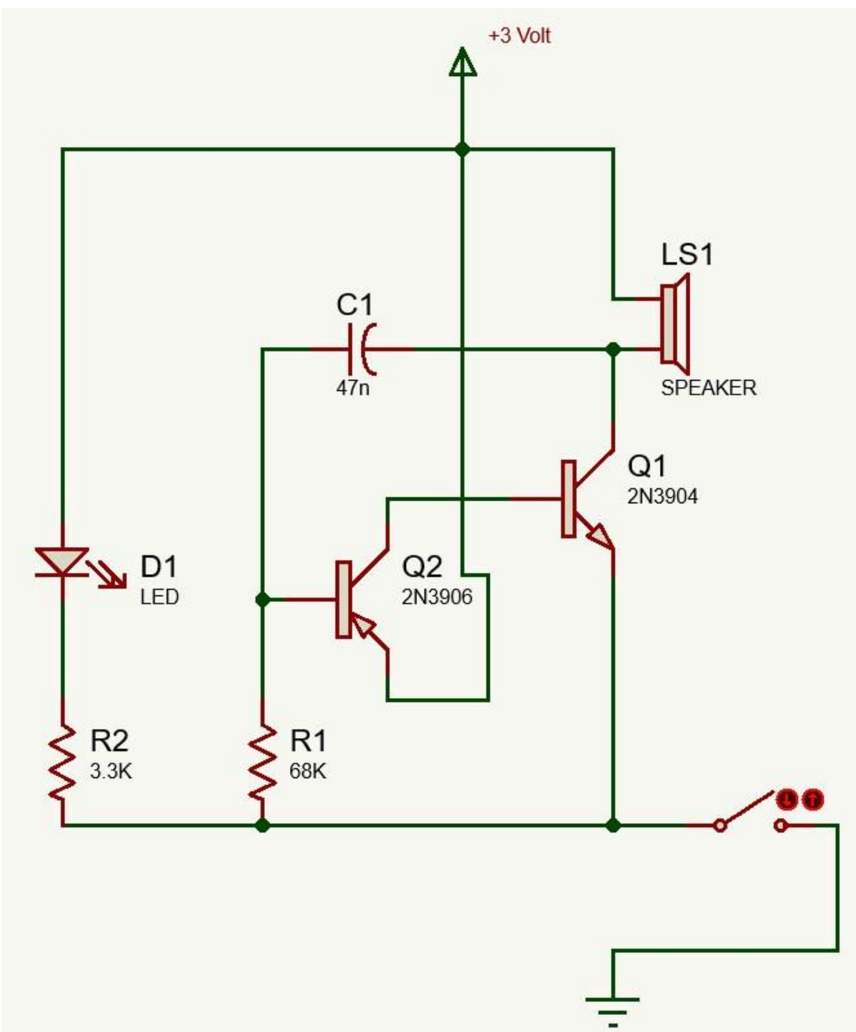
Simple CW practice tone generators

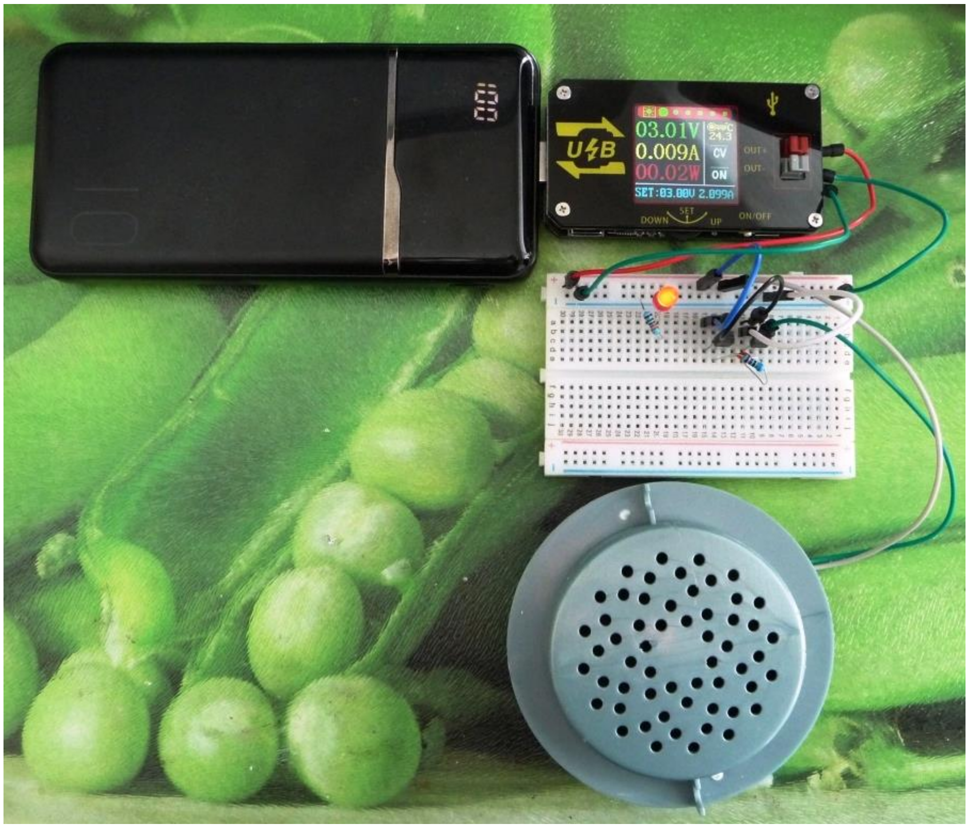
Note: all pictures from this article can be found in higher resolution at:
https://github.com/danielromila/Simple-CW-practice-tone-generators

Following an exchange of emails with John, the editor of The Communicator, I made some simple audio oscillators that can be useful for CW practice. I started from observing some errors in a to be published schematics, and after that I could not stop myself to re-make on the breadboard schematics that I made many-many years ago.

The first generator is 2 bipolar transistors oscillator. One is pnp and one is npn. In my version of this schematics (there are plenty of versions of it on the Internet) I use 3 Volt as power supply. It works without any change from 1.5 v to 6 V. After 6 V the tone changes a bit and it might be necessary to adjust the 68 KOhm resistor in order to keep the generated tone in the 800 Hz – 1000 Hz range. It would work, anyhow. But at 3 V the transistors do not run hot. I used 2N3904 and 2N3906. The consumption is under 10 mA and the total power is under 30 mW. The schematics:



I made it on a breadboard, and I used a power bank with a power supply adapter:

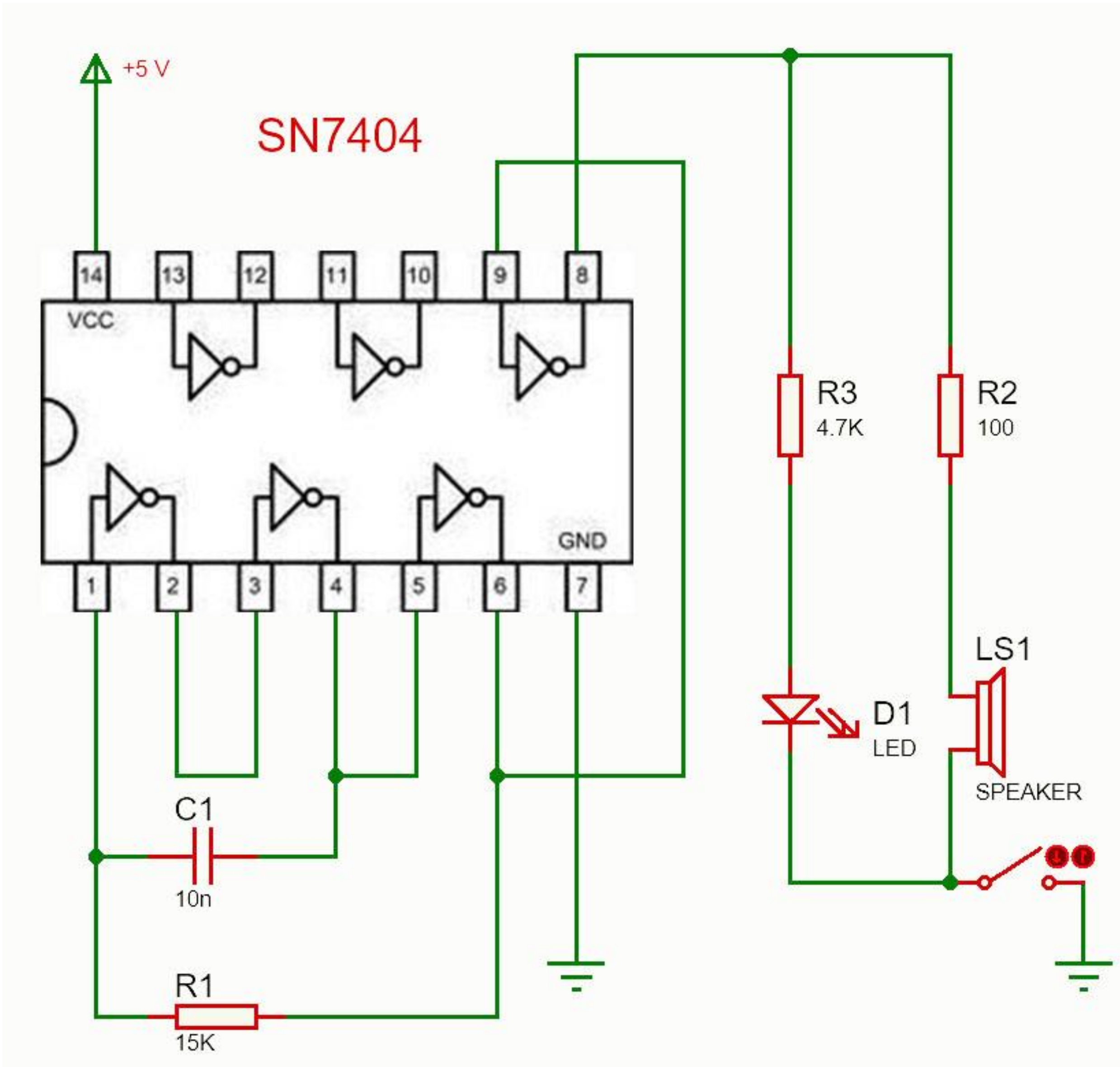


My target current for LEDs is 0.5 mA. They work fine at higher current, with a shorter life span. They can be seen OK even at 50 micro Amps. Pictures and a table with currents and voltages for common LEDs are published by me in SARC the Communicator from December 2018, page 40. LEDs became more and more efficient in the last years, and the days when they needed 20 mA are gone. They are so efficient that they are even used in street lightning (I learned it form The Communicator – LOL!).

You can see and hear this simple audio tone generator at:

https://youtu.be/d2I5sujsM_c

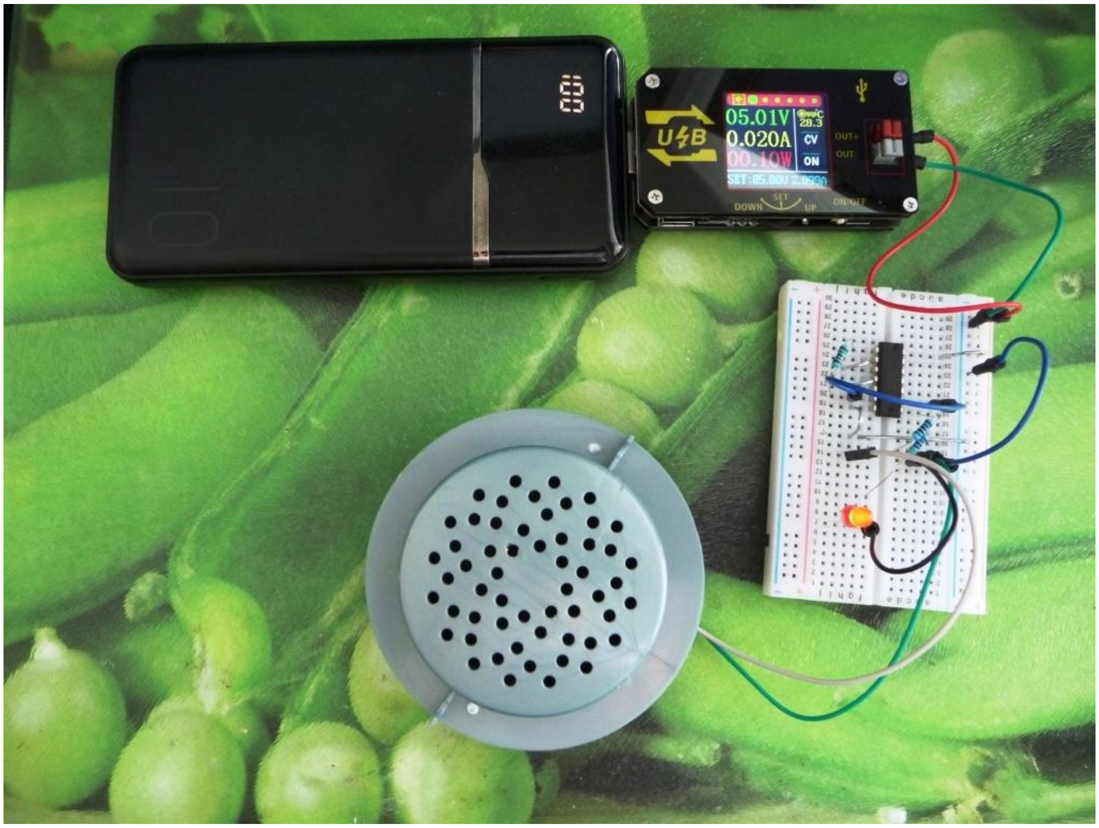
Another simple tone generator is done with a TTL inverter integrated circuit, SN7404:



The keying is done in the speaker/LED ground circuit. In this way the oscillator functions continuously, and it does not change the frequency when the manipulator is pressed. The consumption is under 1 mA without keying and around 20 mA when the manipulator is pressed. The audio frequency is dictated by R1 and C1. F = 1/(1.1*R1*C1). The values from the schematic work and sound good. The sound is more pleasant at this second tone generator because:

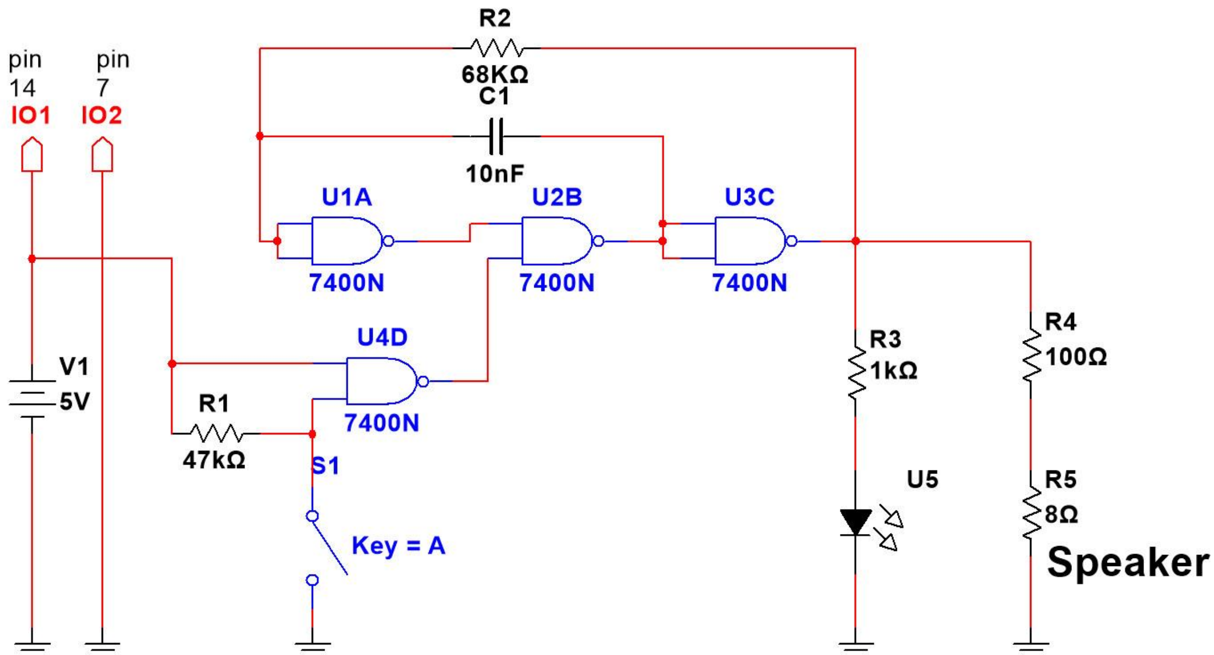
- The rectangular signal is 50% - 50%, while at the first generator there is a train of short impulses, something like 95% - 5%.
- The oscillator is always powered, so it has its frequency stabilized already in the moment(s) of keying.
- The oscillator part is separated from the speaker/LED output by an inverter buffer (the inverter between the pins 8 and 9 of the IC SN7404.

On the breadboard it looks like this:

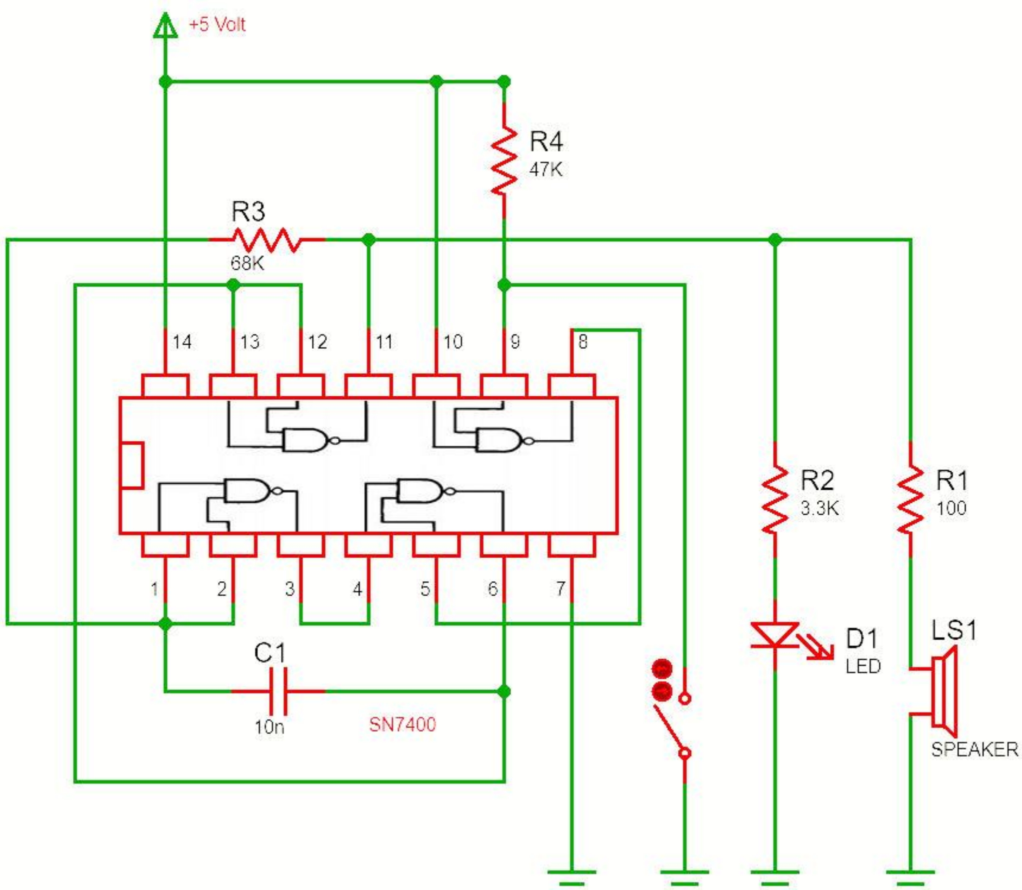


You can see it and hear it in function on youtube at: https://youtu.be/e0-t8pNq5rw

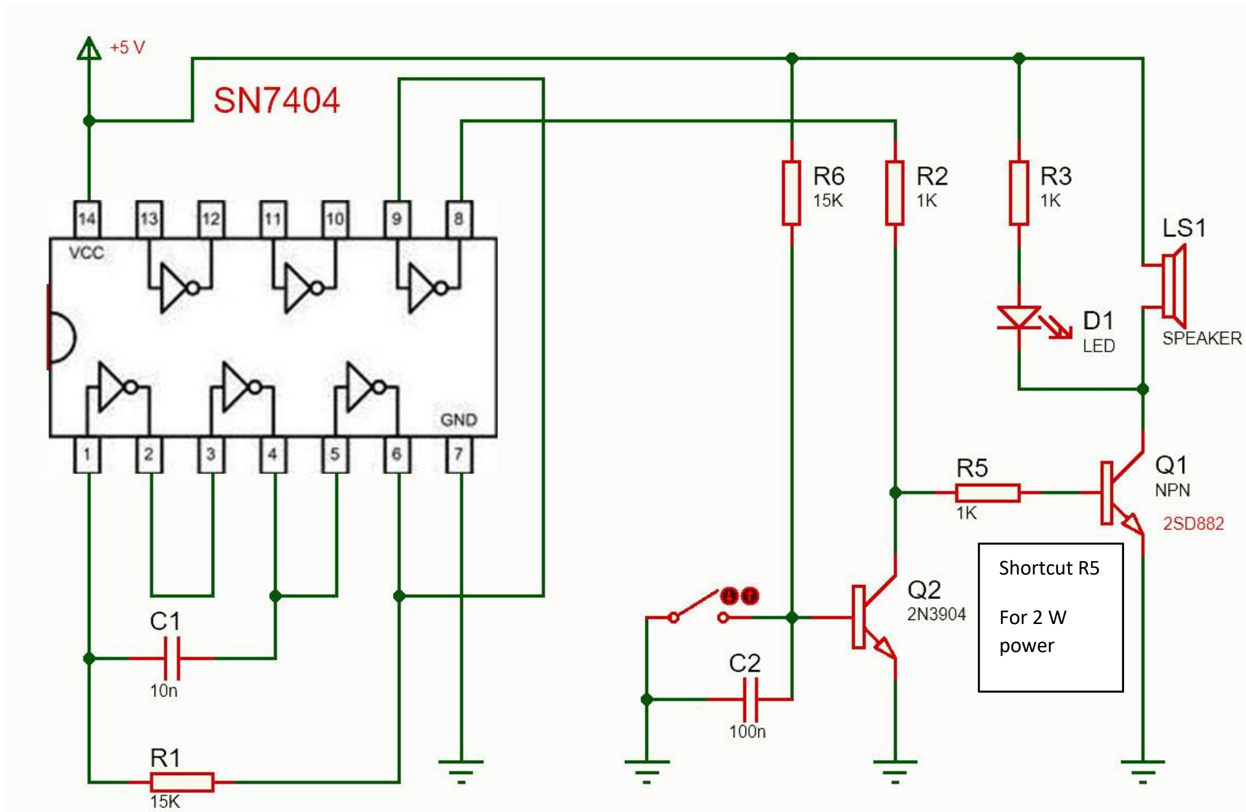
A version of the above uses SN74HC00 instead of SN7400 (SN74HC04). The 14 pins integrated circuit has inside 4 NOT AND gates. One of the gates is used to block or allow the oscillation. It requires a very small current to pass through the manipulating key/switch:



I also drawn the schematic to show the integrated circuit in it:



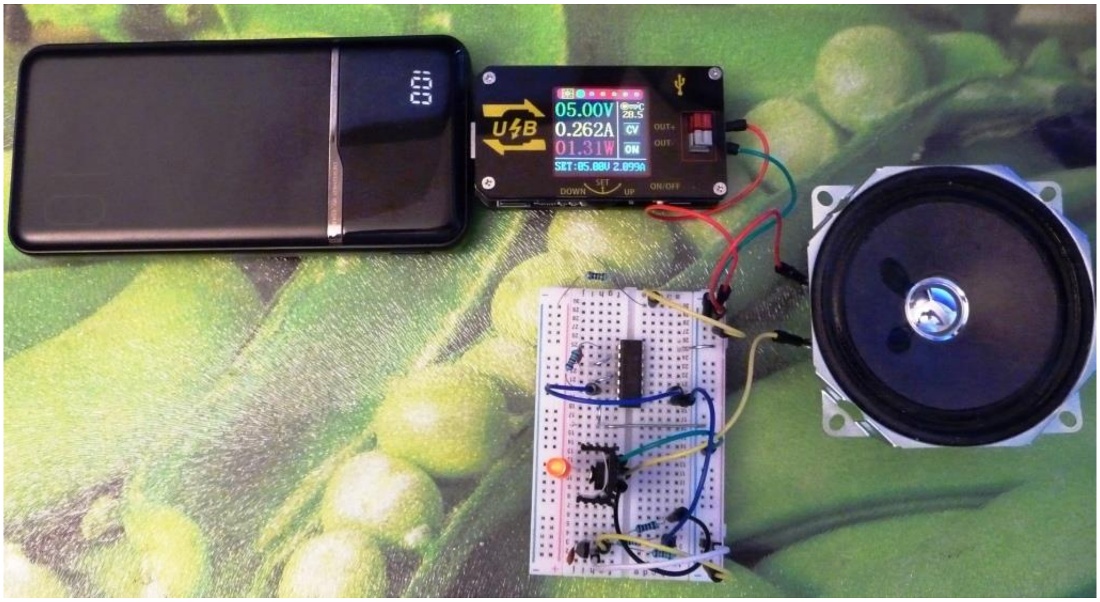
Based on previous schematics I made a “heavy-duty” CW tone generator; if your neighbors did not know you are a ham radio, this is a good opportunity to hear you and find out. I did not want to jump over the top, so I limited the audio power at some 1.3 Watts (in the video I showed how to make it 2 W), but it is possible to obtain 3 Watts by simply playing with the values of the resistors connected in the base of the final 2SD882 transistor:



The inverters 1, 2 and 3 (the lower 3 inverters from SN7404) oscillate and supply with signal the buffer inverter connected between the pins 9 and 8. The output of this last inverter goes through R2 and R5 to the base of the final transistor 2SD882. If Q2 (2N3904) is not put in the circuit, the speaker will be loud, continuously with audio signal, and the LED will lit. But the signal path is cut to the ground by Q2, and there is no sound on the speaker. The base of Q2 is connected with R6 (15 KOhm) to plus 5 Volts. The CW manipulation is done in the base of Q2. In this way the manipulator switches very small current – otherwise the switching would have been done in the emitter of Q1 and hundreds of mA would have been on the contacts of the CW key. C2 limits the unwanted clicks of the contacts.

It seams I created a new schematic that nobody else did (yet). The final transistor does not go into saturation – so there is still reserve to play with the values of R2 and R5 (to reduce them) and to obtain more audio power. By just shortcutting R5 the total power will become 2 Watts. But even with 1.3 Watts it is enough for a classroom, especially if the speaker is inside a dedicated box. The LED requires here a smaller series resistor R3 (1 KOhm) exactly because there is some voltage on the emitter-collector of Q1 and it does not shortcut to the ground. The consumption in standby (power supplied) is 4 mA.

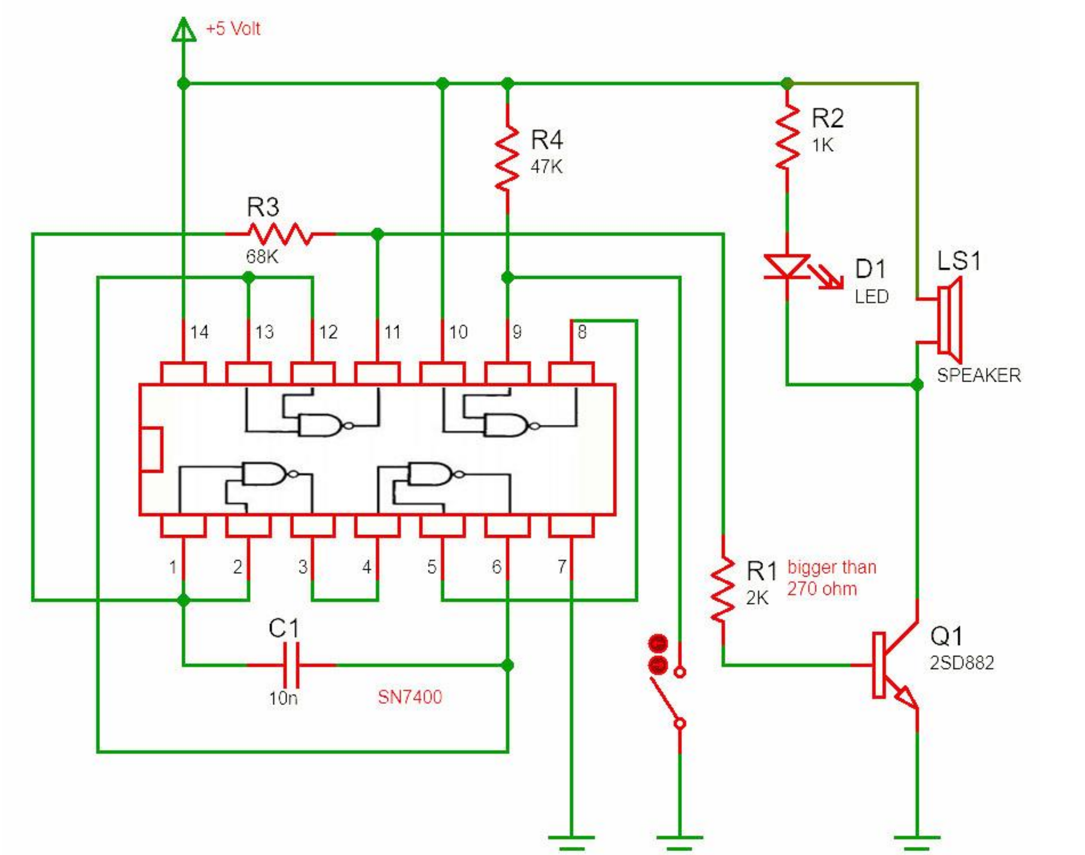
The breadboard is in the following picture, showing the maximum consumption of 262 mA, 1.31 Watts:



You can see it and hear it in function on youtube at: https://youtu.be/hhRU2ucu3Us

The first part of that video is with R5 shortcut. In the second part of the video I removed the shortcut green wire and I repeated the sound test and measurements.

Here is the “heavy-duty” version with SN7400 (SN 74HC00) integrated circuit:



The maximum power can be obtained by reducing R1 from 2 KOhm towards 270 Ohm. Using less than 270 Ohm would put in danger the last NAND gate, because it knows to supply only 16 mA.