A VLF RECEIVER SYSTEM FOR MONITORING SOLAR FLARES

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Abstract

The construction of a VLF receiver and loop antenna for monitoring solar flares is described.

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The Solar Division of the AAVSO has been monitoring solar flares for many years. The ionospheric disturbances associated with solar flares are easily detected by their effect on very low frequency radio transmissions. Radio receivers tuned to these low frequencies monitor any change in the propagation characteristics of the "D" layer of the ionosphere. This paper describes a simple transistor receiver and loop antenna system for monitoring these frequencies.

A prime consideration in selecting this receiver circuit was the easy availability of parts from local electronic shops. Special integrated circuits are not always as available as common transistors, resistors, and capacitors. The circuit is a basic three-transistor capacitor-coupled audio amplifier. The final transistor is configured as an integrator to drive a 100-microampere Rustrak recorder. Frequency selection is all done in the first stage by two inductively coupled resonant coils. One coil is connected to the antenna and the other coil to the base of the first transistor. The capacitors across the coils set the tuning range from about 20 khz to 35 khz. This range provides adequate coverage for a great many stations that are available for monitoring. A potentiometer between the first and second transistors acts as a gain control. A wall plug transformer, rectifier, and voltage regulator IC comprise the 12 volt regulated supply for the receiver. The unit can be assembled on a small circuit board and mounted in a small metal cabinet. The circuit is shown in Figure 1.

The antenna system is extremely important for successful monitoring. Although a conventional wire antenna and a good ground rod can be used, the author has had much better results with tuned resonant loops. The loop is a compact portable antenna system requiring no ground and is much less susceptible to local noise pickup. A square or diamond shape loop 16 inches on a side with 75 turns of #26 enameled copper wire has proven to be very effective for monitoring the VLF band. The loop must be tuned with the proper value of capacitance to resonate at the required frequency. Tuning to exact resonance is very important. A diagram of the loop system with a selection of capacitor values for tuning is illustrated in Figure 2.

Further information on this receiver system is available from the AAVSO Solar Division Chairman, Mr. Peter Taylor, P.O. Box 5685, Athens, GA 30604.

C2,C3,C4,C6,C7	2.2 mfd	R10,R12,R14	10K ohms
C5	.1 mfd	R8,R11,R13	470 ohms
C10,C11,C12	.001 mfd	R9	10K pot
C8	10. mfd	D1,D2	1N34 rectifier diodes
C9	100. mfd	L1,L2	Inductor coils Miller 6319
C13,C14	50. mfd	T1	12 volt transformer
R1,R3,R5	100 K ohms	D3	1N4001 rectifier diode
R2,R4,R6 R7	10K ohms	VR	7812 12 volt regulator

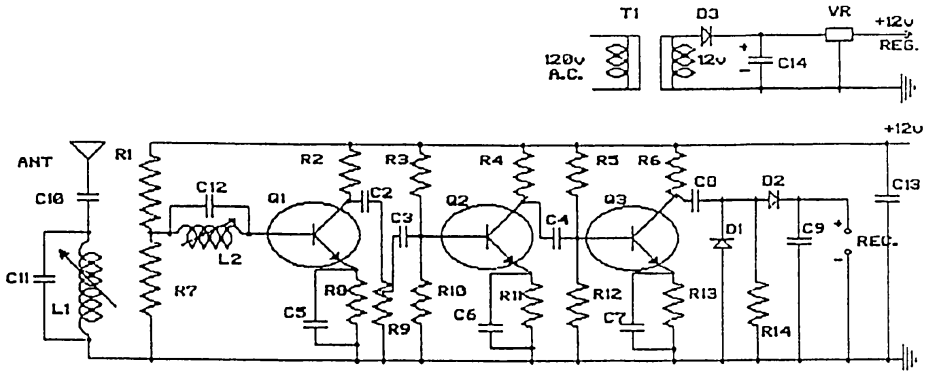
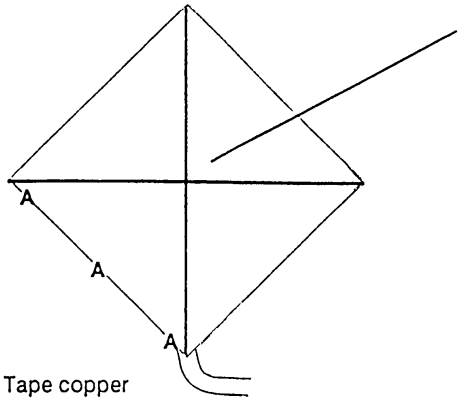


Figure 1. Circuit design for a VLF receiver system for monitoring solar flares.



Tape copper wire on each side at points marked "A."

Wood cross-arms, 3/8 inch square, 23 inches in length. (Fasten at center.)

Notch ends of cross-arms for wire loop.

The loop consists of 75 turns of #26 enamelled copper wire, placed in the notched ends of each cross-arm. The wire is bound by electrical tape at 3 places per side (see sketch).

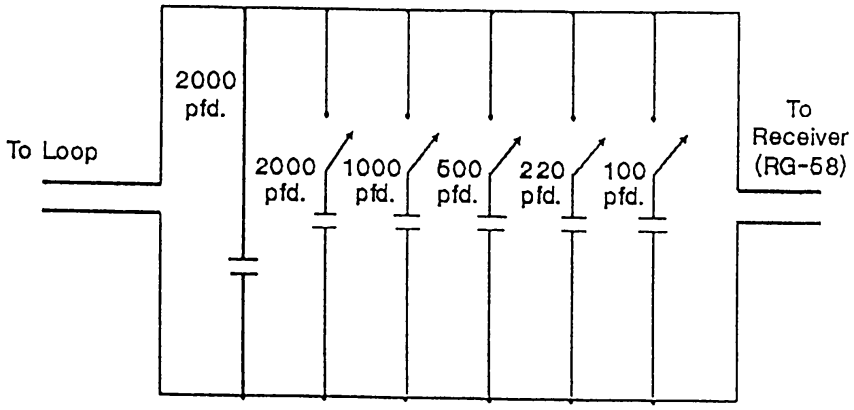


Figure 2. Loop system design with a selection of capacitor values for tuning.