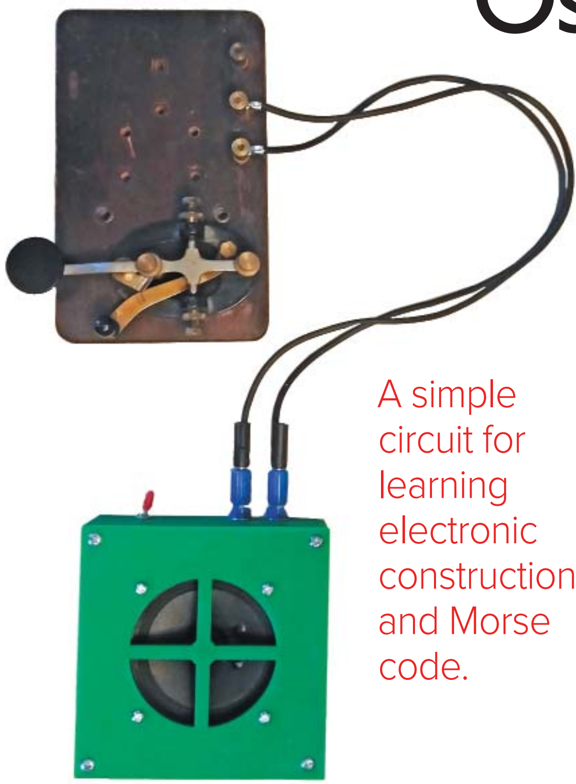
A Budget Code Practice Oscillator for Morse Code Learners



A simple circuit for learning electronic construction and Morse code.

Mark H. Hoffman, KC3BNV

In recent years, I've witnessed a renewed interest in CW, mainly on the 80- and 160-meter bands, especially among DXers. With this comes the need for Morse code training, provided by web tutorials, online classes, and phone apps, using Farnsworth, Koch, and other methods for learning code. One of the best online websites to learn CW is **https://lcwo.net**. In addition, Rol Anders, K3RA, periodically hosts a Morse code *Zoom* class, sponsored by the ARRL Eastern Pennsylvania Section.

As many students know, receiving and sending code can be two different skills. Forty-five years ago, when I was a young B-52G combat navigator and electronics officer, it took me longer to compose words in code than it did to receive messages in code, because I knew I was being graded only on how many words I could accurately translate in 1 minute. Since then, I've put together what I call a budget code practice oscillator (CPO) for code learners (see the lead photo).

Materials and Construction

I used a handful of electronic parts, a vintage World War II J-38 key that I bought at a flea market for nostalgic reasons (not knowing that I would eventually put it to use), and a case to house the parts that I designed using a 3D printer. See Tables 1 and 2 for lists of parts you'll need to build this project.

The oscillator circuit revolves around the NE555 timer chip, which is an eight-pin dual inline package (DIP)-integrated circuit chip that's available online at a low cost. A schematic diagram of the circuit I designed is shown in Figure 1. It produces a 50% duty cycle square wave over a wide range of values of R2 (more on this later). The prototype printed circuit board (PCB) I used to wire the oscillator circuit is an ElectroCookie

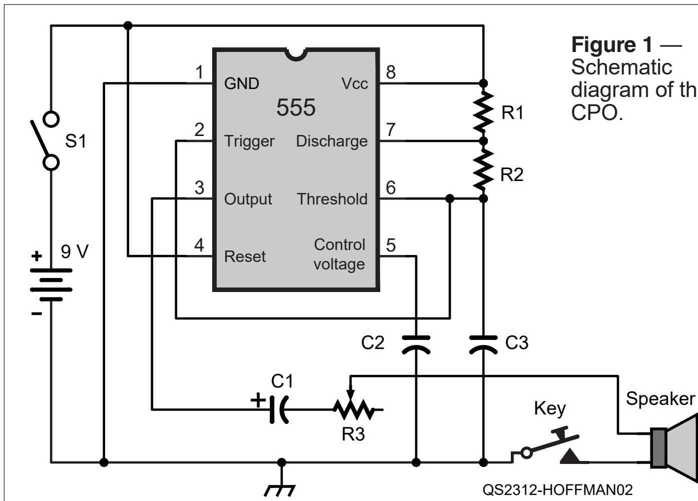


Figure 1 — Schematic diagram of the CPO.

Table 1 — Schematic Parts

Schematic Designator	Part	Mouser Electronics Part Number
IC1	NE555 DIP IC	595-NE555P
S1	SPST switch, mini	633-M201101
R1	10 kΩ, ½ W resistor	588-OL1035E-R52
R2	120 kΩ, ½ W resistor	588-OL1245E-R52
R3	2 kΩ 20-turn linear potentiometer, PC mount	858-66XR2KLF
C1	33 µF, 25 V or more electrolytic capacitor	667-EEU-FC2A330LB
C2 and C3	0.01 µF, 25 V or more capacitors	594-D103Z25Z5VF63L6R

Table 2 — Other Parts

Part	Retailer/Manufacturer
3-inch 8 Ω speaker (or equivalent)	Mouser Electronics 485-1313
9 V battery	Mouser Electronics 613-MN1604
9 V battery clip	Mouser Electronics 375-LS-00033
Telegraph straight key for Morse code	Used on eBay or new MFJ-550
Two banana plugs	Mouser Electronics 530-108-0312-1
Two banana plug receptacles	Mouser Electronics 565-1581-8
#22 AWG solid copper-insulated hook-up wire	Mouser Electronics 474-PRT-08026
ElectroCookie solderable breadboard (compatible with DIY Arduino)	Amazon
3D-printed base housing*	
3D-printed battery clamp*	
3D-printed speaker enclosure*	
**Autodesk Inventor* files used to design these parts, and the files to 3D-print them, are available on *QST* in Depth.	

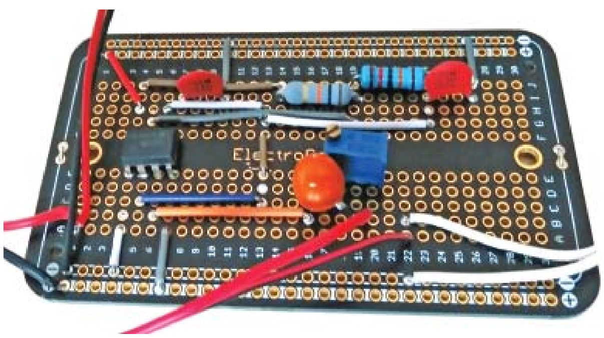


Figure 2 — The ElectroCookie breadboard with the parts mounted. Try to copy this layout exactly to avoid errors, though a socket for the NE555 timer chip is optional. Schematic designator R3 adjusts the volume; the lower the volume, the less current the circuit draws.

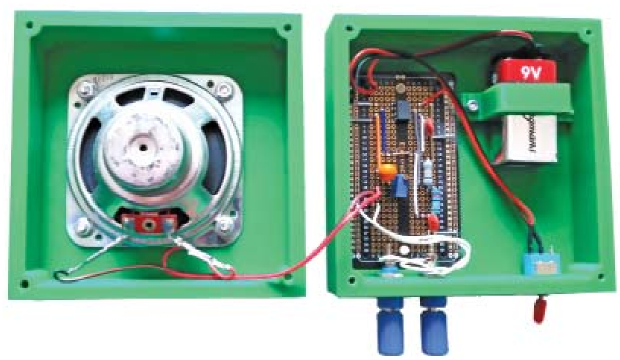


Figure 3 — The 3D-printed CPO housing consists of a base that accommodates the PCB, the battery with a clamp, the power switch, and banana receptacles for the keyer. The cover houses the speaker.

and is available from Amazon (see Figure 2). Notice that this PCB acts like a solderless breadboard, where contacts in the same column are connected on the top and bottom halves of the board.

My vintage J-38 straight key required some work to clean the contacts and make it operable. If you look around at hamfests or on eBay, you can find a key for about $20. MFJ Enterprises sells a model with a stamped metal key on a plastic base for $34.95 (**https://mfjenterprises.com/collections/cw/products/mfj-550**). Any commercial key can be used (except for paddles because they're used only with an electronic keyer), as it's a simple switch and doesn't require any special considerations. The key I used is connected to the CPO with banana plugs, but the wires can be connected directly to the CPO.

Additional Notes

This CPO operates using S1 as an on/off switch, producing a square wave tone. The frequency of the oscillator can be changed by altering the value of R2. Lower values of R2 increase the oscillator frequency. Keeping the oscillator frequency between 400 and 600 Hz is preferable for learning. This corresponds to a range of R2 values between 108 K (600 Hz) and 163 K (400 Hz). A table of typical resistor values for R2 and the corresponding frequencies are available on the *QST* in Depth web page at **www.arrl.org/qst-in-depth**.

In the digital edition of *QST* (**www.arrl.org/qst**), we take you through a build of this code practice oscillator. See how easy it can be to complete this on your own workbench!

The 3D-printer files I used to create the two housing halves and the battery clamp (shown in Figure 3) are available on the *QST* in Depth web page. I also used the *UltiMaker Cura 4.12.1* slicer software program to generate the G codes. This program can be downloaded for free at **https://ultimaker.com/software/ultimaker-cura**. Otherwise, any type of casing, such as a Bud Industries box, can be used to package the oscillator. I hope you enjoy building and using this project!

See *QST* in Depth for More!

Visit www.arrl.org/qst-in-depth for the following supplementary materials and updates:

- ✓ A diagram of the circuit board and more photographs. You can print them in a larger format to more easily see how to build your circuit board.
- ✓ Files for making your own 3D-printed enclosure.
- ✓ Details about changing the frequency and volume output of the CPO.

All photos by the author.

Mark H. Hoffman, KC3BNV, graduated from Lehigh University with a Bachelor of Science in Electrical Engineering, Master of Science in Electrical and Computer Engineering, and a Master of Education. He served in the USAF as a B-52G Electronic Warfare Officer for 8 years, then worked as a Microwave Traveling Wave Tube Engineer/Manager/Senior Scientist for 15 years at ITT in their Defense Electron Technology Division until its closure. Mark was a high school teacher for 20 years and taught mathematics, AP physics (electromagnetics), and pre-engineering, and he coached the high school's Science Olympiad and Robotics teams. He's a licensed master electrician, a certified electronics technician, an Amateur Extra-class radio operator, and a member of the International Association of Electrical Inspectors. In his spare time, Mark refurbishes 1960s stereo consoles; designs, builds, and flies RC aircraft; designs parts on his 3D printer, as well as designs and builds electronic and radio circuits and HF antennas. He can be reached at **b52ewo54@gmail.com**.

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