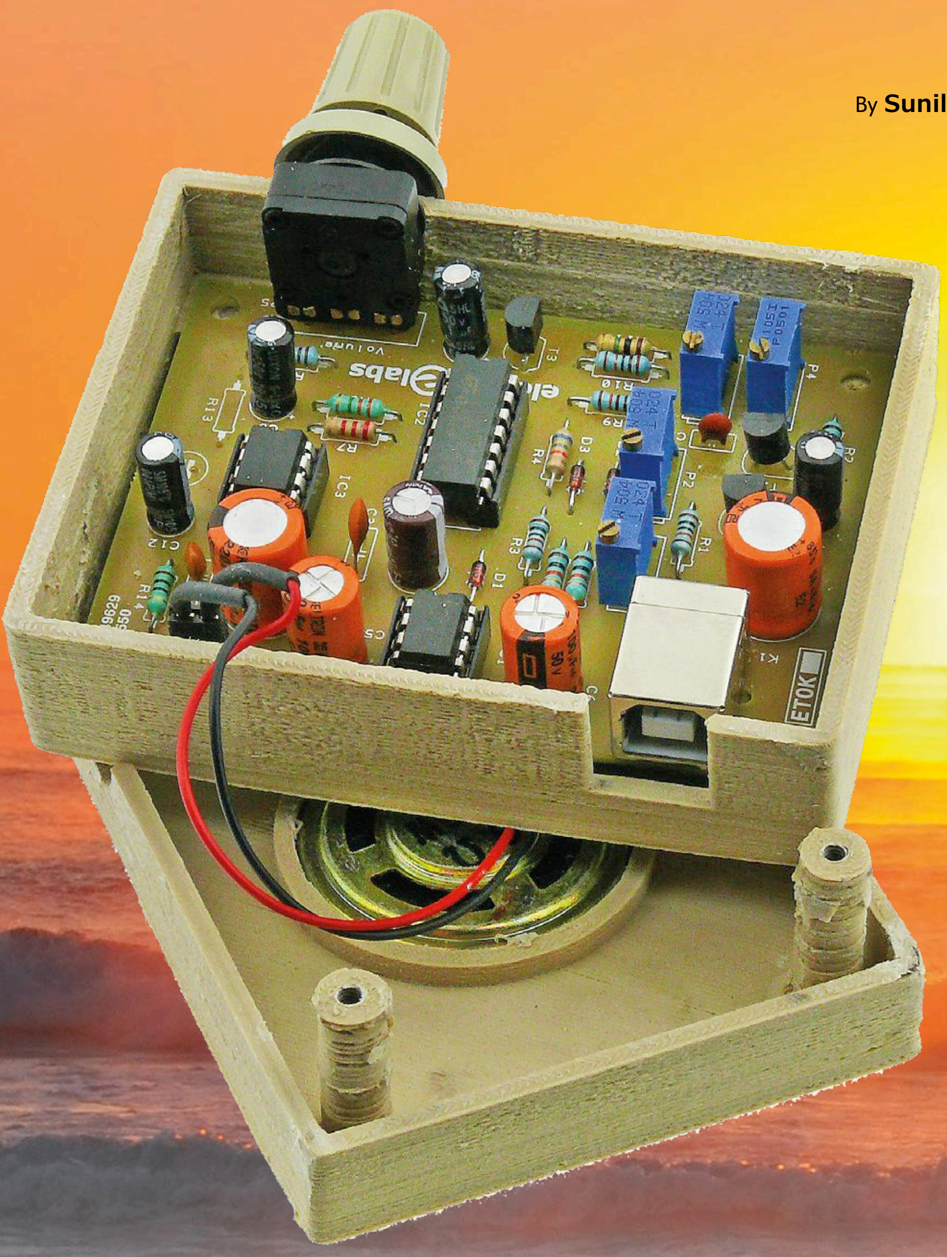
eLABS PROJECT

Sea Murmur Simulator

Gentle noise to help you go to sleep



By **Sunil Malekar** and **Clemens Valens** (Elektor Labs)

When Morpheus' arms keep eluding you, listening to the sound of surf and waves breaking on a beach may help you to relax. With the circuit presented here switched on at your bedside Mr Sandman is sure to stop by.

You may think that for producing a magazine like *Elektor* all that is required are some editors to write articles and one or two graphics designers to create nice illustrations. That is only partly true. One of the main reasons — possibly the only one — for you to be able to read your favorite magazine every eight weeks is because of our Multifunctional Power Planner and unsung hero Hedwig. Although electronics is not her specialty (*"is this capacitor thing or whatever it is supposed to be this kind of blue?"*), Hedwig does have a pet circuit: the sea sound generator. So Hedwig, this one is for you.

PROJECT INFORMATION

Noise
Simulator
Relaxation

➡ entry level
intermediate level
expert level

1 hour approx.

Soldering iron,
small screwdriver,
bed

£12 / €15 / $17 approx.

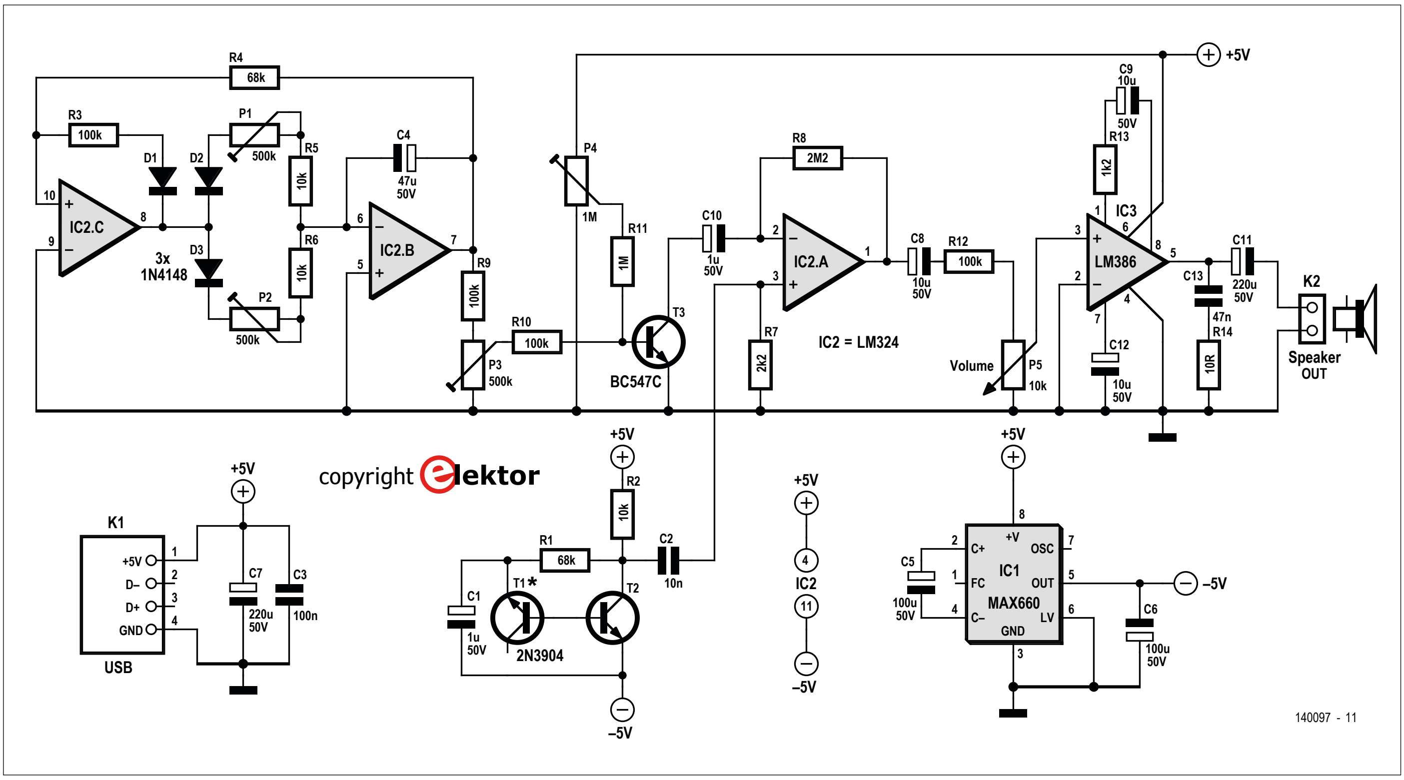
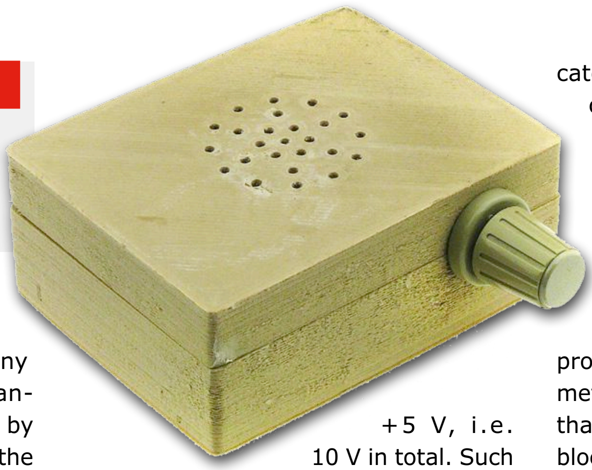


Figure 1. The internals of the sea murmur simulator.

Features

- Independent control of wave attack and decay shape
- Powered from a phone charger
- No (0) Arduino inside



The sound of waves breaking on the beach is considered relaxing by many people. As relaxing and even romantic as it may appear, when analyzed by the impartial and objective scientist the sound turns out to be modulated noise in essence. Perhaps slightly pink noise, as a vague reminiscence of the setting sun, but noise it is. Noise is easy to produce with an electronic circuit — as a matter of fact, it is much more difficult to not produce noise with electronics. Basically, all you need to do is reverse-bias a diode.

The circuit

Even though generating noise is easy, making usable noise requires some effort. **Figure 1** shows the schematic of the contraption we came up with. Here the noise source is T1 wired as a reversed-biased diode with its emitter mimicking a cathode and its base, an anode. The noise it produces is buffered by T2. Looking closely you will notice that this transistor is connected between –5 V and +5 V, i.e. 10 V in total. Such a 'high' voltage is necessary for producing good noise. T1 and T2 are specified as 2N3904 because it was found that these transistors produce more noise than the more Elektor-savvy BC547 a.k.a. TUN in the old days. We tried that one too, and it worked, but you may obtain better results with the given types. If you want to experiment with these transistors, keep in mind that the 2N3904 for which we designed the printed circuit board does not have the same pinout as the BC547.

Now that we have noise, we have to modulate it to simulate the sound of the waves and the surf. Modulation requires an oscillator. Some sort of asymmetric sine-like wave is likely to result in the most realistic effect, but this complicates matters a bit, especially because of the asymmetrical aspect, i.e. the swell or attack of the sound should not have the same duration as its decay. An asymmetric triangle generator is much easier to build, see the circuitry around IC2.C and IC2.B, and the result is more than satisfying. Normally such an oscillator produces a triangular wave that's symmetrical around zero, but we don't want that here as the negative halves would block our modulator T3, resulting in discontinuous breakers. To prevent this happening, D1 was added. Now the output of IC2.B sweeps nicely between 0 V and about 3 V.

Pots P1 and P2 control the slopes of the modulating signal; P1 adjusts the rising slope, P2 the falling slope. Together they determine the frequency of the signal, the speed of the waves so to speak. The smaller their total value, the higher the frequency. Their ratio determines the symmetry of the signal.

Transistor T3 acts as a current-controlled resistance controlling the amplification of IC2.A; the smaller the resistance, the stronger the output signals. Pots P3 and P4 then, provide a means of fine tuning the amplification.

The output of IC2.A is fed through P5, the overall volume control, to a power amplifier built around IC3. This is a classic LM386 circuit capable of driving a loudspeaker or headphones. The gain of the amplifier can be set to anywhere from 20 to 200 by using the right combinations of parts R13 and C9.

Without these parts the gain is 20, with only C9 between pins 1 and 8 (i.e. R13 = 0 Ω) the gain is maximum (200). The values shown in the schematic set the gain to 50 or so.

Although a large part of the circuit is powered from a symmetric ±5 V supply, a standard 5-V USB phone charger is sufficient to make it all work. This is made possible by IC1, a MAX660 chip wired as a switched-capacitor voltage inverter, and USB connector K1.

Calibration

Like every high-precision instrument, our sea murmur simulator has several trimpots that require adjustment in order to get the best result. Luckily, the procedure is simple. It starts by turning P3 to its minimum position (i.e. wiper to 0 V). P4 controls the background noise of the virtual sea when there are no waves at all. Adjust P4 for a nice, soft whisper in the loudspeaker.

Now adjust P3 to add waves. It effectively controls the amplitude of the waves — simply set it to a realistic level. If the sound appears to start clipping, lessen off on P4 a little. Remember that P3 and P4 affect each other so that further fine tuning may be necessary.

Finally the 'shape' of the waves has to be adjusted with P1 and P2. Extensive studies and simulations in the lab have shown that the rise of a wave (P1) is usually 5 to 10 times shorter than its decay (P2); the required wave shape is therefore more like a sawtooth than a triangle. The wave period should be several seconds — adjust to taste.

(140097)

FROM THE STORE

→140097-1
PCB

Web Link

[1] www.elektormagazine.com/140097

COMPONENT LIST

Resistors
R1,R4 = 68kΩ
R2,R5,R6 = 10kΩ
R3,R9,R10,R12 = 100kΩ
R7 = 2.2kΩ
R8 = 2.2MΩ
R11 = 1MΩ
R13 = 1.2kΩ
R14 = 10Ω
P1,P2,P3 = 500kΩ trimpot
P4 = 1MΩ trimpot
P5 = 10kΩ linear potentiometer

Capacitors
C1,C10 = 1µF 50V
C2 = 10nF
C3 = 100nF
C4 = 47µF 50V
C5,C6 = 100µF 50V
C7,C11 = 220µF 50V
C8,C9,C12 = 10µF 50V
C13 = 47nF

Semiconductors
D1,D2,D3 = 1N4148
IC1 = MAX660
IC2 = LM324
IC3 = LM386
T1,T2 = 2N3904
T3 = BC547C

Miscellaneous
K1 = USB-B connector
K2 = 2-pin pinheader, 0.1" pitch
PCB # 140097-1