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SUDDEN IONOSPHERIC DISTURBANCES RECORDED DURING July, 2002

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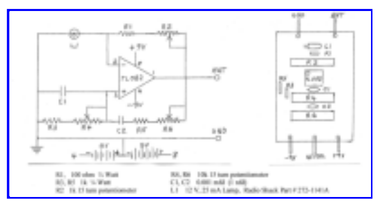
A SIMPLE EASY-TO BUILD SIGNAL GENERATOR.

The hexagonal loop antenna receiver described in the April Solar Bulletin SID Supplement can be tuned to a signal on a given frequency without the need of an oscilloscope and signal generator. Only a multimeter is needed to tune it. If the loop antenna is wound with #14 wire it has a high Q and tunes quite sharp with a pass band that can be about 500 Hz. It is very desirable to have a narrow pass band but this makes it unlikely you can use the formula or capacity table to tune it to the frequency of the station you want with ordinary readily available capacitors. The reason is they have wide tolerances, some vary as much as 20%. An easy way around this problem is to build the tuner that is described in the May SID Supplement. Some have found their station with the tuner but others had difficulty, especially if they were trying to tune to a weak signal. It is for them that I have designed the simple signal generator described below. It is portable and operates from two 9-Volt batteries. The parts are all from Radio Shack and cost about US$12. You hang it right on the loop antenna and it puts out a powerful signal you can't miss. It Tunes from 15 kHz to 40 kHz but you need to set it to the exact frequency of the station you want to receive with a frequency counter. If you don't have one and don't have a friend who has one you can mail it to me and I will set it to your desired frequency and mail it back to you. It is very light and can be mailed in a padded envelope to anywhere in the USA for 60 cents or all the way to Australia by air for US$1.70. It is a Wien-bridge oscillator, an analog device that produces a true sine wave signal. You zero in on its powerful signal and when you turn it off your desired station will be right there ready to record and produce sunrise and sunset patterns and detect SIDs from Solar Flares.



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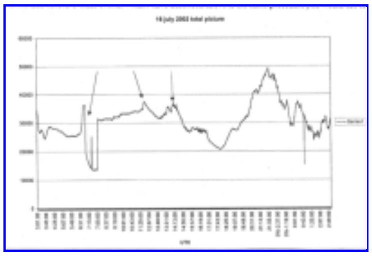
In order to make the schematic above easy to follow for those not very experienced in building electronic devices, I have made a drawing of how to lay the parts out on a little printed circuit board, Radio Shack part #276-149A. Notice the little circle in the top left corner of the TL082 opamp. It identifies where pin number 1 is. It is also in the top left corner. The pins are numbered down and across and up with pin # 4 in the bottom left corner and pin # 8 in the top right corner. This is a top view of the opamp and you will find the same pin out diagram on back of the card the TL082 comes on. It is also a top view. Turn the board over and solder pins 4 and 8 into the board so the opamp don't fall out. Connect pin # 8 to the +9 V lead and pin # 4 to the - 9V lead remembering you are now seeing the bottom view and the pins have changed sides. Now that you see how the leads and components connect to the numbered pins the rest is easy. Use thin uninsulated wire to hook things together point to point. Wire from the four-wire telephone cable is suitable. Cut the insulation with a knife and you can slide off long pieces to provide hook up wire. It is bare copper wire so tin the ends with solder before soldering them in place. Check your hook up several times to make sure everything goes to the right numbered pin. Now it is ready to hook up the batteries and test to see if it is generating a signal.

Before you test it, it helps to understand how this simple device made from six resistors, two capacitors and a little lamp, hooked to a TL082 dual operational amplifier (opamp) can generate a pure sine wave signal. The resistors, R3, R4 and C1 form a parallel resonant circuit that connects the noninverting input, pin 3, to ground. Resistors, R5, R6 and C2 form a series resonant circuit that connects it to the output, pin 1. Together these provide positive feedback that will make the thing oscillate at a frequency that can be tuned by variable resistors R4 and R5. It will "swing between the rails", +12 V and -12 V, and generate a square wave. The lamp, L1 plus R1and R2 provide negative feed back that will keep it from oscillating. The resistance of R2 is adjusted so before the signal reaches the positive rail it draws enough current through the lamp to heat the filament and increase its resistance and this produces negative feedback that quenches the signal and it turns back and heads for the negative rail. Before it gets there the filament cools and the resistance goes low and the signal turns around and heads back again for the positive rail. There is enough time lag in the filament heating and cooling to turn the signal back and forth slowly so it produces a sine wave. This requires R2 to be set so the signal swings about half way between the rails. This clever little analog oscillator was invented by Mr. Wein way back in the 1920s and so it has been named a Wien-bridge oscillator. I'll let you figure out why it's a bridge oscillator.

To test your oscillator to see if it is generating a signal, first set the three variable resistors, R2, 4 and 6. Use your multimeter set to measure resistance. Set R2 to 185 ohms. This will balance the resistance of the lamp so the signal swings about 75% of the distance between the rails but never reaches them before tuning around to produce the sine wave. Set R4 and R6 both to 5700 ohms. These settings tune my oscillator to 24 kHz using the 0.001 mfd ceramic capacitors from Radio Shack. The best way to test the oscillator is with your receiver. If you have the 24-turn, 1 �m hexagonal loop antenna connect about 0.0185 mfd across it for C1 and it should tune somewhere close to 24 kHz. Attach about 1 meter of flexible stranded insulated wire to the oscillator for an antenna. Attach the ground lead of the oscillator to the loop's ground and wrap several turns of the antenna wire around the loop antenna. Hook the 9-volt batteries to the oscillator and it should put out a powerful signal the receiver will pick up even if neither the receiver nor the oscillator is tuned very close to 24 kHz. You will see the signal level of the receiver output increase when you hook the batteries to the oscillator. The signal level increase shows that the oscillator is putting out a signal. The next step is to have somebody tune the oscillator to exactly 24 kHz with a frequency counter and then use it to tune the receiver to 24 kHz. You do this the same way you tested the oscillator. Connect the ground and wrap some of the antenna wire around the loop and hook up the batteries. The receiver output will increase and probably be driven to saturation. Unwrap some of the antenna wire so the signal level Decreases to about half its saturation level. Now you are ready to tune the receiver to 24 kHz. Close one of the switches that connects 100 pfd across C1 and notice if this changes the signal level. If there is no difference switch in a little more capacity 100 pfd at a time until you see a change. If the change is a lowering of the signal level it means you are tuned below 24 kHz and need to remove capacity to get to 24 kHz. Switch off a .001 capacitor(1000 pfd) so the total value of C1 is 0. 0175. This should lower the signal level. If not switch out another 0.001 mfd capacitor to make C1 equal 0.0165 mfd. Once you have gotten the signal level down a little you know you are now tuned to a frequency higher than 24 kHz. From there start adding capacity slowly 100 pfd at a time until you reach a maximum signal level but this should be at a level well below saturation. Keep below saturation by unwrapping the oscillator's antenna wire. With patience you will find a combination of capacitors switched in that gives the maximum signal. This means you have the receiver tuned to 24 kHz. Unsolder these capacitors from the tuner and solder them across the loop for C1. Protect the amplifier from lightning with a new automobile spark plug with the gap set to 0.2 mm (0.008 inch) In addition protect it by connecting back-to-back 1N914 diodes across the loop. Let the receiver run for a few days. You should see sunrise and sunset patterns and record SIDs if there are any. To find out go to << http://www.sel.noaa.gov/ftpmenu/indices/events.html >> and see if any are listed for your daylight hours. If there were M-class events you certainly should have recorded them. If the receiver is working right it will also record C-class events. What I have described above is the same procedure you would use to tune to a VLF station on another frequency.



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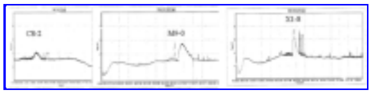
The chart above on the previous page was made by Erik Smith, new observer, A-105,who lives in Hoogstraten, Belgium. He records VLF station DAO38 in Ramsloh, Germany, A North Atlantic Treaty Organization (NATO) VLF station transmitting on 23.4 kHz and 270 km east of where he lives. He can also record HWU in Le Blanc, France which is 700 km to his southwest. Eric, like many of us is an amateur radio operator, ON1DAG. He has already been posting letters on the SID Network so we are getting to know him.



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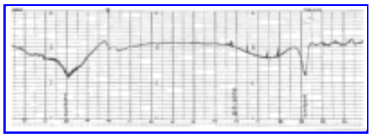
Three charts above were made by Georgio Bressan, A-101, who lives in Italy and also records VLF Station DAO38 in Germany. He uses a Gyrator II receiver to which some improvements have been made by his friend, Guglielmo di Filippo, A-93. Georgio is also a ham radio operator with call letters, IV3ZCY. We have also gotten to know him better through a letter he posted on the SID Network.



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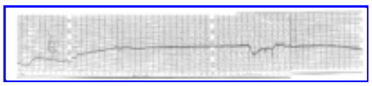
The above chart was made by Len Anderson, A-91, in South Perth, West Australia. He records NWC at Northwest Cape which is about 1000 km north of where he lives.



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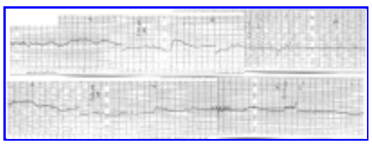
The chart above was made by Jamie Ellerbe, A-62, in Spain recording ICV in Sardinia The nice big SID he recorded on 5 July is also seen below on one of the charts made by Werner Scharlach, A-9, in Tucson, Arizona, USA. Werner's other chart shows five SESs on 4 July.



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