27

Elektor Classic: **Surf Synthesizer**

Ocean Watersports Background Sound Generator (OWBSG)

By Clemens Valens (Elektor)

Over the years, Elektor has published many designs for ocean sound generators, from simple noise generators to more complex circuits with user controls. The one presented in this article is probably the most complex, but is very realistic.

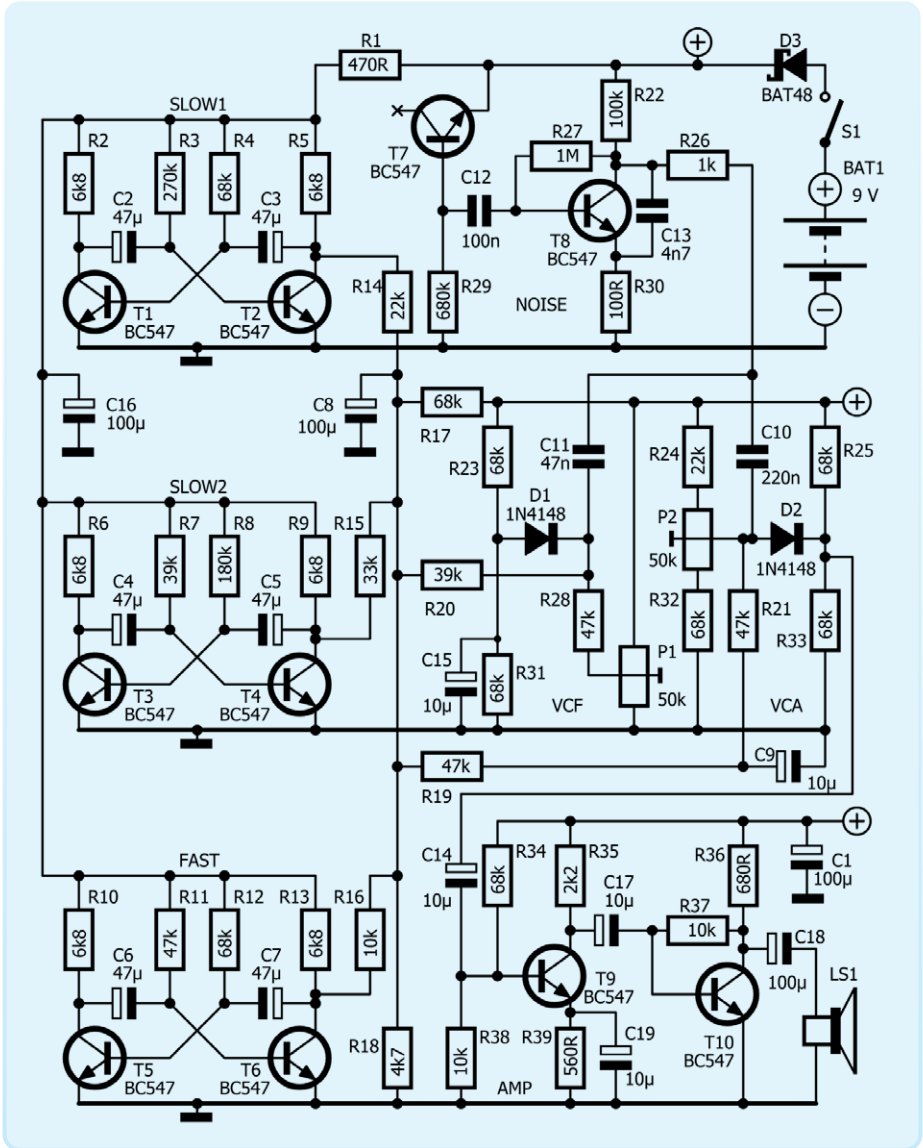


Figure 1: Almost every value from the E12 resistor series is represented in the circuit. The three LFOs (astable multivibrators) are on the left, the VCF and VCA are formed by diodes D1 and D2.

The Surf Synthesizer presented here convincingly imitates the sound of breaking waves. The circuit, originally published in the February, 1972 edition of American magazine *Popular Electronics*, was printed in that year's summer edition of Elektor as part of a collection of five circuits dedicated to the Summer Olympics held then in Munich, Germany. In the Dutch edition [1], the circuit was called "zwsaggg," which is an onomatopoeia for the sound of breaking waves. The German title was "Mwsh3g" [2]. Only in Germany does the sea sound like that.

The Surf Synthesizer is probably the most complicated sea sound generator ever developed. It can be considered a real analog music synthesizer, as it follows the paradigm of voltage-controlled subtractive sound synthesis made popular by Robert Moog and friends (remember the Elektor Formant?). True, it does not have a VCO (voltage-controlled oscillator), but that is because it has a noise generator as a sound source. It does have a VCF (voltage-controlled filter), a VCA (voltage-controlled amplifier), and three LFOs (low-frequency oscillators).

The Circuit

The schematic of the Surf Synthesizer is shown in **Figure 1**. Transistor T7, connected in reverse bias with its collector left unconnected, serves as the noise generator. T8 amplifies the weak signal and sends it to the VCF and VCA.

Three astable multivibrators (T1 & T2, T3 & T4, T5 & T6) produce three periodic signals, each with a different frequency and duty cycle. They are added together (R14, R15 & R16) and smoothed (C8) to create a slowly and semi-randomly varying voltage across R18. This signal modulates the VCF and VCA. The control signal is smoothed a bit more by the VCA (C9) so the amplifier lags the filter, which improves realism.

Voltage-Controlled Diodes

The noise filtered by the VCF is mixed with the unfiltered signal and fed into the input of the VCA. Both the VCF (D1) and VCA (D2) use the current-dependent resistance of a silicon diode to obtain voltage control. The level of control can be adjusted with P1 and P2.

The output of the VCA is amplified by T9 and T10 to drive a small loudspeaker or headphones.

Building the Surf Synthesizer

Assembling the circuit is easy if you have the printed circuit board that we freshly designed for it (**Figure 2**). The only rule to keep in mind is to work your way up in component size, i.e. start with the diodes, then the resistors and save the electrolytic capacitors for the end. The very last part to mount is the battery holder that goes on the rear side of the board. Fixing it with at least one bolt and nut is recommended, as that makes it easier to remove the battery.

Note that a hole is provided for mounting a panel-mount 3.5 mm headphone socket instead of a speaker. Connect it with two wires to the audio output on the backside of the board, see **Figure 3**.

The power supply is a 9 V battery. This "high" voltage is required by the noise generator. It will not work with a lower voltage.

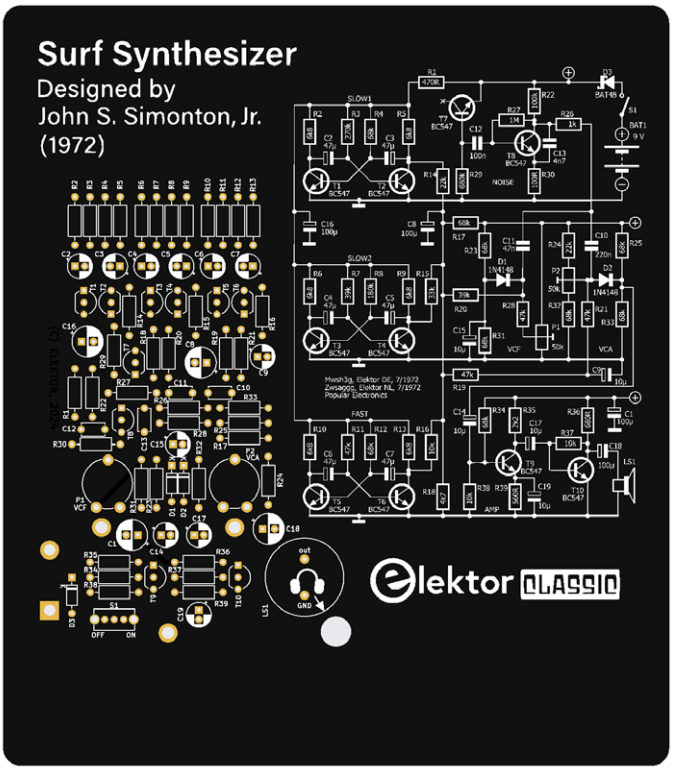


Figure 2: A stylish PCB was designed to celebrate the Surf Synthesizer.

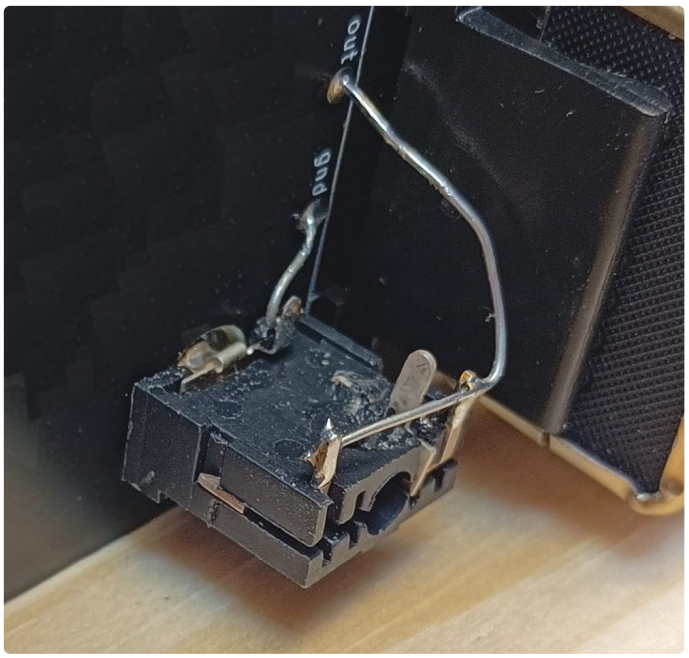


Figure 3: This is how you can connect a 3.5 mm socket for headphones. You can probably do better.

Adjust to Taste

Adjusting the circuit is simple and quick, but personal. Connect a speaker or headphones and turn P1 and P2 to their maximum position. You should hear continuous unmodulated noise. Turn P1 (VCF) back until you are happy with the wave effect. Then adjust P2 (VCA) to improve realism. You may have to play around a bit with both trimmers to obtain the sound you like best.

240095-01

Component List

Resistors (5%, 0.25 W)

R30 = 100 Ω
R1 = 470 Ω
R39 = 560 Ω
R36 = 680 Ω
R26 = 1 kΩ
R35 = 2.2 kΩ
R18 = 4.7 kΩ
R2, R5, R6, R9, R10, R13 = 6.8 kΩ
R16, R37, R38 = 10 kΩ
R14, R24 = 22 kΩ
R15 = 33 kΩ
R7, R20 = 39 kΩ
R11, R19, R21, R28 = 47 kΩ
R4, R12, R17, R23, R25, R31, R32, R33, R34 = 68 kΩ
R22 = 100 kΩ
R8 = 180 kΩ
R3 = 270 kΩ
R29 = 680 kΩ
R27 = 1 MΩ
P1, P2 = 50 kΩ trimmer

Capacitors

C13 = 4.7 nF
C11 = 47 nF
C12 = 100 nF
C10 = 220 nF
C9, C14, C15, C17, C19 = 10 µF, 16 V, 2 mm pitch
C2, C3, C4, C5, C6, C7 = 47 µF, 16 V, 2 mm pitch
C1, C8, C16, C18 = 100 µF, 16 V, 2.5 mm pitch

Semiconductors

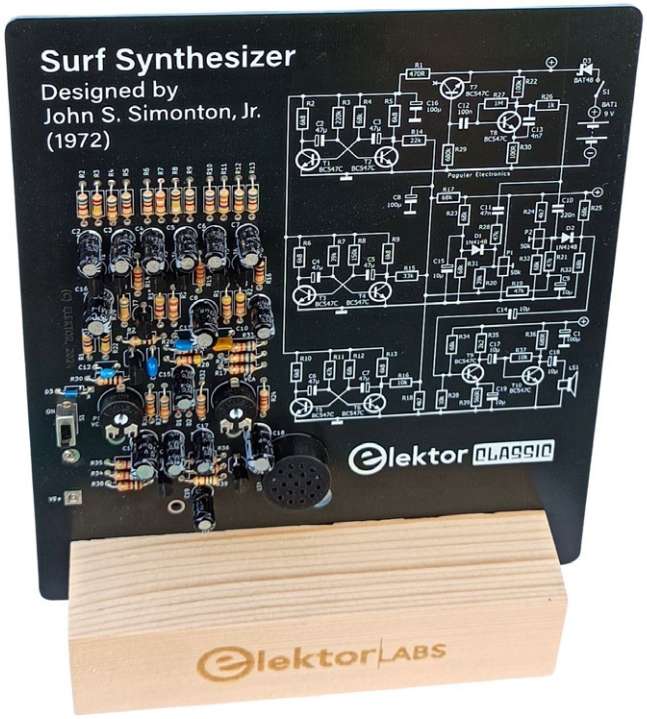
D1, D2 = 1N4148
D3 = BAT48
T1, T2, T3, T4, T5, T6, T7, T8, T9, T10 = BC547C

Divers

BAT1 = PP3 9 V battery holder
K1 = speaker 8 Ω, 200 mW
S1 = slide switch

Related Products

- **Elektor Surf Synthesizer Kit**
  www.elektor.com/20896
- **Elektor Funny Bird Kit**
  www.elektor.com/20523
- **Elektor One-Armed Bandit Kit**
  www.elektor.com/20516



WEB LINKS

[1] "Zeewatersportachtergrondgeluidgenerator (zwsaggg)," Elektuur 7-8/1972: https://elektormagazine.nl/magazine/elektor-197207
[2] "Mwsh3g (Meereswassersporthintergrundgeräusch-generator)," Elektor 7-8/1972: https://elektormagazine.de/magazine/elektor-197207/55057
[3] J. S. Simonton, Jr., "Build the Surf Synthesizer," Popular Electronics, February 1972, p45: https://tinyurl.com/popelec7202