Scanners have become very popular accessories for the v.h.f. f.m. buff. In this article Robert Glaser describes how to incorporate a scanner into the well-known GLB synthesizer.

A Scanner for the GLB Synthesizer

BY ROBERT GLASER*, WA3MSW

With the increasing popularity of two meter f.m. operation, the use of frequency synthesizers is becoming quite commonplace. One of the more versatile synthesizers available is the Model 400B Channelizer from *GLB Electronics*. This channelizer is not as fancy as others, but it is possible to choose any transmit/receive frequency pair desired, something which is difficult, if not impossible, with some other synthesizers and synthesized rigs. The GLB Channelizer has two banks of BCD switches which are used to select the operating frequencies. It is useful, when listening, to set the banks to two popular receive channels, allowing the operator to monitor either frequency with the flick of a single receive select switch. It is convenient to monitor local two meter activity while busily occupied on the workbench. However, while so doing I often found myself scurrying over to the rig to flip the receiver to the other bank of switches when one channel dropped. This constant attention the channelizer took time away from the project on the workbench, a completely intolerable situation. I (being of the type who has no aversion to spending three weeks on a gadget which will save one week's time over the next year and a half) scratched my head and thought, "There must be a better way!" Being of sound mind I quickly reached a simple solution—I would get married and have the XYL sit at the synthesizer attending to the switches. Unfortunately this attack on the problem had some undesirable attributes, so the search for a better way began. The result is a simple two channel scanner circuit for the GLB synthesizer.

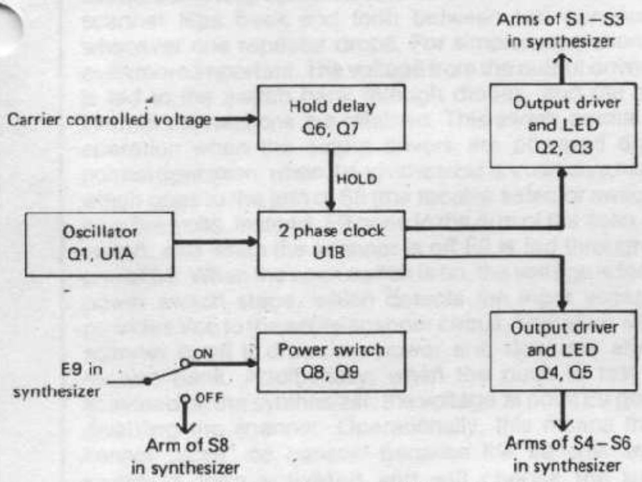

Fig. 1 – Block diagram of the scanner.

A multichannel scanner could certainly be added to the channelizer. However, if more than a few frequencies are to be monitored, it would become necessary to have lockout switches for each of the scanned channels, and the scanned channels themselves would most likely be hardwired. It would take a considerable amount of front panel space for the switches and lights, to say nothing of the circuitry. I didn't wish to add another box to the collection, and it is not feasible to fit the switches and lights on the front panel of the GLB. The synthesizer already has two banks of frequency selection switches, so why not just automate the simple task of switching the receive bank selector switch? This gives a two channel scanner which has the flexibility to allow any desired pair of frequencies to be monitored. I use the same synthesizer at home as in the car, so placing a scanner in the channelizer has the added advantage of having a scanner on two rigs with only the effort of building one scanner.

The scanner circuit had to:

1) implement the desired scanner function.
2) require no unusual switches.
3) entail little modification to the synthesizer.
4) be small enough to fit into the channelizer box.

The implementation satisfies the above and uses one single pole double throw switch.

How It Works

A block diagram of the scanner is shown in fig. 1. The oscillator generates a square wave and feeds the two-phase clock generator. This provides two complementary outputs. Each output goes to an output driver stage which includes a light emitting diode. The LED indicates which bank of frequency selection switches is active. The output of these stages is high enough to drive the synthesizer circuitry in the normal fashion. With the aforementioned stages the synthesizer will switch alternately between the two switch banks at a rate determined by the oscillator.

It is necessary to have a carrier operated relay in the receiver being used, or a point in the receiver where there is a voltage present only when an incoming carrier is being received. The voltage output should be between five and twelve volts. This voltage is fed to the *hold delay* stage. The function of it is to stop the two phase clock generator from toggling, and to wait a certain length of time after the received signal drops before letting the scanner resume scanning. This

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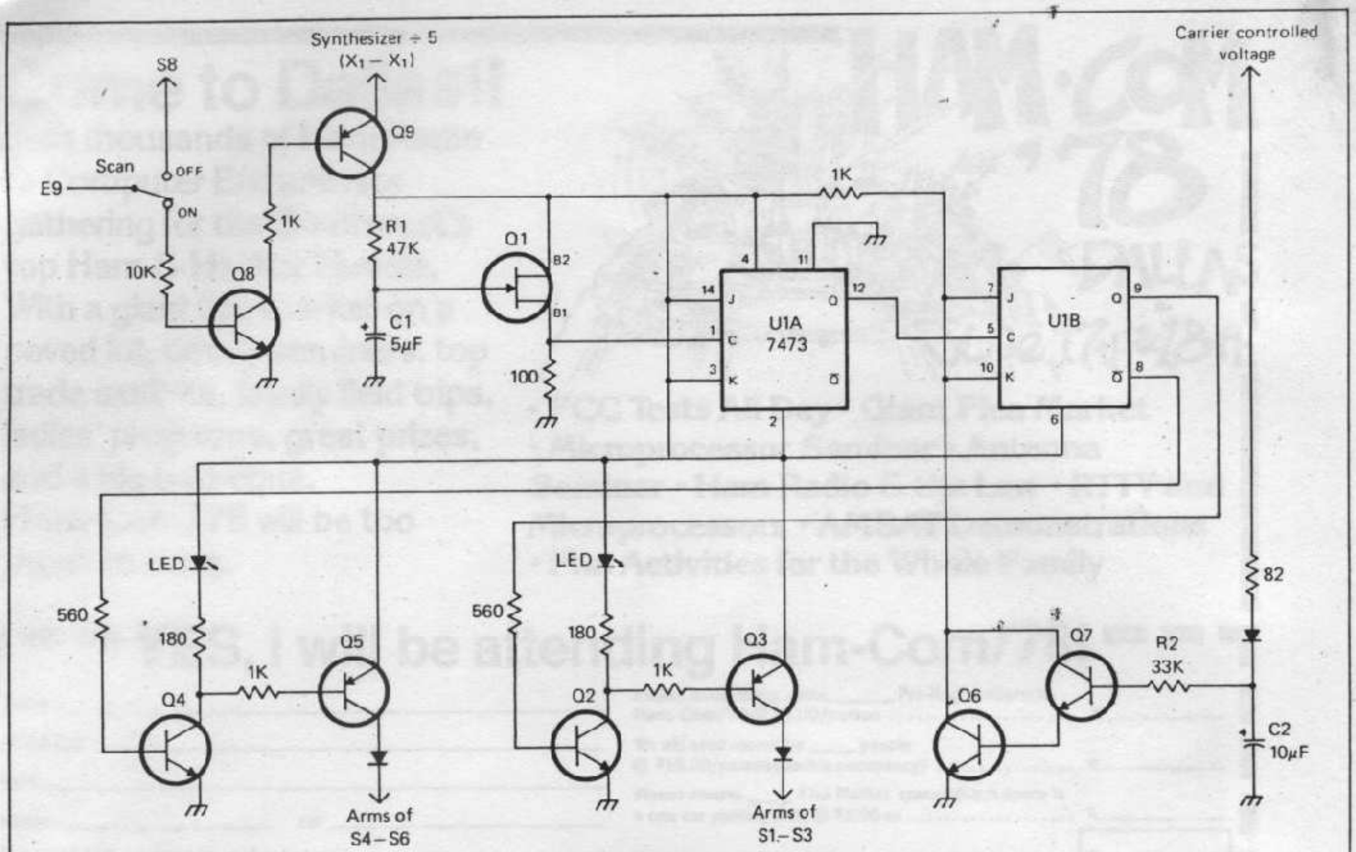

Fig. 2 – Schematic diagram of the scanner.

allows complete conversations to be heard. Otherwise, the scanner flips back and forth between two conversations whenever one repeater drops. For simplex operation this is even more important. The voltage from the output driver stage is fed to the switch bank through diodes, and the original internal connections are retained. This allows normal circuit operation when the output drivers are powered down. In normal operation, when the synthesizer is in receive mode, E9 which goes to the arm of S8 (the receive selector switch) is at plus five volts. Instead, E9 goes to the arm of the scan enable switch, and when the scanner is off E9 is fed through to the arm of S8. When the scan switch is on, the voltage is fed to the power switch stage, which detects the input voltage and provides Vcc to the entire scanner circuit. Therefore when the scanner is off it draws no power and does not affect the receive bank. Additionally, when the push to talk line is activated on the synthesizer, the voltage at point E9 goes low, disabling the scanner. Operationally, this means that you cannot "scan" on *transmit* because the transmit selection switch is then activated and will choose the transmit frequency. Normally this would not be done, but at least you cannot bother two conversations at once by switching frequencies on transmit by mistake.

The schematic is shown in fig. 2. Q8 and Q9 constitute the power switch. When the scan switch is in the *off* position, Q8 receives no base drive current and is cut off. This causes Q9 to be cut off as well, and the plus five volts applied to the emitter of Q9 does not get fed through to the rest of the circuit. The entire scanner is powered down, and the channelizer operates normally. When the scan switch is on and the synthesizer is in the transmit mode, E9 is low and the power switch is still turned off. When the synthesizer is in the *receive* mode and the scan switch is in the *scan* mode, E9 goes high, turning Q8 on which in turn turns Q9 on which powers the rest of the scanner circuitry.

Q1 is a unijunction transistor obtainable from Radio Shack. R1 and C1 determine the frequency of operation which sets the scan rate. This rate has purposely been set relatively slow when compared with normal scanners. This is because it is necessary to allow time for the synthesizer to lock up, and this

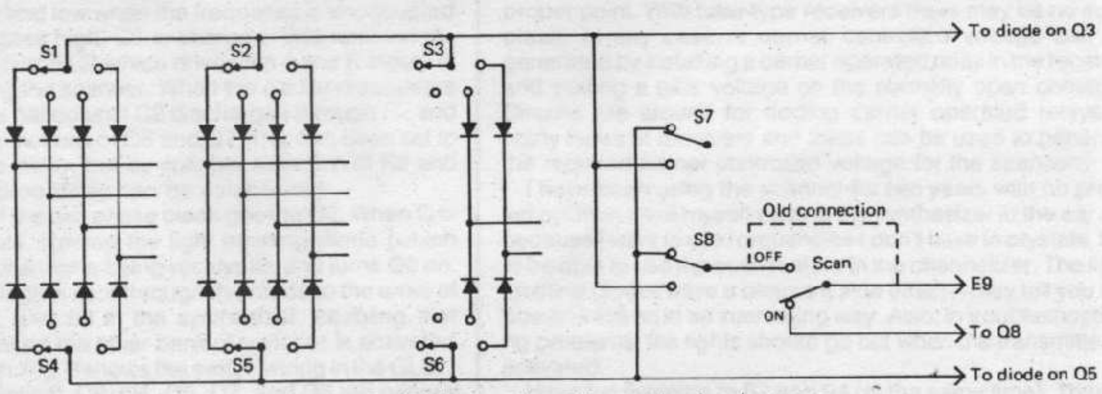

Fig. 3 – Switching matrix of the synthesizer/scanner.

may be a fraction of a second when the two banks are set far apart in frequency. With the parts shown, the scanner switches channels about twice per second. The output of the unijunction oscillator is not a square wave. It is fed into half of a 7473 dual master—slave JK flip flop which divides the frequency in two and generates a square wave. This signal is then sent to the second half of the 7473. When the J and the K inputs of the flip flop are high, the flip flop counts and divides the frequency of the input signal in half and gives complementary outputs. If the J and the K inputs are both low, the flip flop stops toggling and remains in the state it was in at the time the J and K inputs went low. We wish the scanner to stop on a channel when it has a signal present, so it is necessary to force the J and K inputs low when a signal is received. A carrier controlled voltage is brought out from the receiver which has the characteristics of being high when a signal is present and low when the frequency is unoccupied. When this point goes high, C2 is charged. This turns on the Darlington pair Q6 and Q7 which drives the J and K inputs of U1B low, stopping the scanner. When the carrier disappears the scanner stays halted until C2 discharges through R2 and the base emitter junctions of Q6 and Q7. This has been set to a several second delay, but by suitable selection of R2 and C2 any desired drop delay can be established.

The Q output of the two phase clock goes to Q2. When Q is high, Q2 conducts, lighting the light emitting diode (which indicates which channel is being received), and turns Q3 on. When Q3 is on a high is sent through the diode to the arms of switches S1, S2, and S3 in the synthesizer, enabling that switch bank. Likewise the other bank of switches is activated when Q bar is high. Fig. 3 shows the switch wiring in the GLB.

Parts are not critical. Q2, Q4, Q6, Q7, and Q8 are general purpose silicon NPN transistors. Q3, Q5, and Q9 are general purpose silicon PNP transistors. The scanner circuit can be built on a piece of perforated board small enough to fit inside the synthesizer unit. The connections to the channelizer are simple. The plus five volt connection may be made to the X1 - X1 jumper on the main board. The connection of the switch banks to Q5 and Q6 requires no breaks. Remove the wire connected to the arm of S8 (this is E9) and place it on the arm of the added scan switch. Connect the arm of S8 to the scan switch as shown. The light emitting diodes and the scan switch must be mounted on the synthesizer box. An extra jack and, preferably, a feedthrough capacitor should be mounted on the rear of the unit for the carrier controlled voltage input.

A point must be located, in the particular receiver being used, which is high when a signal is being received and low otherwise. With solid state receivers such a point usually exists and careful perusal of the receiver will indicate the proper point. With tube-type receivers there may be no such place. In any case, a carrier controlled voltage can be generated by installing a carrier operated relay in the receiver and putting a plus voltage on the normally open contacts. Circuits are around for adding carrier operated relays to many types of receivers and these can be used to generate the required carrier controlled voltage for the scanner.

I have been using the scanner for two years with no problems. Often I find myself putting the synthesizer in the car not because I want to use frequencies I don't have in crystals, but to be able to use the scan feature in the channelizer. The light emitting diodes have a pleasant side effect—they tell you the power is still on in an interesting way. Also, in troubleshooting rig problems, the lights should go out when the transmitter is activated.

Have fun listening to 67 and 94 (at the same time). Thanks go to K3RUQ for his help in construction. ■