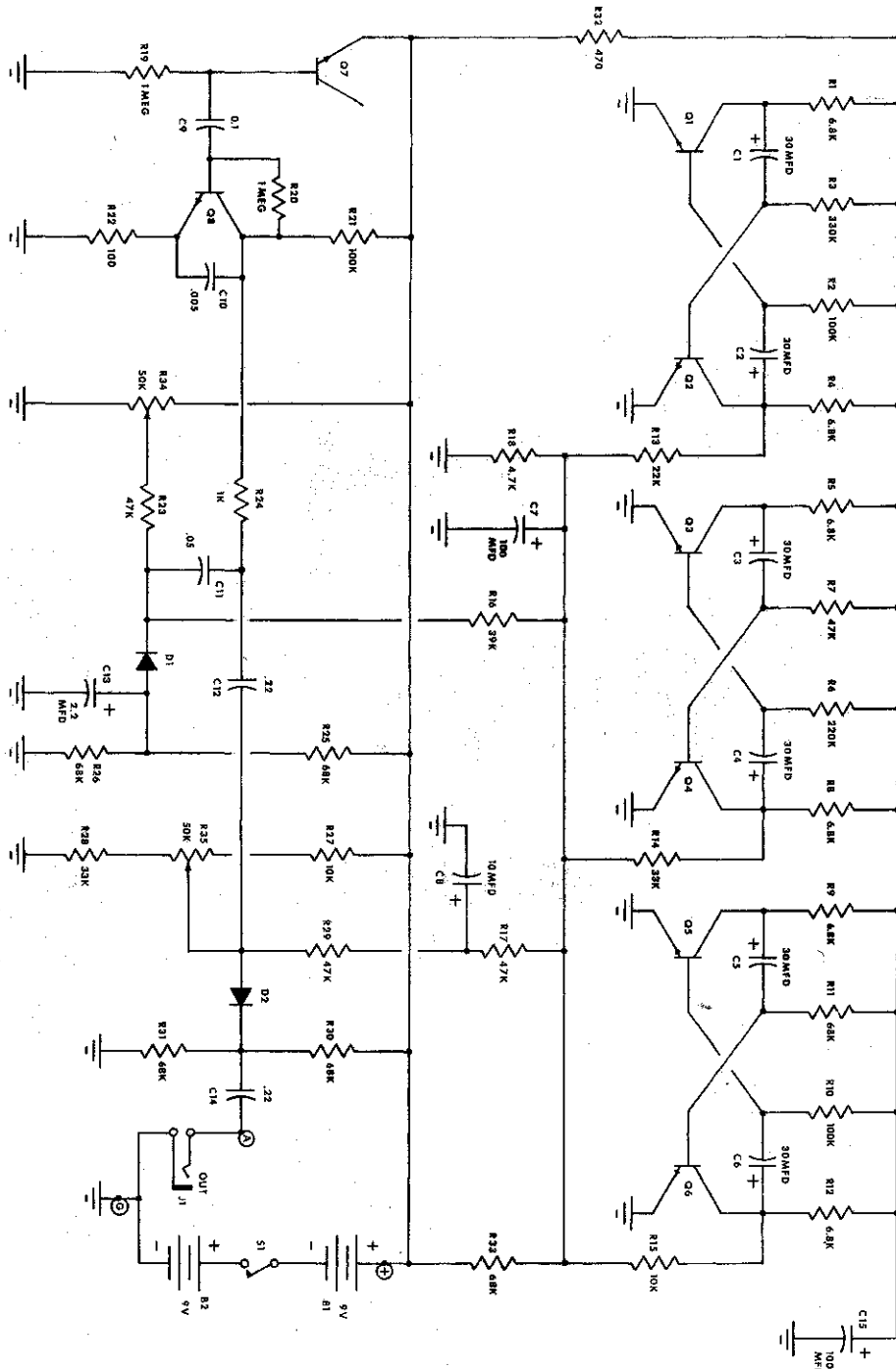
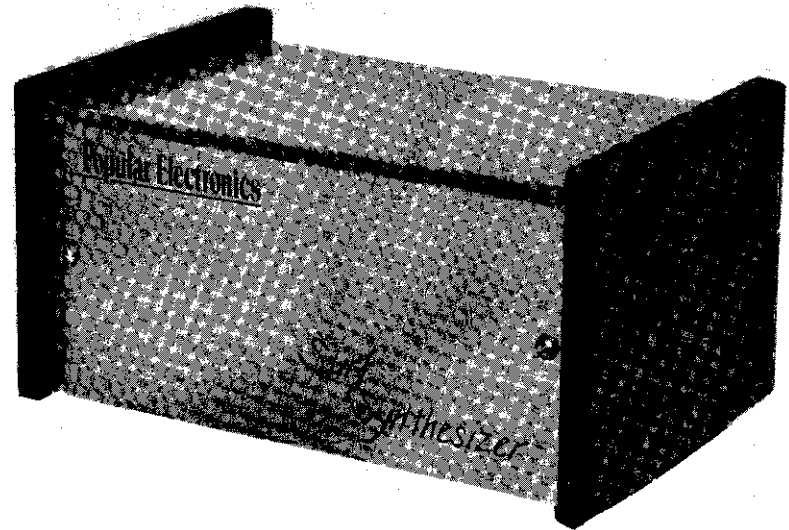


# SURF SYNTHESIZER

## Instruction Manual



One of the most relaxing sounds imaginable is the roar of the surf. From presidents on down anyone who is close enough and has the time heads for the sea shore when they want to unwind. But what is really nice to have is the sound of the surf always available at the flick of a switch and now you can. The Surf Synthesizer turns your living room into the next best thing to a Malibu Beach apartment.

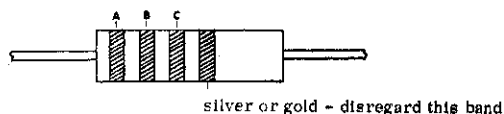
The Surf Synthesizer is actually a special purpose electronic music synthesis system. White noise generated by an inexpensive silicon transistor is voiced by a voltage controlled low pass filter and attenuator under the control of a random voltage generator to convincingly reproduce the sound of the breakers washing against the shore line.

#### CIRCUIT BOARD ASSEMBLY

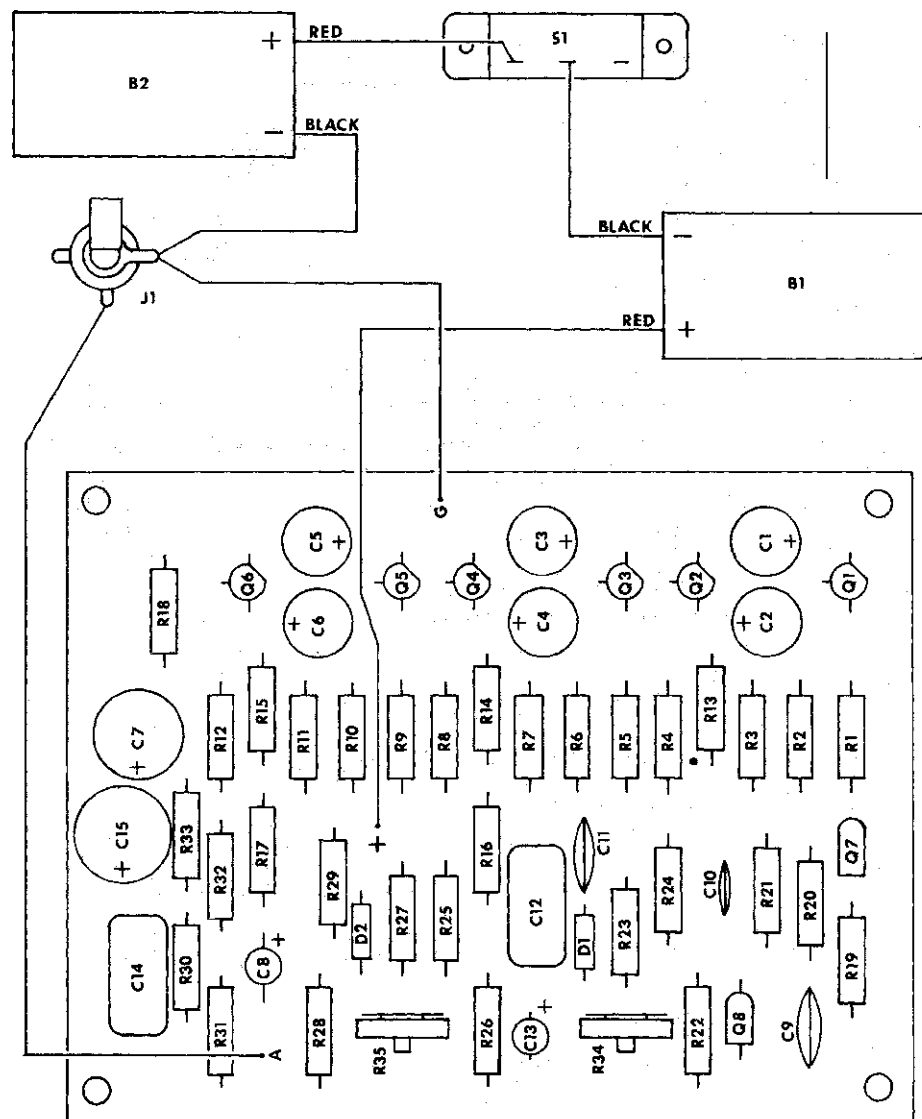
Use care when mounting all components. Use only rosin core solder ( not acid core ). A proper solder joint has just enough solder to cover the round soldering pad and about 1/16 inch of the lead passing through it. There are two improper connections in particular to beware of: Using too little solder will sometimes result in a connection which appears to be soldered but actually there is a layer of flux insulating the component lead from the solder bead. This situation can be cured by re-heating the joint and applying more solder. If too much solder is used on a joint there is the danger that a conducting bridge of excess solder will flow between adjacent circuit board conductors forming a short circuit. Unintentional bridges can be cleaned off by holding the board up-side down and flowing the excess solder off onto a clean, hot soldering iron.

Select a soldering iron with a small tip and a power rating not more than 35 watts. Soldering guns are completely unacceptable for assembling transistorized equipment because the large magnetic field they generate can damage solid state components.

Begin assembly by mounting and soldering in place all resistors following the parts placement designators printed on the circuit board and cinching them in place by bending their leads outward to about a 45° angle on the conductor side of the board. As each lead is soldered clip it off flush with the solder joint. Resistor color coding is listed below.



DESIGNATION	VALUE	CODE A-B-C
R1, R4, R5, R8		
R9, R12	6.8K	blue-grey-red
R2, R10, R21	100K	brown-black-yellow
R3	330K	orange-orange-yellow
R6	220K	red-red-yellow
R7, R17, R23		
R29	47K	yellow-violet-orange
R13	22K	red-red-orange
R14, R28	33K	orange-orange-orange
R15, R27	10K	brown-black-orange
R16	39K	orange-white-orange
R18	4.7K	yellow-violet-red
R19, R20	1 megohm	brown-black-green
R22	100 ohm	brown-black-brown
R24	1K	brown-black-red
R11, R25, R26		
R30, R31, R33	68K	blue-grey-orange
R32	470 ohm	yellow-violet-brown



When all resistors, including the two 50K trimmers, have been mounted move on to the capacitors and mount the ceramic disks as listed below:

DESIGNATION	VALUE
C9	0.1 mfd.
C10	.005 mfd.
C11	.05 mfd.
C12, C14	.22

Next, mount the electrolytic capacitors. Note that these capacitors are polarized and must be correctly oriented for proper operation. The value of these components is marked "+" or "-". If the polarization marking is not clear you can count on the longer of the two leads being "+". In some kits the voltage rating of the capacitor may not agree with the list below. The listed values are the minimum acceptable and unless the component is marked with a LOWER voltage than that listed there is no need for concern.

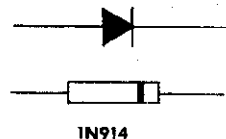
DESIGNATION	VALUE
C1, C2, C3, C4, C5, C6	30 mfd./10v.
C7	100 mfd./16v.
C8	10 mfd./10v.
C13	2.2 mfd./16v.
C15	1,000 mfd./10v.

Complete the circuit board by installing the diodes and transistors. Note that the parts placement designations printed on the circuit board are shown as the transistors will appear as you look down on the board from the COMPONENT side. The basing diagrams below are bottom views of the devices as they appear with the leads pointing toward you.

Transistors and diodes are heat sensitive and must be protected from temperature damage. While soldering them in place grip the lead being soldered with a pair of needle nose pliers between the body of the component and the point being soldered.

Note that one of the 2N2712's has been pretested and selected for it's noise characteristics. The middle lead (collector) of this device has been clipped short and this unit is intended for use as Q7.

DESIGNATION	TYPE NO.
Q1, Q2, Q3, Q4, Q5, Q6	2N5129
Q7† Q8 *see above	2N2712
D1, D2	1N914 or similar



This completes the circuit board assembly.

There are only four connections to be made from the circuit board. Two of these connections go to the output jack and two to the battery clips. Note that both the ground side of the output jack and the negative side of the battery connect to the same circuit board point (G).

#### SET UP AND OPERATION

The only adjustments to be made to the Surf Synthesizer are the settings of R34 and R45. While these settings are largely a matter of personal preference a couple of tips will get you started.

Jumper together the Surf Synthesizer and the amplifier you intend using and turn both on. Rotate R35 fully clockwise and adjust R34 for the widest and most natural sounding tone changes.

When you're satisfied with the adjustment of the tone control you can set R35 for volume changes. Adjustment of R35 is to your taste but you will probably find that the most natural sound results when the synthesizer is completely muted for short periods of time. There is little electrical interaction between R35 and R34 but it will probably take some twiddling before you're completely satisfied with their adjustment.

Bear in mind that the quality of the amplifier used with the Surf Synthesizer will greatly affect the final sound. Select an amplifier with the best bass response available so that the "roar" of the surf can be heard as well as the crescendo-like crash as the "waves" break. It will probably be necessary to advance the bass boost control of whatever amp. you use to achieve a really natural sound.

When you have the Surf Synthesizer set up and operating you will find it's not only the greatest gadget in the world for relaxing while you're reading or studying but it's also a great mood setter for inland luaus and other parties. As a conversation piece it's unbeatable - no one will believe that a little bundle of electronics can make the sound of the ocean.

#### HOUSING

Once completed the Surf Synthesizer may be housed in any convenient enclosure. Settings of R34 and R35 will not change once adjusted so these controls need not be accessible.

The case shown in the photograph is made from a sheet of aluminum folded into a U shape measuring approximately 5" long by 2 1/2" high by 3 1/2" deep. The ends of the U are sealed with solid walnut blocks which have a rabbet cut around each edge to form a plug. The end caps are held in place with #4 wood screws through the aluminum into the wood. Holes are cut in the back of the case to provide clearance for the output jack and power switch. The battery clips are simply glued to the underside of the top of the channel using epoxy cement. Thoroughly clean the mating surfaces of the case prior to gluing to remove any oxide from the aluminum.

The circuit board is fastened to the aluminum bottom plate of the case with 4-40 hardware and 1/4" standoffs. Secure the bottom plate to the case by running #4 wood screws through it into the wood ends. These same #4 screws also mount the rubber feet.

Duplicates of the prototype case which are pre-punched and complete with all hardware are available from PAIA Electronics for \$2.50 each plus 50¢ postage and handling.

#### DESIGN ANALYSIS

A complete schematic of the Surf Synthesizer is shown in figure 1 but it is convenient to break the unit down into a noise source, Voltage Controlled low pass Filter (VCF), Voltage Controlled Attenuator (VCA), and random voltage generator as shown in block diagram figure 2. These sections may be analyzed one at a time.

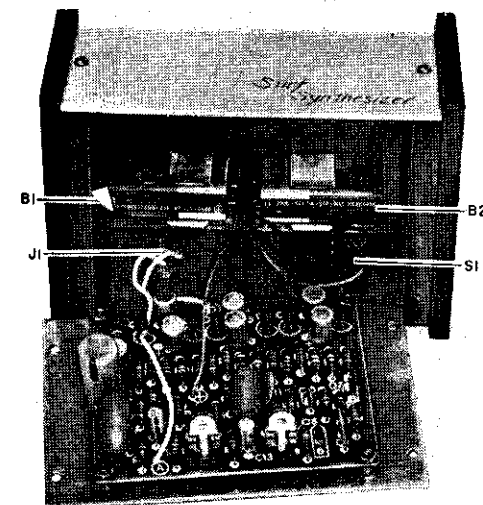
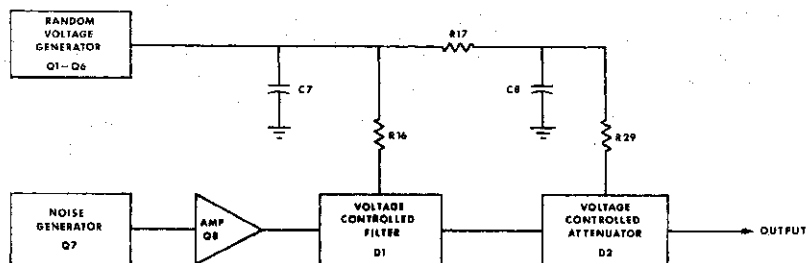
The noise source is built around a reverse biased p-n junction operating above it's breakdown potential. The shot noise resulting from the avalanche breakdown mechanism of the reverse biased base-emitter junction of Q7 is amplified by Q8 and passed on to the VCF and VCA circuits for voicing.

Control voltages for the VCA and VCF originate in the random voltage generator which consists of three astable multi-vibrators (Q1-Q6) running at different rates and with different duty factors. The outputs of the three astables are summed with resistors R13-R15 and appear across R18. While the voltage appearing at this summing junction is to a certain extent random it is weighed by the different periods and duty factors of the astables and the different values of the summing resistors to approximate the "roll" of the ocean. After being smoothed by the integrating action the summing resistors and C7 the output of the random voltage generator is applied to the VCF.

If there is a secret to the Surf Synthesizer it is the use of the VCF. When the VCA is disabled and only the VCF is operating the resulting sound will still be close to that of the surf even though there is no amplitude change. If, on the other hand, the VCA is working alone the result only sounds like inter-station radio static fading in and out.

The VCF uses the non-linear V-I characteristics of a standard silicon diode as a voltage controlled resistor. By proper adjustment of trimmer pot R34 diode D1 is ordinarily forward biased resulting in a loss of high frequencies through C11, D1 and C13. As the control voltage of the VCF increases it reverse biases D1 and allows less high frequency loss to ground. The high frequencies not shunted to ground naturally become part of the signal appearing at the output.

The action of the VCA is similar to that of the VCF in principle. D2 is inserted in series with the signal path and slightly reverse biased by properly setting trimmer pot R35. As the control voltage applied to the anode of D2 increases, D2's effective resistance becomes less thereby allowing more signal to pass to the output. Capacitor C12 serves only to block DC potential from the VCF stage and does not noticeably contribute to the overall frequency response of the device.



#### REPAIR NOTE

In the event that you experience difficulty a repair service is available. Before sending a unit back for repair please write:

PAIA Electronics, Inc.

~~P. O. Box 14359~~

~~Oklahoma City, OK 73114~~

Attention: Repairs

giving as full a description of the malfunction as possible. It is possible that some malfunctions can be diagnosed by mail but if no diagnosis can be made you will be supplied with a repair address and shipping instructions. Repairs are charged at the rate of ~~\$4.00/hr.~~ plus parts and shipping. Repairs ordinarily take from an hour to an hour and a half but repair times in specific cases cannot be estimated in advance.