

## EXAMINING THE ICOM IC-R7000 RECEIVER

Bob Parnass, AJ9S

The long awaited ICOM R7000 is here. I bought my R7000 (S/N 001400) on June 14, 1986 from Spectronics, and agree with other R7000 owners: ICOM did their homework on this radio.

I had several questions about the R7000 that were not answered in ICOM's advertisements, and could only be answered by fiddling with the real thing:

1. Can one set the R7000 to behave like a "normal" scanner, waiting for a transmission to complete before resuming the scan? Contrary to the review in July Monitoring Times, the answer is YES. There are 4 choices of when to resume scanning (or seaching), and this is one of them.
2. Does the R7000 have a "search and store" mode, like the old Bearcat 250? Yes, and it's well done. There is a mode which will search between two frequency limits, and store the active frequencies in the top 20 channels. The R7000 is smart enough not to store duplicate frequencies.
3. Does the R7000 use the concept of a "channel bank"? Yes, one can select and deselect any of the 99 channels to be in a bank. This is much more flexible than traditional scanners. For example, the user can form a bank composed of channels 2, 5, 31, 48, and 79.
4. Does the Priority Scan feature work like a Bear- cat scanner? Well, sort of. The best way to describe the ICOM R7000 priority algorithm is to say it resembles using a Bearcat scanner in the manual mode with the priority feature selected. One cannot "scan" more than one channel on the 7000 while sampling the priority channel. On the plus side, the priority frequency does not use up any of the 99 channels, but is programmed from the keyboard and has its own register. The user can use the "scan speed" control to set how often the priority frequency is sampled, a nice touch. In practice, the R7000 dwells on the priority frequency for a little too long, essentially chopping up the signal on the non priority frequency too much.

Using the internal, top-mounted speaker, the R7000 has good audio power and fidelity, better than my R71A.

The user manual is generally good, and a schematic is furnished. Some broken English makes it unclear as to whether the R7000 battery backed up RAM contains firmware as in the R71A.

There are provisions for activating a tape recorder when a signal is received, but there is about a 1 second delay in activation, causing the recorder to miss the start of the transmission. I may replace the capacitor in that relay circuit when I get the nerve to open the cabinet for the first time.

Another relay is used to switch in some filters for reception above 512 MHz, so one hears the relay clicking while scanning a mixture of low and high frequencies, a bit unnerving.

There's a lot of fun to be had with the R7000. It was interesting tuning through the link and paging signals in the 72-76 MHz band, and listening to military aircraft in the 200-400 MHz band.

My UHF antenna system consists of a government surplus FAA discone, good for coverage between 150-1200 MHz. Although not as good as a Butternut SC3000 antenna in the 150-174 and 440-512 MHz ranges, the discone has the edge in the 225-400 and 512-1200 MHz bands. At these frequencies, a low loss feedline is very important, and I use a Belden 9913 clone made by International Wire and Cable.

## COOL YOUR ICOM R7000 RECEIVER WITH ANOTHER HEAT SINK

Bob Parnass, AJ9S

The new ICOM R7000 25-2000 MHz receiver is a super radio, but the power supply tends to run hot. The two biggest heat generators are the pass transistor and bridge rectifier module. The stock heat sink, a flat piece of metal bolted to the inside of the cabinet rear, is inadequate. After 30 minutes of use, the back panel gets very hot, and the entire cabinet warms.

I added a small heat sink to the outside of my radio, using the screw that holds the bridge rectifier to the stock heat sink. An application of heat conductive grease between the added sink and the cabinet helps the heat transfer process. Now the rest of the cabinet gets barely warm to the touch.

## ADD A COOLING FAN TO YOUR ICOM R-7000 RECEIVER

by Brian Kantor, WB6CYT1

In my R-7000, adding a fan makes a big difference. I've had it on continuously for three days now, and it's still nice and cool. Turns out most of the heat comes from the transformer core in the AC supply. One of those 3-1/2" 12V DC fans fits just nicely - a pair of 1/4" standoffs screwed through two of the upper back panel ventilation slots holds it in place, the power leads snake through the lower ventilation slots, and some duct tape to form a gasket, and it pulls the hot air right out. If you pick the 12V off the power supply regulator board at W3 (orange lead), it will even work properly when you run the radio off 12 volts.

[In order to blow hot air out, the fan must suck in cool air from somewhere. Users are advised to be on guard for dust being drawn into fan-equipped R-7000s. - Editor]

## TV INTERFACE FOR R7000

John Biro

I just got the video interface for the R7000, and to my surprise it is not an internal option. It bolts to the side of the radio (right side where the rubber feet use to mount). It is about 1 inch wide, and the same height and length as the R7000, and in a matching cabinet.

TV video is taken off the 10.7 MHz IF output jack, this presents a problem if you are using it for a Band Scope. It also "steals" the power from the IF output (the center pin of the IF out carries 12VDC so be careful not to short it out).

The interface provides RCA type jacks for both Video out and Audio out. The Video is standard levels and the Audio is low level output for input to a typical audio amp (it can not drive a speaker directly). I am not sure why the audio output is there as you can monitor the audio on the R7000, looking at the circuit they do have a sideband filter circuit so I would assume the audio is cleaner but I have not tried it and do not have any problem with the R7000 audio receiving

WBFM from the TV stations.

Results: The TV-R7000 works OK, but I am just disappointed in the fact that it does not mount internally in the R7000. This could also help in its high price tag of \$119. I had a Yaesu FRG9600 with video option (only about \$30), and it worked about the same. The picture quality is good, and it is very stable. My antenna is vertically polarized, so I am working crossed polarized for TV stations but still get good results, strangely better on UHF than VHF freq. In fact, I get UHF on this set up better than my late model TV upstairs.

I think that I am most disappointed in the fact that the unit mounts on the side of the R7000. I don't have the extra inch of bench space, so I had to put rubber feet on the unit and lay it on its side on top of the R7000. It works fine and I do not see any difference with the case of each unit tied together or not.

I made a "T" adapter and ran both the BAND-SCOPE and TV on the IF output. I have not tried to add a third option to the IF output yet but it seems to be buffered from the main IF (wide band data 9600 baud).

The unit comes with schematic, installation info, and cables to hook it up to a video/audio monitor. Installation is 5 minutes or less if you know where to find your screw driver the only tool required.

Now to look for some Amateur TV and for Hidden TV stations. There is more out there than featured in the TV Guide.

## 198 CHANNELS FOR YOUR R7000 RECEIVER?

by Bob Parnass, AJ9S

The ICOM R7000 appears to use a uPD446C, 16K static RAM chip, for storing 99 memory channels. By looking at the pinout of this chip (IC8 on the Logic Unit) in my service manual, it appears that ICOM is only using 1/2 its memory capacity. Address lead A10 (pin 19) is soldered to a ground pad.

To double the number of memory channels in the R7000 to 198, it looks like one could "lift" pin 19 of IC8, and connect it to pin 24 (+Vcc) through a 10,000 ohm resistor. A SPST switch could be used to ground pin 19.

Another challenge would be finding a place on the R7000 to put the added "Memory Bank" switch. Perhaps one could use the Noise Blanker switch, and just leave the NB on at all times.

I don't have time to try this experiment, and would be interested in hearing results from any enterprising hobbyist willing to try this.

Long live tinkering!

[PS: Jack Albert, WA9FVP, reports that he tried the modification, and it works! Jack doesn't have the remote control option in his R7000, so he elected to use the front panel REMOTE switch as a bank switch. He installed a 48,000 ohm resistor between IC8 pin 19 and ground, and ran a wire from the REMOTE switch, through an 82,000 ohm resistor, to pin 19. When you switch between banks, you must also rotate the channel selector knob, forcing to the microprocessor to read from memory.]

## MODIFY YOUR ICOM R7000 TO SCAN AND SEARCH FASTER

by Bob Parnass, AJ9S

This article describes how to increase the scan and search speeds of the ICOM R7000 receiver by 60% without noticeable performance degradation.

### Background

The front panel SCAN SPEED control on the R7000 receiver allows the user to adjust the speed of scanning and searching operations, as well as the rate at which the priority channel is sampled. Rotating the control counterclockwise decreases the speed, and rotating it clockwise increases the speed.

When the SCAN SPEED control on my R7000 (serial number 001400) was turned fully clockwise, the radio would scan a maximum of about 8 channels/second, or search about 8 increments/second. As the following table shows, the stock R7000 can scan about as fast as a Radio Shack PRO-30 or PRO-2003.

TABLE 1. Maximum Scan Rates of Selected Receivers

Scanner	Maximum Scan Rate (channels/second)
Kenwood TR-2600	1.2
Radio Shack PRO-30	8
Radio Shack PRO-2003	8
ICOM R7000 (stock)	8
ICOM R7000 (after modification)	13
Regency M400	13
Bearcat 20/20	15
Bearcat 300	15

## R7000 Scan Circuits

The scan rate of the R7000 is determined, in part, by a simple clock outside the microprocessor. The front panel SCAN SPEED rheostat and resistor R18 (and other components in the LOGIC UNIT) control the speed of this clock. The clock output is connected to what appears to be an input port on the microprocessor. The upshot is that we can affect the scan rate without affecting the other chores performed by the microprocessor.

The modification consists simply of soldering a 470,000 ohm resistor across the leads of resistor R18 on the LOGIC UNIT circuit board.

How was the value of 470,000 ohms chosen? Experimentation with different resistor values showed that for values both above and below 470,000 ohms, the R7000 scan rate decreases. Not having the R7000 Service Manual, I assume this can be explained by the firmware within the microprocessor associated with the scan rate input port.<sup>2</sup>

Adding the 470,000 ohm resistor in parallel with R18, rather than just replacing R18, has a few advantages:

1. The modification is easily undone, returning the radio to stock condition.
2. The LOGIC UNIT board does not have to be removed, as would be the case if R18 was unsoldered from the foil side.

## Making the Modification

Accessing this circuit board is not difficult, and involves the same steps used when installing the optional Remote Controller or Speech units.

Use a towel to cover your work area to avoid scratching the R7000 cabinet. Unplug the R7000 from the AC line, and turn the radio upside down. Remove the bottom cover by removing the 12 screws holding it in place.

Remove the 4 screws holding what ICOM terms the "partition panel". Pictures on pages 32 and 34 of the R7000 Instruction Manual show the partition panel. After removing this panel, the component side of the LOGIC

UNIT circuit board is accessible.

- 
2. Perhaps the firmware polls the scan rate input port infrequently. Another possibility is that the scanning pulses interrupt the processor, and the interrupt firmware is limited in its ability to process frequent interrupts.

Locate R18, a 270,000 ohm 1/8 watt resistor, near connector J5. You may wish to remove plug P5 from J5 temporarily if it gets in your way. Carefully solder a 470,000 ohm resistor in parallel with R18. I used a 1/4 watt resistor as it was the smallest on hand.

Reassemble the radio, connect it to AC power and antenna, and enjoy.

In the modified R7000, the scan and search rates are still adjustable using the SCAN SPEED control. With the control turned fully clockwise (maximum speed), the modified R7000 scans at about 13 channels/second and won't miss weak signals.

#### A LOW COST PANADAPTOR FOR THE R-7000

by Bob Parnass, AJ9S

A panadaptor, or spectrum display, is a device which portrays visually the signals in a part of the radio spectrum. Panadaptors allow radio listeners to "see" activity on a portion of band without requiring the listener to tune the receiver.

They are useful for detecting the presence of spread spectrum signals or "hidden" signals riding on a sub-carrier of a main channel. Panadaptors are invaluable for detecting spurious emissions from transmitters, and unwanted products caused when 2 or more signals mix.

Panadaptors most often employ a cathode ray tube (CRT) for the display, and must be connected to the intermediate frequency (IF) amplifier stage of a receiver, at a point before filtering takes place.

The ICOM R-7000 2-2000 MHz receiver rear panel has a phono jack for wide band 10.7 MHz IF output. A DC voltage is also present at this connector and is used to

power an ICOM TV accessory.

I've seen mention of 3 panadaptors for the R7000:

1. John Biro's article on retuning a Yaesu YO901 Multiscope panadaptor for 10.7 MHz, restricted bandwidth use. Selectable bandwidths of 20, 100, or 200 KHz are available.
2. The Sherwood Communications SCA-7000 signal monitor, priced at \$1600, and reviewed in May 1987 "Monitoring Times".<sup>3</sup> Bandwidth adjustable from 1 KHz - 1 MHz.
3. The Spectra-Display, priced at \$350, which requires use of an external scope.<sup>4</sup> Bandwidth

---

3. Sherwood Communications, 1310 Industrial Highway, Southampton, PA 19866. tel (215)357-9056.

4. Spectra-Display is sold by GTI Electronics, RD 1 Box 272, Lehighton, PA 18235. tel (717)386-4032.

adjustable from 200 KHz - 10 MHz. Optional preamplifier required for 12 MHz wide sweep.

In the past month, several Kenwood SM-220 monitor scope/panadaptors have appeared at hamfests selling in the \$200 to \$250 range. The Kenwood SM-220 can display transmitted or received signals. To add spectral display capability to the SM-220, one must purchase the optional BS-5 or BS-8 module, which consist of a printed circuit board, a steel enclosure, interconnecting cables, and a new graticule. The panadaptor module mounts inside the SM-220 cabinet.

The BS-5 is used with the TS520 and TS530 transceivers, which have an IF of 3.395 MHz. The BS-8 is used with the TS820 and TS830 transceivers, which have an IF of 8.830 MHz. Since the IF of the ICOM R7000 is 10.7 MHz, one must alter the panadaptor circuitry to accept 10.7 MHz input.

If you have any choice in the matter, get the BS-8, as it requires fewer changes than the BS-5, and may even require no changes at all!

The panadaptor module circuit consists of several

stages, but only two are directly related to the IF frequency:

1. A crystal oscillator is used as a marker generator.
2. A voltage tuned oscillator is swept across the IF of the receiver, and employs a varicap diode, an inductor and capacitors.

The marker generator is not vital for panadapter operation. It merely provides a single "pip" that one may use to center the display on the CRT screen, and is similar in purpose to the crystal calibrator in older receivers.

The marker generator circuits in the BS-5 and BS-8 are identical except for one crystal. One need only replace the 3.395 MHz crystal (in the BS-5), or 8.830 MHz crystal (in the BS-8) with a 10.7 MHz crystal to adapt the SM-220 marker to 10.7 MHz IF. I did not alter this stage, although I would if I had a 10.7 MHz crystal handy.

The voltage tuned oscillator is the stage that deserves our attention. The changes required depend on whether you have the BS-5 or BS-8 panadapter module.

#### Changes for BS-5 Module

Change the following capacitors:

1. C231 from 1000 pf to 68 pf.
2. C232 from .01 uf to 1000 pf. (You can use the capacitor which used to be C231.)
3. C234 from 100 pf to 22 pf.
4. C236 from 47 pf to 22 pf.
5. C237 from 680 pf to 100 pf. (You can use the capacitor which used to be C234.)

Solder a 10 microhenry inductor in parallel with L204, a 20 microhenry inductor.

#### Changes for BS-8 Module

I haven't tried the BS-8 module, but encourage you to



try using it as is, without modification unless necessary.

These steps are needed only if you cannot find settings of the side mounted alignment controls that get the display to behave as specified in the owner's manual:

1. Remove C233, the 33 pf disc capacitor, from the printed circuit board.
2. Replace coil L204, the 4.7 microhenry inductor, with a 6 or 7 microhenry inductor.

### Alignment

Follow the alignment procedure in the SM-220 owner's manual to adjust the panadaptor. This consists of adjusting 2 potentiometers and 1 trimmer capacitor through holes thoughtfully provided in the side of the cabinet.

The alignment instructions rely on the use of the internal Marker Generator to generate a signal at the center of the passband. If you haven't converted the Marker Generator circuit, you can tune your receiver to a frequency with a signal present at a known frequency (like 162.550 MHz - the National Weather Service), and use that as a frequency standard.

Most of the time spent in alignment will be in alternate adjustments between the trimmer capacitor and the wide band sweep potentiometer, which interact with each other.

### Wider Bandwidth

The SCAN WIDTH switch on the stock SM-220 can be set to display a 40 KHz or a 200 KHz wide picture. I adjusted my modified SM-220 to display a 100 KHz or a 500 KHz wide picture. By adjusting the controls on the side of the SM-220, wider bandwidths are possible, but wider bandwidths make it more difficult to resolve individual signals close to each other in frequency. As the bandwidth gets wider, the horizontal sweep loses linearity, causing the graticule calibration lines to be inaccurate.

### Connection to R-7000

As mentioned earlier, a DC voltage is present at the R-7000 IF output connector and is used to power an ICOM TV accessory. A direct connection between the R-7000 IF output connector and SM-220 would damage at least one of these units.

To block the DC voltage, a 0.1 microfarad capacitor was soldered inside the R-7000, between the IF output jack and the adjacent jack labeled "spare". Connection between the R-7000 and SM-220 is then made using a short length of RG-58/U coaxial cable, with one end plugged into the R-7000 "spare" jack, and the other end plugged into the rear of the SM-220.

This leaves the original IF output jack undisturbed so it can be used with the TV adaptor accessory.

### Vertical Sensitivity

When I connected my modified SM-220 to my R7000, the SM-220 would display only the strongest of signals. To improve the display sensitivity, I inserted a 20 dB gain RF amplifier between the R7000 and SM-220. The amplifier was a spare Ameco PLF2 FET receiver preamp, adjusted for 10.7 MHz, but other amplifiers can be used, provided they have at least a 500 KHz bandwidth, and sufficient gain, at 10.7 MHz.

### False Readings - Images

The SM-220 circuit is like a superheterodyne receiver. The panadaptor itself has a 455 KHz IF, and like other superheterodyne receivers with a low IF frequency, is prone to images.

An image is manifested as a false pip, which moves across the screen as the receiver is tuned, and is 910 KHz (twice the IF) away from the actual signal.

The images discussed here are in the SM-220, not in the receiver. Images are bothersome on the strongest signals, like those 300 watt paging transmitters that saturate the county with RF, belching out out strange digital noises or voices (now illegal to monitor).

### Use With Other Receivers

The modified SM-220 can be used with other receivers having a 10.7 MHz IF. In other receivers, one would

need to find the proper point in the IF stage (before filtering takes place), install a connector, then wire a DC blocking capacitor between the IF stage and connector.

---

---

If you are having trouble with you Icom R7000 display being flaky and then a sudden decress in sensitivity try the following:

PROBLEM: ICOM R7000 radios that are used 24 hours a day for a long time (2 years ) when shut off the display will become flaky and it is also possible for a lost in overall gain (3 to 40 db).

SOLUTIONS: Officially there is ICOM ECO SB# 9288-004, attached below.

Unofficially from Tech who repairs R7000  
The ECO does help the display problem, but most likely it is not the problem. \*

\* note repairing your own radio my void you warranty and only allow a qualified technician to do the job, otherwise damage could happen to your R7000. If the VCO does not track then a major alignment would have to be done after. Check the ICOM IC-R7000 Service Manual for more details before starting this repair, and to make sure I have not made any typeing errors you should get a copy of the ECO from ICOM !

#### 1st SOLUTION:

Replace on the DC to DC Board the following capacitor.  
Check the noise with an oscilloscope on both sides of R3, if the noise is not way down on one side then replace C2 a 33uf 16V capacitor. Noise feedback can decress the overall sensitivity of the R7000.

Replace on the Display Board  
C19 and C20 a 10 uf 16VDC capacitor

I found that on my R7000 C19 & C20 were the cause of my display problems. They are 10 uf eletrolytics capacitors that are lemmon yellow pc mounted units, when they go bad the base of the yellow caps change to a brown color.

I put in the following ECO first but it did not help. If you look at the service manual you will see that the ECO values are on the schematic but my unit had the old values. I suggest that you check the above first, it is a lot easier to do, C19/C20 can be done in 10-15 min while the ECO will take about a hour.

## 2nd SOLUTION: The ECO

ICOM America, INC  
2380-116th Ave, N.E.  
Bellevue, Washington 98004  
206-454-7619

### SERVICE BULLETIN

UNIT MODEL      R7000  
SB#              9288-004  
EFFECTIVE DATE    4/1/88  
SERIAL # AFFECTED:   ALL  
PRODUCT GROUP:    Amateur

#### BACKGROUND INFORMATION:

Display failure do to weak components

#### TECHNICAL INFORMATION:

Improvement in DC to DC converter and display power supply.

#### PARTS AFFECTED    BOARD TYPE    CHANGE TO    NEW PART NUMBER

Q1/Q2 2SC 1214    DC to DC Board    2SC 2655    906-00385

R1/R2 3.3 KOHM    DC to DC Board    5.16 K      915-01173

C3/C4 PF    DC to DC Board    0.001 MF 50V    918-01500

ceramic cap

Q11/Q12    Display Board    2SC2655      906-00385

R31/R32    3.3KOHM    Display    5.16k Ohm    915-01173

C13/C16    Display      0.001 MF    918-01500

#### DETAIL PROCEDURE:

1. Remove top and bottom cover.
2. Remove front panel sub-assembly from main chassis of radio
3. Remove the DC to DC board and replace components as listed
4. Reinstall DC to DC board.
5. Replace front panel sub-assembly onto main chassis of radio
6. Replace top and bottom covers.

ESTIMATE TIME TO COMPLETE IS 1 hour