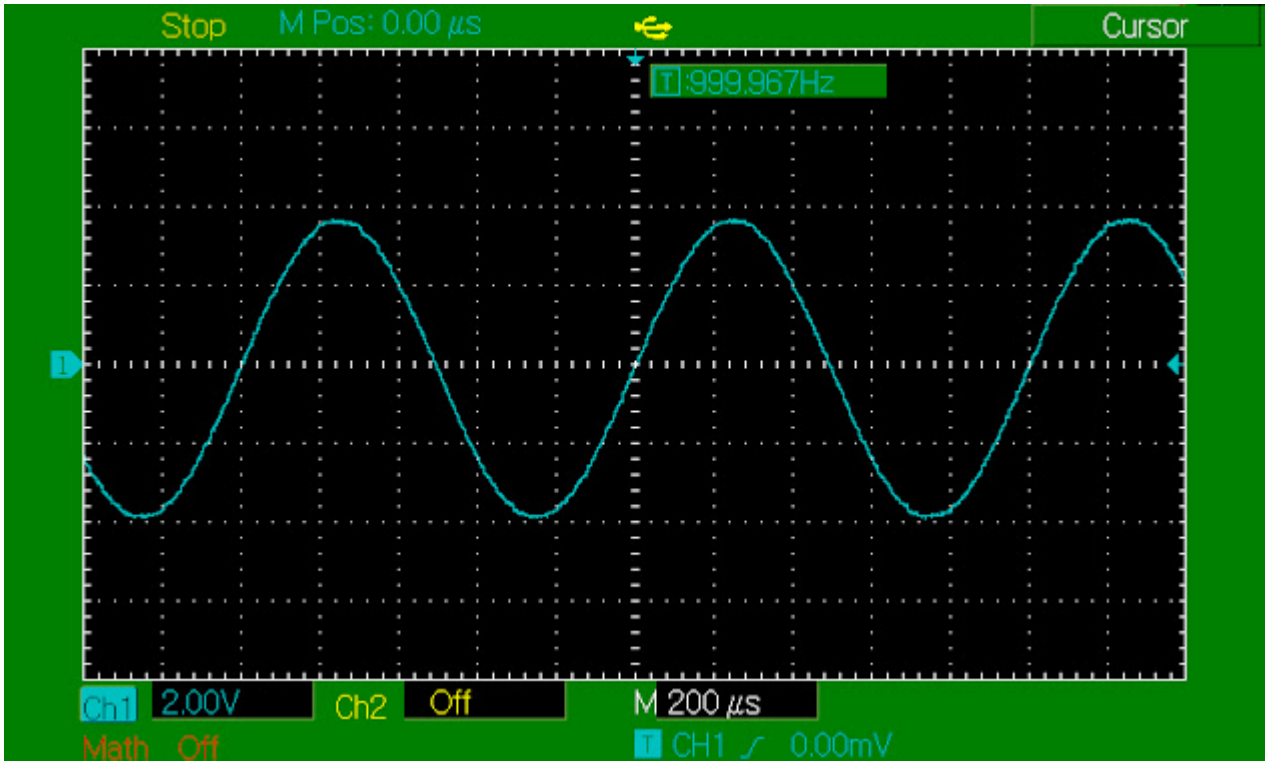
ŚREDNI BŁĄD

$$\overline{\delta} = \frac{\delta_1 + \delta_2 + \delta_3}{3} \approx 0,0093\%$$

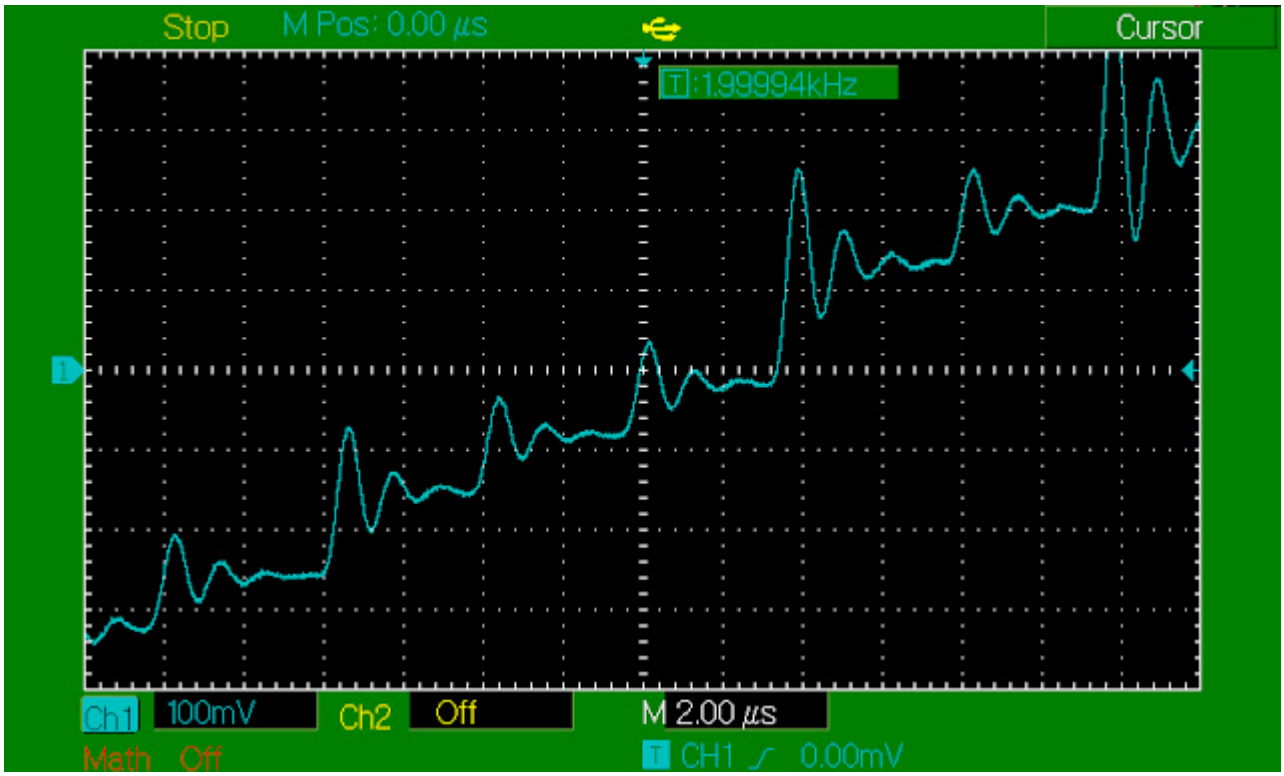
As you can see, the average error of the frequency displayed by this generator is less than 1/100th of a percent. WOW ?!! A good result for a device at around 100PLN. In conclusion, the frequency

indications of this generator can be trusted.

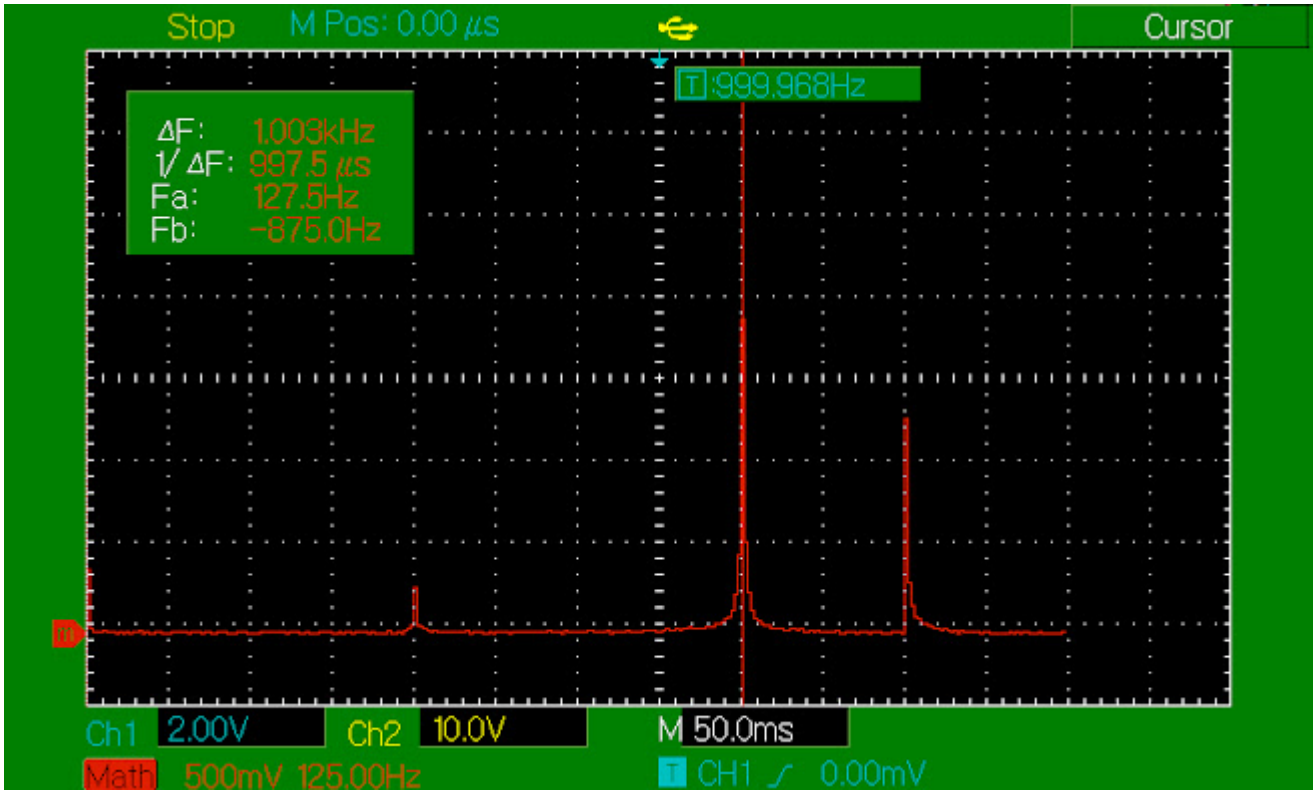
However, what about the shape of the waveforms. Below is a sine wave with a frequency of 1kHz.



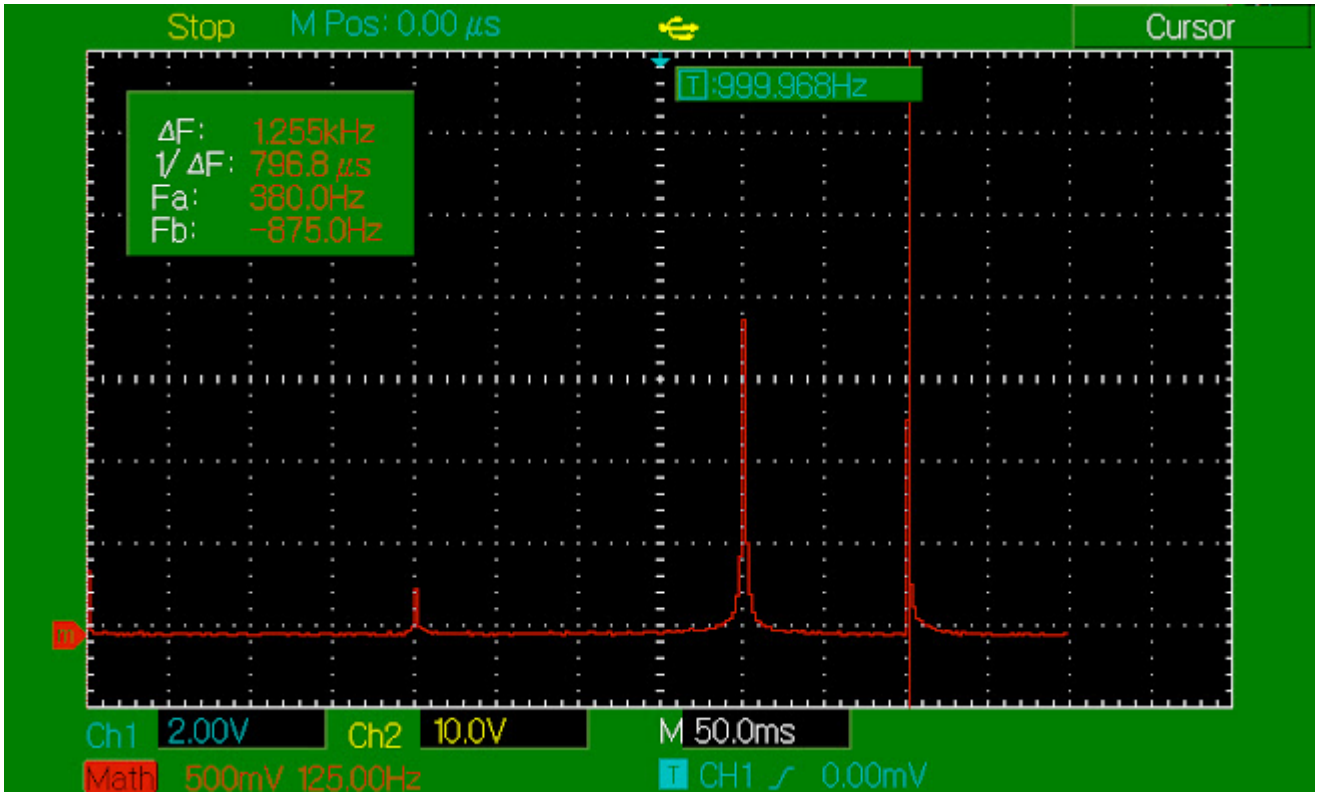
It looks nice with no distortion visible. Now let's look at the rising edge of this sine wave



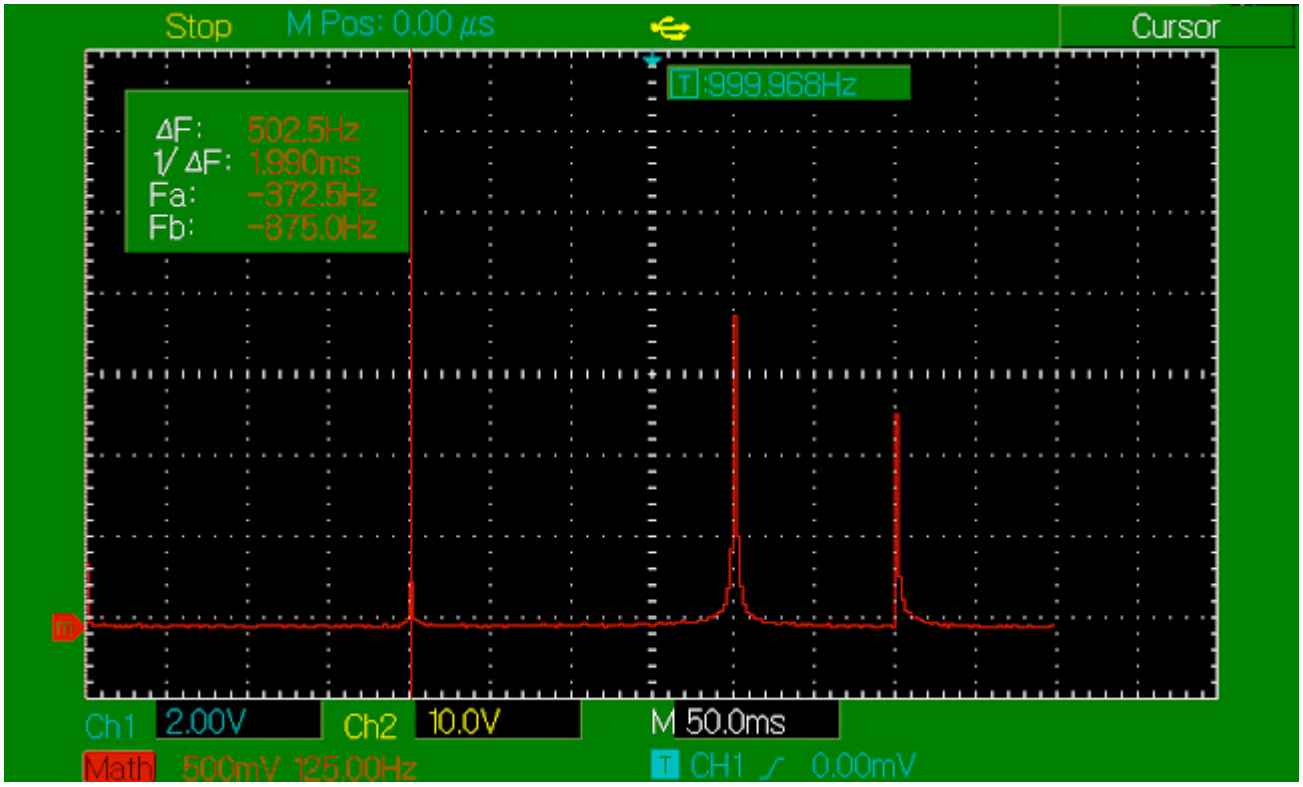
Well, and the great disadvantage of DDS generators begins to reveal itself to us. Namely, they do not generate frequencies from some oscillator but use some intermediate signal e.g. PWM or PCM and then filter it to form a smooth sine wave leaving a response such as you can see above. Below you can see a spectrum analysis of the above sine wave.



Here we are dealing with three component frequencies. The largest of course is the frequency set on the generator.



The second largest of these is 1.255kHz

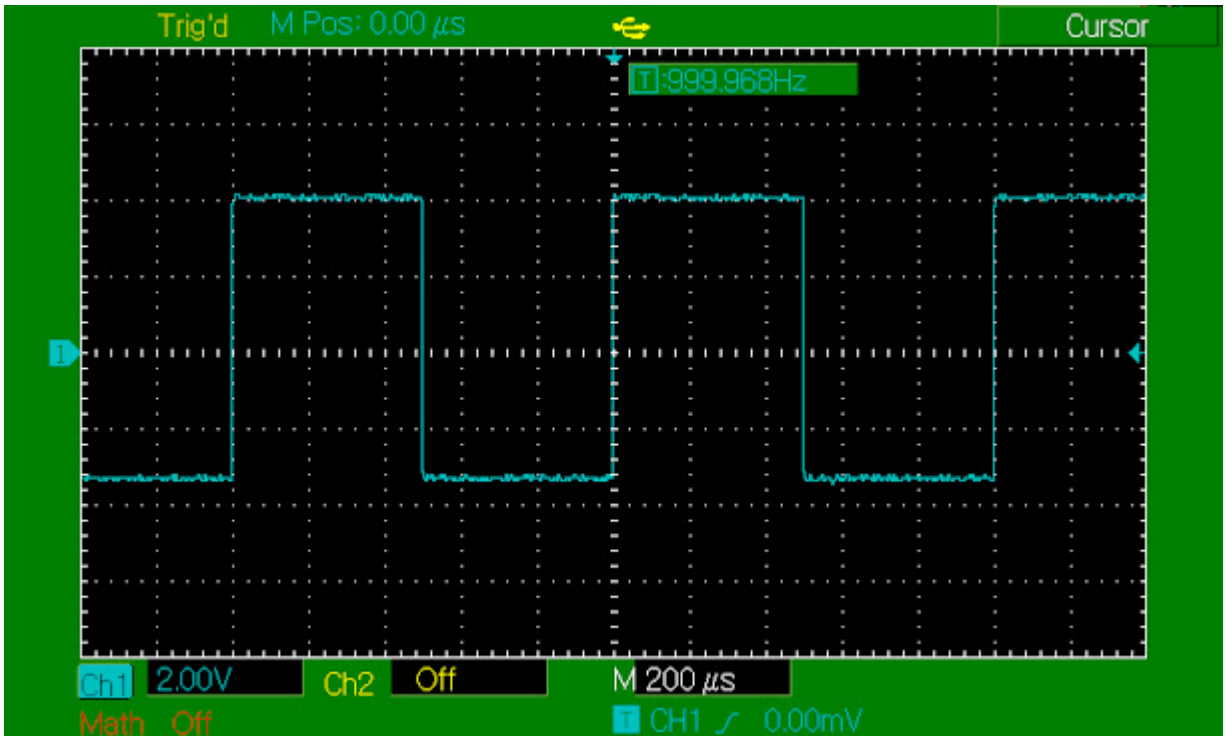


The third smallest is 503Hz.

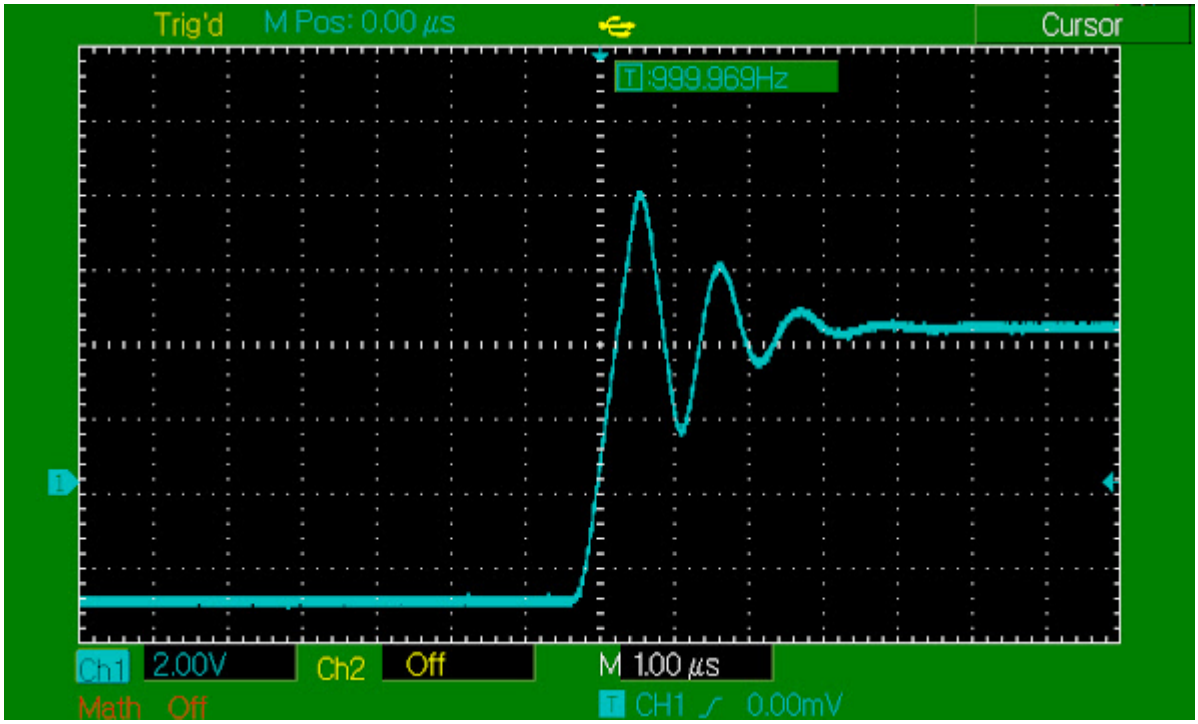
These are strange frequencies while apparently the generator uses them to create a 1kHz frequency.

In summary, the frequency is stable, while it is not quite clean, but that's the way it is with cheap digital technology. For simpler measurements it is sufficient.

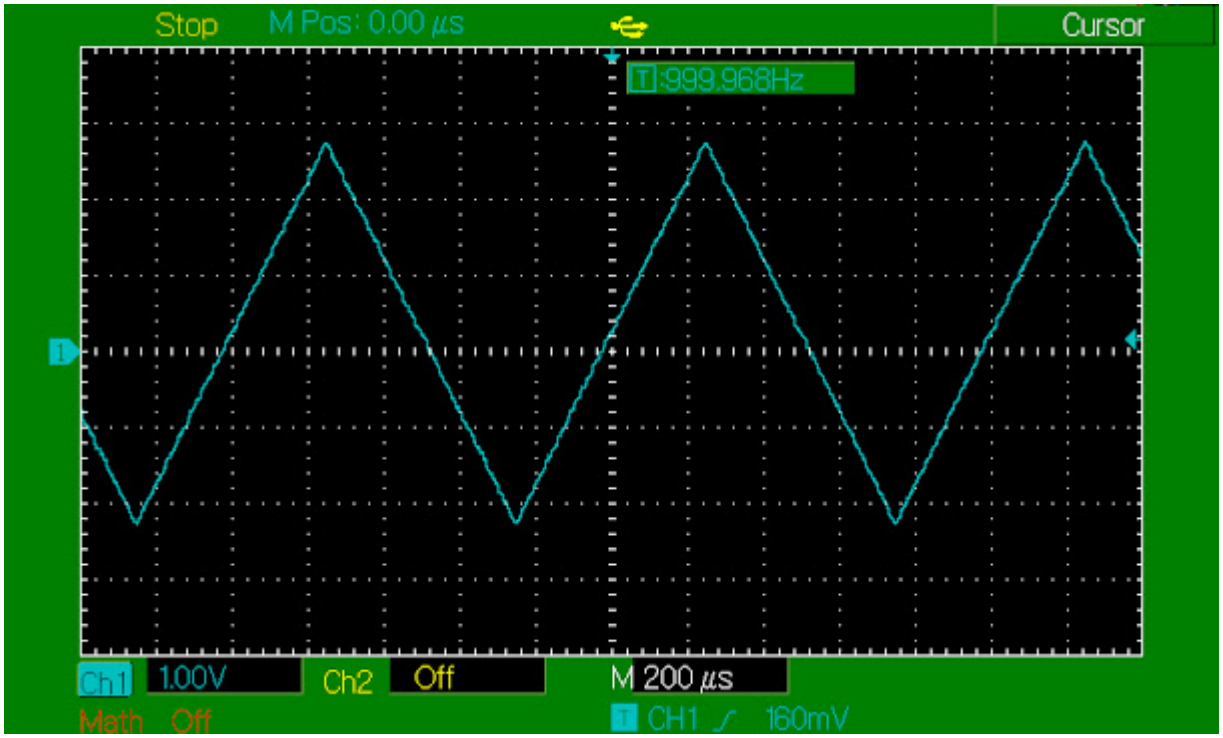
Let's test the rest of the waveforms then.



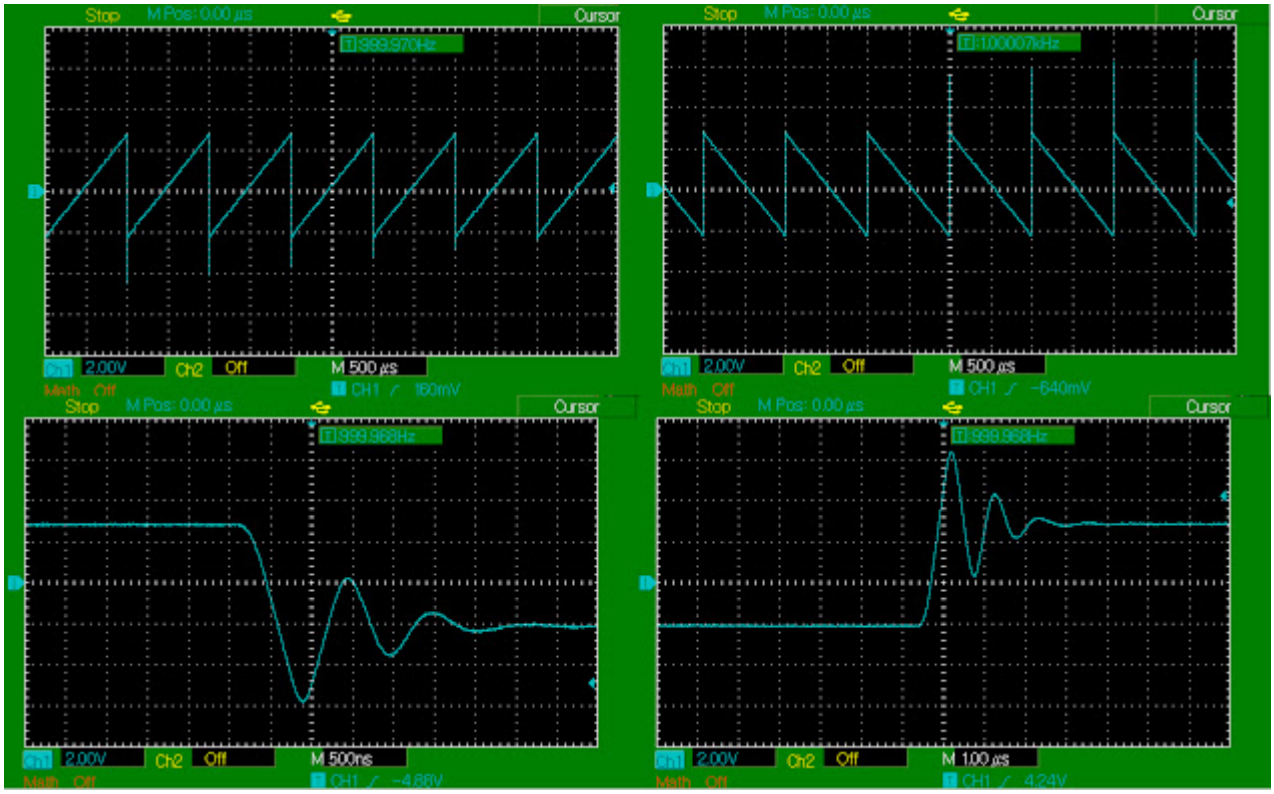
The 1kHz rectangle looks good but let's look at its rising edge



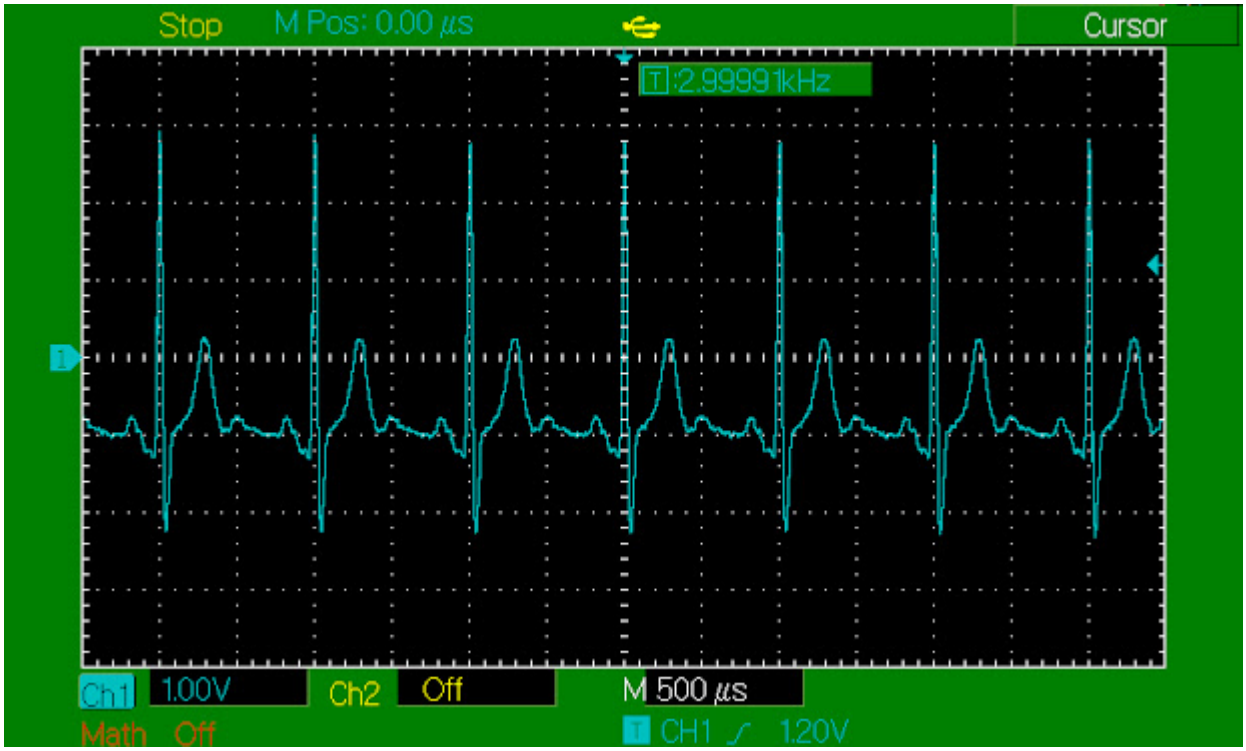
The rising edge of the rectangle does not look so good, we have a lot of overshoot and a lot of oscillation fading



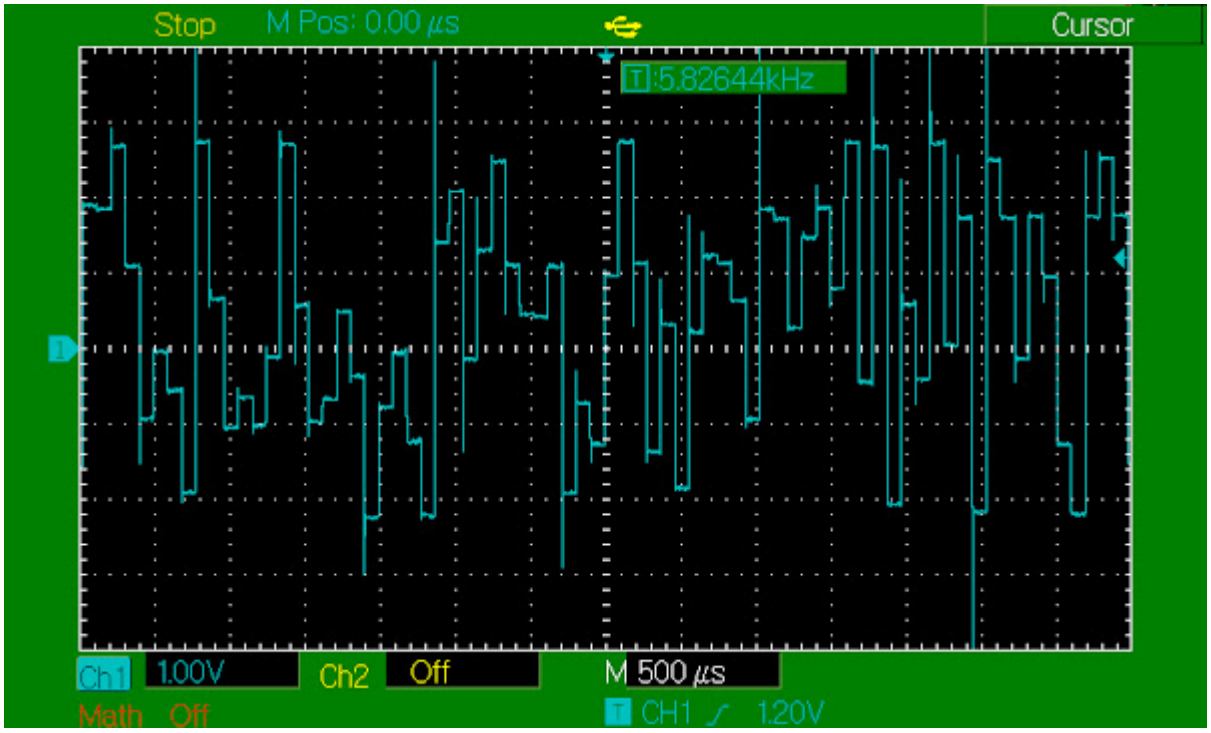
Triangle 1kHz (I looked at the slopes and they look the same as with the sine)



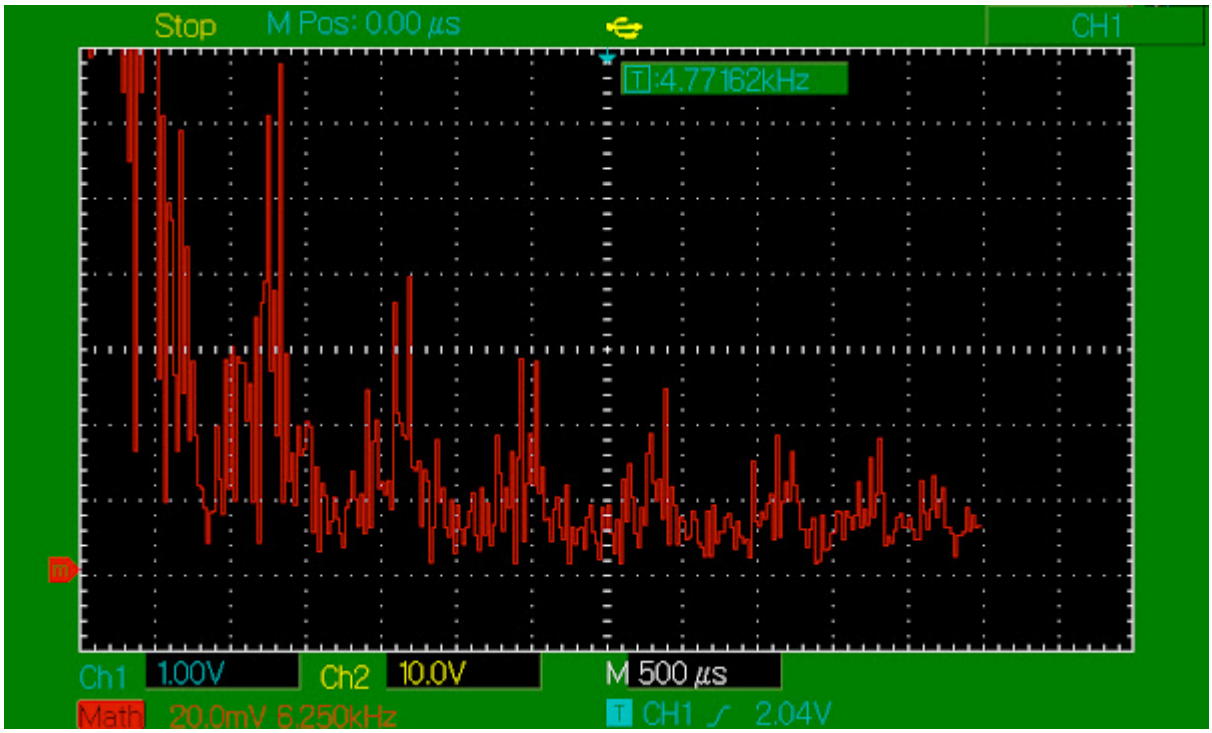
Summary of the waveforms and their rising and falling edges



I am not involved in medical electronics, so I cannot comment on the ECG waveform, except to say that the oscilloscope does not know how to measure its frequency.



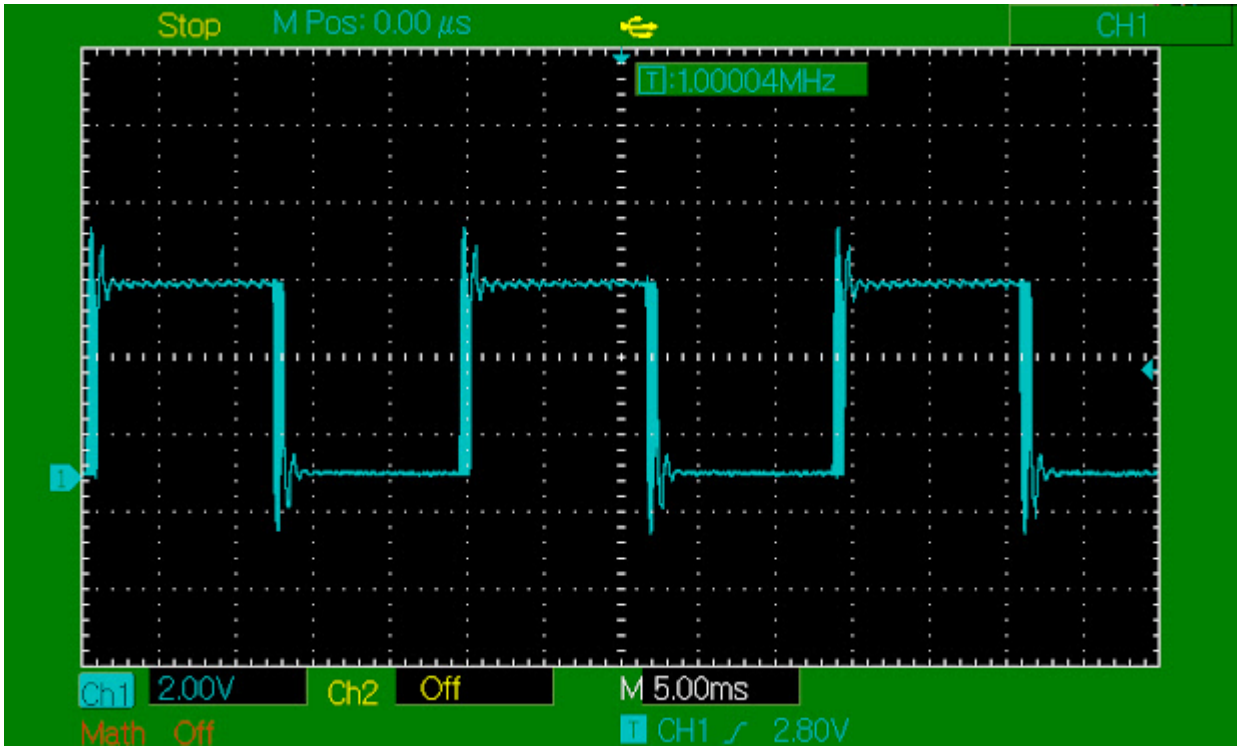
Random noise is of course what it is called, but as you can see it has a lot in common with a rectangular wave. Below is a spectral analysis.



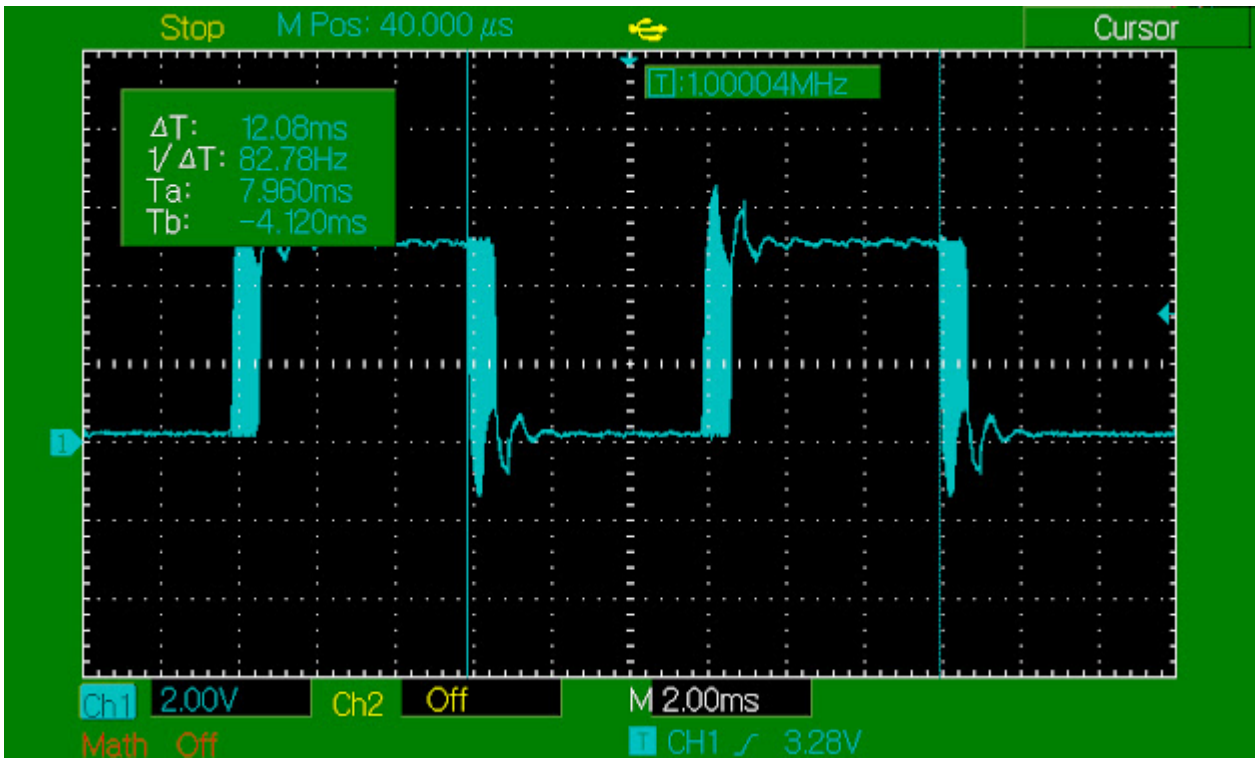
As we can see, the FFT shows that we have here quite a lot of places where harmonic frequencies stand out, the spectrum of the real noise should be more uniform and even resemble the graph of a 1/x function.

Let's move on to the next function of this generator, namely the so-called „fast” channel on which we can obtain the frequencies of a rectangular waveform at 1,2,4 and 8 MHz. This channel only allows us to obtain a rectangular waveform and select only single frequencies, it does not allow a smooth frequency adjustment.

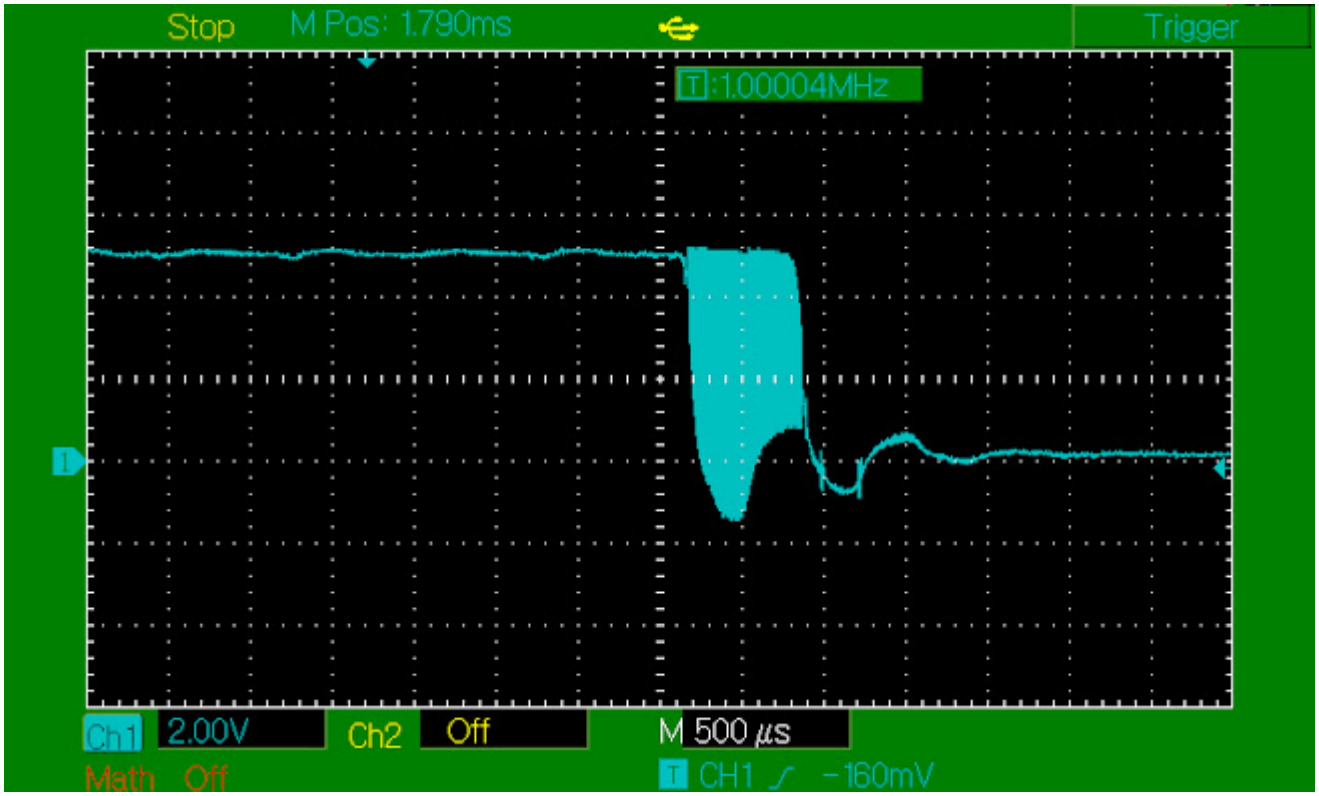
Below is the rectangle I managed to get from this channel.



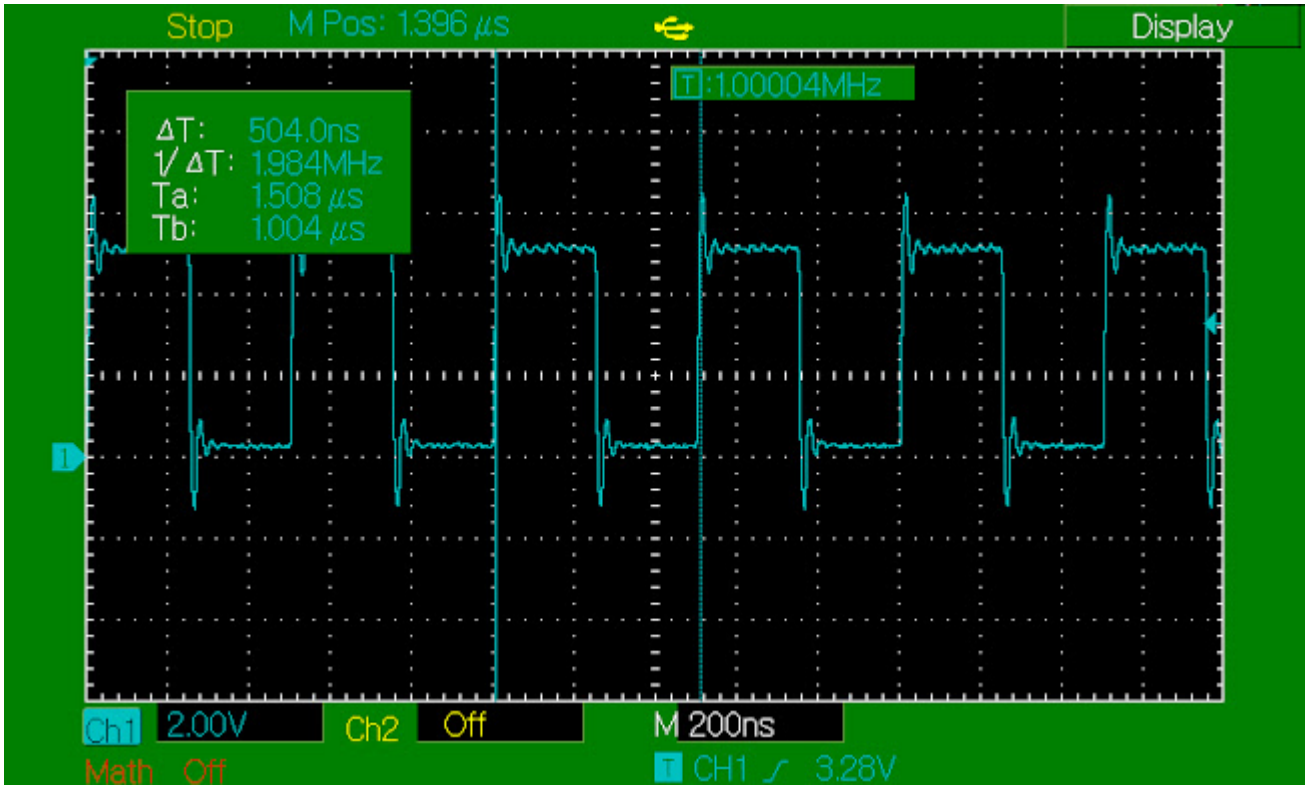
It looks a bit suspicious. The frequency meter shows 1 MHz but looking at the scale on the timeline we can see that something is wrong here. Let's measure this frequency with the cursors. First, of course, by approximating for extra accuracy



There you go ... that's not the frequency you're after. Well, but we still don't know what the oscillations at the slopes of the rectangle are. Let's zoom in and see what it is.



Closer and closer …



Here we go … here it is and our waveform was measured at 2 MHz. As you can probably guess. This is how every frequency on the „fast channel" of this generator looks like. It is completely unsuitable for any use.

In summary, the generator is good if you want something handy to generate simple waveforms for use in analogue circuits. However, for use in logic circuits I would not try it.

I will occasionally use this generator mainly for training and for simple tests such as this ;) for my

blog.

I haven't tested the output load of this generator here because that's not what generators are for, and there's nothing to test for DC and amplitude control because these are purely analogue circuits and I have nothing to complain about.

For electronics beginners, the functions offered by this generator will be great: many different waveforms, digital frequency setting, stable frequency, relatively low distortion of the sine wave, etc. The price is very good and so is the build quality, but the waveforms it generates are not the best.