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There and Back Again

Add band-scanning to your TS-930S for under $20.

I purchased the new Kenwood TS-930S in December, 1982. It is a fine radio and, after some initial problems, has performed as advertised. After hearing of the features of the TS-430S and playing with one, there was one function not included in the TS-930S that made me jealous. That was the scanning feature. On the TS-430S you can program memory channels 6 and 7 and scan between them.

The existing up-scan or down-scan built into the TS-930S is virtually useless. It starts slowly and after 3 seconds speeds up so that it is useful only on the international broadcast or the AM broadcast bands where the bandwidths of the stations are very wide. It goes through single-sideband signals at a rate of knots and nothing can be heard or understood as it zips by. Even if you could discern the signals, the scan would never reset. It would go up or down until it ran out of radio spectrum and would stop at either 29.999.99 MHz or 100.00 kHz.

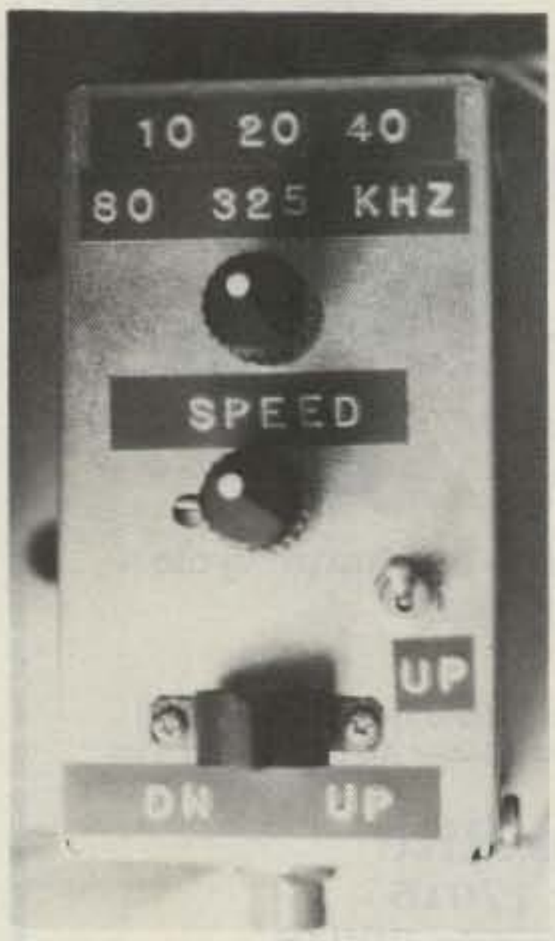
Band scan would be a desirable feature because you could monitor preset sections of a band without having to sit in front of the radio and twist the knob. You could monitor the DX portion of 20 meters for that rare one, scan the net activity on 75, or hunt through a portion of 8 MHz looking for interesting signals to pop up. All this could happen while you are in another part of the shack working on a project or writing an article.

It so happens that if you pulse the up or down control line on the TS-930S microphone connector, the radio will step at the same rate as the pulses. Each pulse moves the radio 10 Hz. For example, if you pulse the up line at a 20-Hz rate (pull the line to ground), the radio will advance 200 Hz a second. A 50-Hz pulse rate will advance the radio 500 Hz per second. With a simple 555 timer chip, a variable-speed scan rate can be achieved. Eventually, however, the radio will be out of the ham band and will happily continue all the way to 29.999.99 MHz and stop. Most unsatisfactory!

Since the TS-930S has memories and memory recall, we can put these functions to use. When we push the memory-recall button, the radio will always return to whatever frequency was programmed into the memory channel selected. If we use the above and add one function, a timer, we end up with a device that will pulse the radio along at a variable speed, determine how wide the frequency range should be, and return to a preprogrammed frequency.

Fig. 1 shows a simple way of performing the scan-recall function. The top 555 timer (IC1) is a pulse generator that pulls the up-scan line to ground at a variable rate, and the second timer (IC2) will pull the memory-recall line to ground after a user-selected time. This will reset the radio to a preprogrammed frequency. The problem with this method is that you end up with two variables, scan speed and reset time. Unless some specific preset variable resistors or capacitors were switched in for both functions simultaneously, you would never know the scan width accurately. Fig. 2 is a circuit to perform the above, but it was discarded prior to incorporation because of the inconvenience of the two variables.

What I needed was a method to count or accu-



The unit in its Bud box, top view.

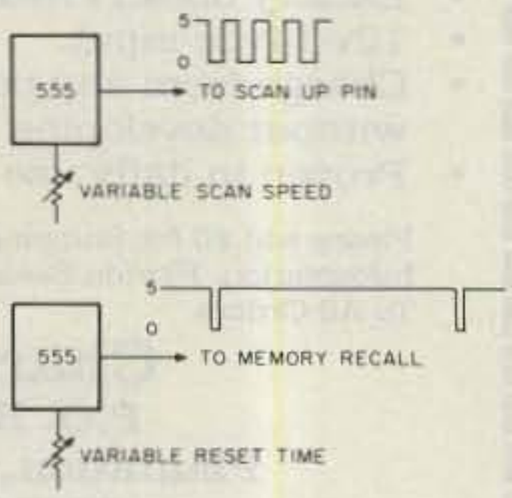


Fig. 1. Simple scan reset.

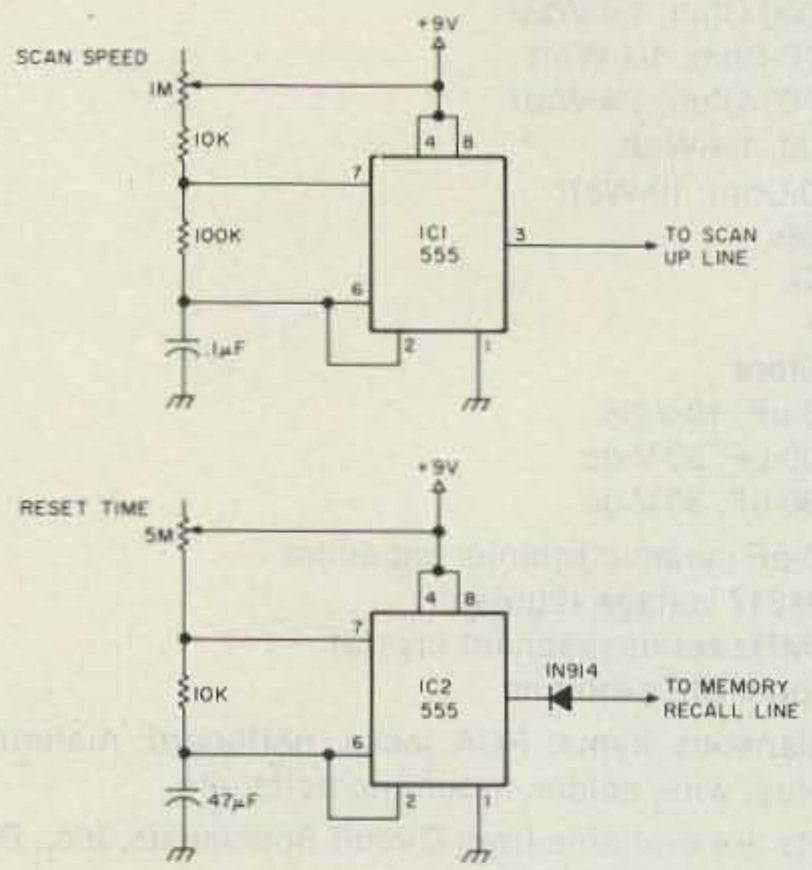


Fig. 2. Simple scan and reset circuit.

Count 2 to the	Counted Pulses	Approx. kHz	Switch Program (Pin #)* 9	10	11	12
9	512	5	0	0	0	0
10	1024	10	1	0	0	0
11	2048	20	0	1	0	0
12	4096	40	1	1	0	0
13	8192	80	0	0	1	0
14	16384	160	1	0	1	0
15	32768	325	0	1	1	0
16	65536	650	1	1	1	0
17	131072	1,300	0	0	0	1
18	262144	2,600	1	0	0	1
19	524288	5,250	0	1	0	1
20	1048576	10,500	1	1	0	1
21	2097152	21,000	0	0	1	1
22	4194304		1	0	1	1
23	8388678		0	1	1	1
24	16777216		1	1	1	1

*0 = ground; 1 = plus 9 volt.

Fig. 3. MC14536B program chart.

mulate the pulses from the 555 pulse generator. If a preset number of pulses were counted, then the scan width at 10 Hz per pulse would be determined independently of pulse speed.

The device I chose was suggested by Mike WA7ARK and Steve KE7G. It was the Motorola MC14536B programmable timer. This is a 24-stage ripple binary counter with the last 16 stages selectable by a four-bit code. (From the Motorola *CMOS Data Manual.*) It has 24 flip-flop stages and will count from 2^0 to 2^{24} pulses and then trigger, reset, and start again. Essentially it can be programmed to count from 2^9 (or 512) pulses to 2^{24} (or 16,777,216) pulses. Since each pulse represents 10 Hz to the radio, 2^9 would be 5120 Hz or approximately 5 kHz; 2^{10} would be 10,240 Hz or 10 kHz, etc. See Fig. 3 for the program and frequency information.

Fig. 4 is the block diagram of the selected design. The 555 pulses at a user-variable rate and the programmable timer uses the pulse rate as its clock. When the timer reaches its preprogrammed count, it pulses a transistor switch and pulls the memory-recall line to ground, resetting the sequence. The radio beeps each time the sequence recycles.

A final circuit is shown in Fig. 5. The components chosen provide a pulse rate between 11 and 68 Hz, which represents a 110-to-680-Hz-per-second scan range. In other words, the radio will scan a 40-kHz bandwidth in 65 to 370 seconds, depending on the scan-speed setting.

To program the scanner, a five-position 4-pole switch was handy and was pressed into service (Fig. 6). The scan widths programmed were 10, 20, 40, 80, and 325 kHz. 10 and 20 kHz are useful for looking for a schedule; 40 and 80 kHz can be used to monitor a complete band segment (i.e., advanced section of 20). Most of the international broadcast bands are between 200 and 350 kHz wide, so 325 kHz is a good compromise (13- through 60-meter bands).

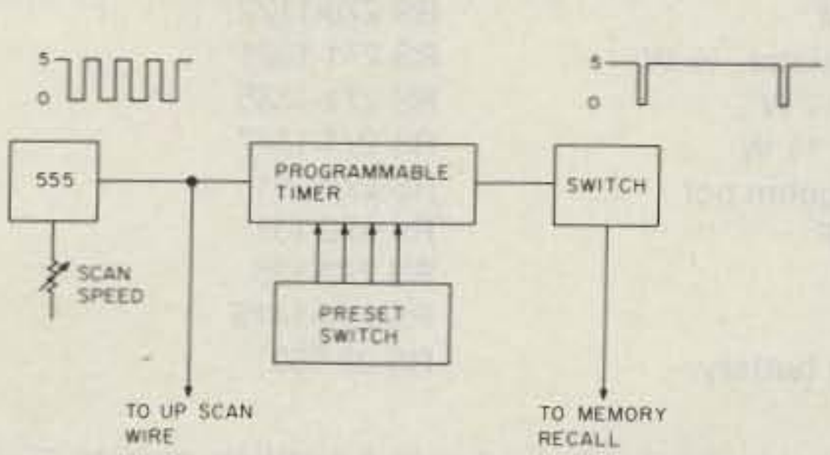


Fig. 4. Block diagram of final circuit.

The unit is at the left, front view.

Now for the bad news. (The news you suspected but did not want to admit.) The radio has to be slightly modified. To ease the pain, this modification adds only one wire. Unplug the radio and remove the top and bottom covers. Keep the radio right side up and refer to Fig. 7. If you do not have the automatic antenna tuner installed, you will easily see where you must attach the extra wire. At point X or Y, tack-solder an insulated small-gauge wire. The other end of the wire must reach the microphone connector, so leave it long. If the antenna tuner is installed, as mine is, you may want to remove it—or just reach in carefully with a small low-wattage iron and tack-solder the wire to the back of the memory-recall switch, as above.

With an ohmmeter, check between the unsoldered end of the wire and the case of the radio (ground). Verify that a short is obtained when you press the memory-recall button.

Next, snake the wire to the bottom of the radio, turn the radio over, and attach the wire to one of the two unused contacts on the microphone connector. That is the extent of the modification to the radio.

The circuit is built in a small Bud box and placed next to the radio. Three wires must be added between the microphone con-

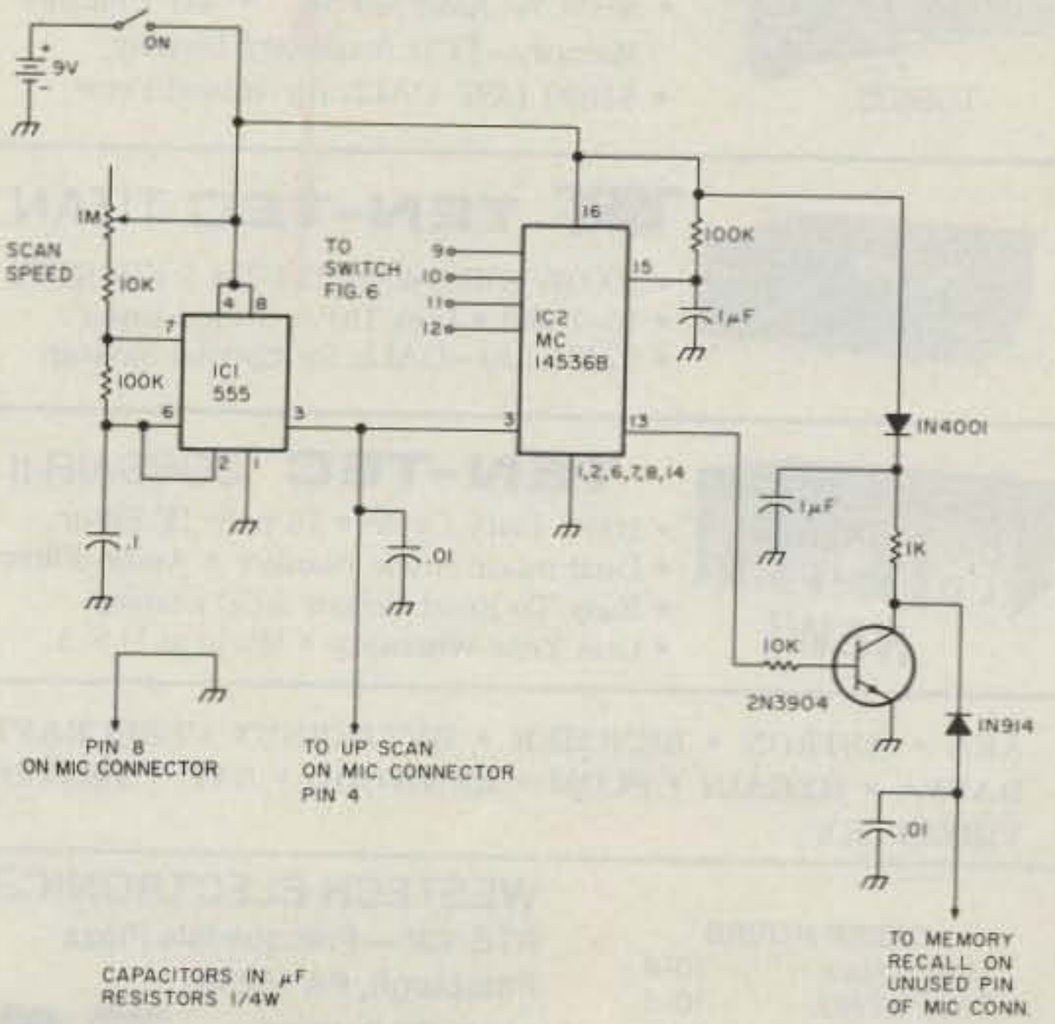


Fig. 5. TS-930S scan circuit.

nector and the scan box. They are ground, scan-up, and memory recall. Shielded wire is recommended.

The unit is powered by a 9-V transistor-radio battery and, due to the low current drain, I expect long life.

The complete circuit could have been built inside the radio, under the VOX access door on top of the radio, using the radio power. This would have been an extensive modification and I did not feel it was necessary. This circuit could also be built into a microphone stand.

I have found this modification most useful. For example, I keep a weekly schedule with Lowell W2HXJ. We meet around 14.260 MHz, plus or minus. I set the scan width to 20 kHz, preprogram the memory for 14.250, and turn the scan on. I set the scan speed to sweep through 20 kHz in about 45 seconds. I haven't missed Lowell yet, and I do not have to be near the radio to hear him call!

The circuit is simple, and the only expensive part is the programmable timer, which lists for approximately $11.00.■

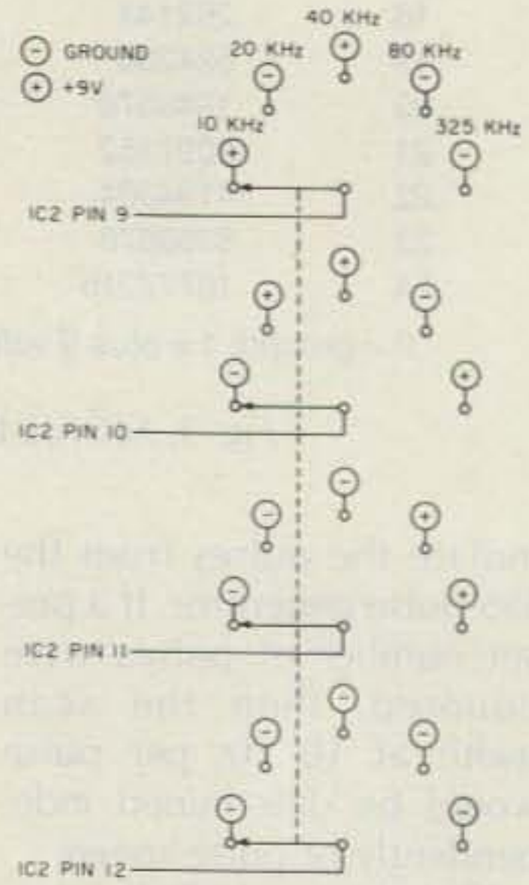


Fig. 6. Preprogrammed switch.

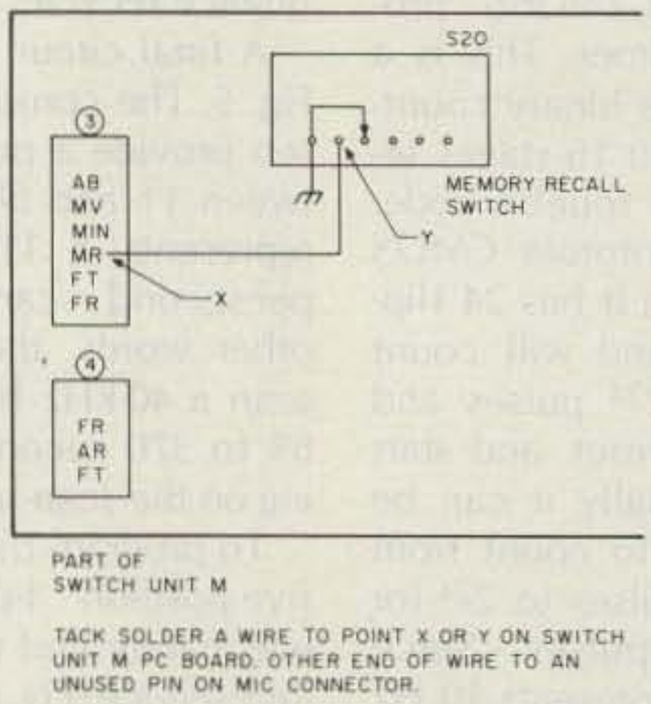


Fig. 7. Part of switch unit M.

Part List

1—555 timer	Radio Shack 276-1723	$.99
1—MC14536B Motorola	Motorola Distributor	11.00
1—2N3904	RS 276-1603	.14
1—1N4001	RS 276-1101	.25
1—1N914	RS 276-1122	.10
1—1k resistor, ¼ W	RS 271-1321	.08
2—10k, ¼ W	RS 271-1335	.16
2—100k, ¼ W	RS 271-1347	.16
1—1-megohm pot	RS 271-211	1.09
2—.01 uF	RS 272-131	.39
1—.1 uF	RS 272-135	.25
2—1 uF	RS 272-1419	.49
1—9-volt battery	RS 23-553	2.19
		$17.29

Hardware (as required): 1—4-pole 5-position switch; 1—Bud box; 2—knobs; 1—SPST switch, and 2—IC sockets.