

# The ICOM IC-7000 HF/VHF/UHF Transceiver

For most of last year ICOM teased us with pictures of its new IC-7000. When it finally arrived in ham radio stores near us, N5AC was among the first in line to purchase one. Here he gives us a tour of the new radio.

By Steve Hicks,\* N5AC

**T**he ICOM IC-7000 was released this past December and I picked up mine on Wednesday, December 7th. The IC-7000 is the first truly mobile amateur HF transceiver that has a TFT color LCD display. The 2.5-inch diagonal display shows standard radio functions and is quite similar to that of the IC-756PRO line. The frequency display is large and easy to read from different angles and can be shown in three different colors and a couple of different type styles. It is very well thought out.

### The TV

One unique capability of the radio is that as designed in Japan, the radio can display NTSC VHF video channels 2 through 13. As shipped in the U.S., however, this capability is disabled due to potential liability issues. Fortunately, the radio is easily modified to enable the TV feature and simply requires the removal of a diode that is read by the radio's microprocessor on power-up. (See the accompanying sidebar for the modification.)

The IC-7000 also has a beautiful operating display that shows frequency, memory information, power out, SWR, compression, and even radio temperature all at the same time. This has become my favorite radio display (see photo). For times when other information is displayed on the lower half of the screen, you can select which of the meters is dis-



*The IC-7000 has a beautiful operating display that shows frequency, memory information, power out, SWR, compression, and even radio temperature all at the same time.*

played just below the frequency readout—power out, SWR, compression, or ALC.

The TV display is nicely done and even has the capability of viewing an NTSC signal on any frequency from 49–218 MHz, in addition to standard U.S. TV channels. Although the TV side will not tune directly to the UHF channels for ATV (I confirmed this with ICOM), downconverters such as the TVC-4G from P.C. Electronics (\$59 kit, \$99 assembled) should work fine with the IC-7000. This has some nice implications for use in public service, ballooning, rocketry, etc.

The IC-7000 does not have dual-receive like so many of its big brothers, so when watching video, you are not able

to transmit (the mic button is disabled) or monitor another channel. Still, the promise of being able to switch over and see a video feed from a descending balloon or for a net control in the local EOC to be able to pull up video at the disaster site is very real.

Much discussion about watching TV while driving down the highway has surfaced on the IC-7000 e-mail reflector. While it seems obvious that this is a “no-no,” most who have the 7000 probably will enable the video, and many will run the IC-7000 as a mobile rig. If you’re driving home at 6:05 PM and the FM radio station and your local repeater aren’t interesting, it would be tempting to turn on the TV and just listen to the local news.

\*900 Carnegie Court, Allen, TX 75002-5734  
e-mail: <n5ac@n5ac.com>



## Modifying the IC-7000 for TV Reception

The ICOM IC-7000 just released in December 2005 promised to have the capability to receive TV broadcasts off air and display these on the IC-7000's 2 1/2-inch TFT display. The feature was disabled at the last minute due to liability concerns, which is understandable given the many disparate state laws on TV displays in vehicles. Re-enabling the TV functionality is simple and can be performed by anyone who feels comfortable with a soldering iron and a pair of tweezers. In addition, the out-of-band transmit modification can also be done at the same time. Keep in mind, though, that making modifications to your new radio may void the warranty. Therefore, proceed accordingly.

Because you will be inside a microprocessor-controlled unit and you will be removing the processor unit itself, it is best to have all tools ready and in one place before beginning. Static discharge can harm or destroy parts of the radio and static buildup is always greater in the dry winter months. Be sure to touch the outer chassis of the radio and discharge any static buildup if you do find yourself walking around the room during this procedure:

1. Remove the top cover of the radio using a Philips-head screwdriver by removing two black screws on each side of the radio holding the top (total of four) and four screws on the top of the radio not immediately adjacent to the speaker (see photo A).

2. The cover of the radio should lift up easily. The speaker cable snakes under the CPU/DSP unit (business-card-size metal enclosure) and can be moved out from under this module. It is not necessary to unplug the speaker. The cover can be just set to the side or if you are more comfortable you may unplug the speaker.

3. Remove two silver screws holding the CPU/DSP module in place (see photo B).

4. Pull up on the CPU/DSP module and remove it from the radio. The unit can be set to the side.

5. Directly under the DSP unit are a number of integrated circuits. Between the two white connectors that the CPU/DSP unit plugs into are four identical integrated circuits, three in a line and one next to the left-most one in the line. These are CMOS 4094 shift registers that are used by the processor to read the diodes on the board that control radio options. All four chips on my radio have the Texas Instruments logo and the part number "HJ4094."

6. Toward the front of the radio are rows of surface-mount (SMT) diodes. The diodes have silver paint on top and the letter "A" clearly marked. Using the supplied photograph, you may remove one



Photo B. Arrows point to the two screws holding the CPU/DSP module in place. Step 3 requires their removal. Step 4 requires the removal of the module.



Photo C1. With the CPU/DSP module removed, the four 4094 shift registers are exposed. They can be identified by the Texas Instruments logo and part No. "HJ4094."



Photo A. The ICOM IC-7000 HF/VHF/UHF transceiver. (All photos courtesy of N5AC)

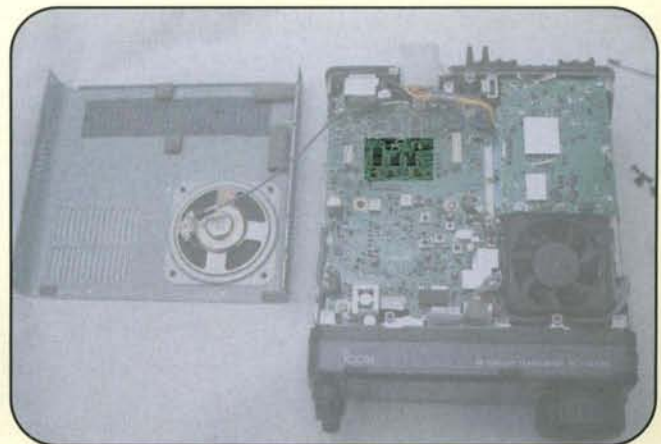


Photo C2. This photo highlights the four 4094 shift registers mentioned in step 5.



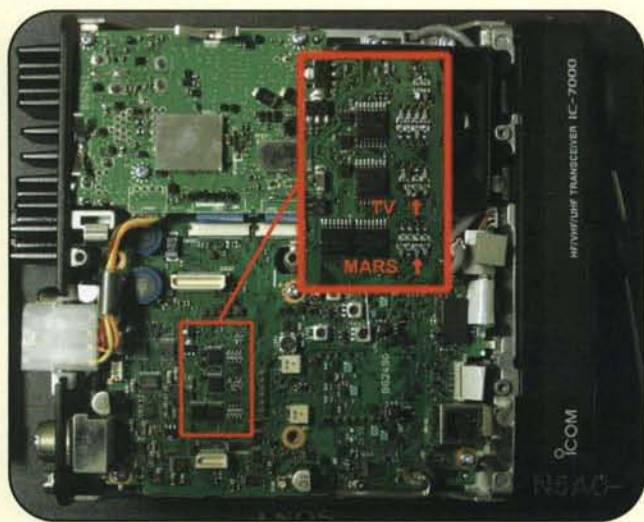


Photo D. Arrows point to the SMT diodes targeted for removal for the modifications. See steps 6 and 7 for instructions on how to remove them. Note that this photo is oriented 90 degrees counter-clockwise from photos B, C1, and C2.

diode for TV reception enable and another diode for MARS out-of-band transmit enable. The diodes may be removed in any number of ways. For most with limited equipment, a good pencil iron and a pair of tweezers can be used. I generally alternate heating up either side of the diode (there are two pads that barely stick out to each side of the diode on the short sides) with the iron and applying gentle pressure to the diode until it moves. Once it moves, it will have moved off both solder pads because it is so small. I then wrestle it into place with just one pad touching and reheat the diode to get it to adhere to the board. This is so that I can go back and add the diode back later if need be. With just one lead soldered, the diode will not operate in the circuit and will be in the radio if you need it later. You may also remove it completely if you like.

7. To enable TV, remove diode number two on the left of the set of diodes in front of the middle 4094 (see photo C).

8. For MARS operation, remove diode number two on the left of the set of diodes in front of the left two 4094s (see photo D).

9. When you are done with the diodes, just reassemble the radio in reverse order. After putting the CPU/DSP unit back into the radio, be sure to slide the speaker cable gently under the upper left and lower left corners of the CPU/DSP module. If you do not do this, you will have trouble putting the top back on the radio.

To use the TV receive mode, press and hold the upper-left knob marked AF(SET) on the radio for one second. The normal radio screen will be replaced with a TV receiver screen. The receiver will tune US TV broadcast channels 2–13 by using either the band-up and band-down buttons or the [M-ch] inner knob on the lower left of the radio. TV channel 2 uses the HF antenna port on the back of the radio, while TV channels 3–13 use the VHF port on the radio. Specific channels can be tuned to a different frequency in the 49–218 MHz range and can be skipped from the channel-up and channel-down function by pressing in the AF (SET) button momentarily and following the prompts.

You can also put an ATV downconverter between the VHF antenna port and your antenna to receive ATV. Such a downconverter is the TVC-4G from P.C. Electronics. The website is: <http://www.hamtv.com>. Unlike your TV set, however, RF can come out of your VHF port, so you will want to be sure not to transmit through your ATV downconverter after you are through watching ATV.

While listening, would you avoid looking at the screen if a video of the overturned tanker on the highway were shown? It's easy for all of us to say that we wouldn't watch TV while driving down the road; it's probably a little more difficult to avoid doing just that if some compelling video were to be shown. Something to think about.

## The Scope

While the IC-7000 also has a spectrum scope like the IC-756PRO radios, it is not as functional as the bigger rigs (see photo). The most obvious difference is in the way the IC-7000 sweeps the band scope. While it is not a "live" scope as in the IC-756PROIII or the IC-7800, this is definitely an improvement over the IC-706MKIIG.

As with the IC-706MKIIG, the 7000 does not have a separate receiver dedicated to the band scope; the receiver is taken "off line," muted, and used to create the band scope. In the slow-speed mode, a tick can be heard about every fifth of a second while the receiver is used to get data for the scope. This does not drastically affect intelligibility of the incoming signal, but the scope takes about five seconds per pass to display. At this speed, you could easily find signals that are either always present or are present much of the time.

To find more intermittent signals, the scope can be put in the fast mode. In this mode, the ticks are about every tenth of a second and render virtually unintelligible the incoming audio on the current channel the radio is monitoring (you can also mute the audio entirely). In trade, you get a much more real-time view of the spectrum. The radio takes under a half-second to display the entire range, which can be varied from 10 kHz to 250 kHz. This is clearly a real first for a mobile radio.

## Weak-Signal Work

For weak-signal contest work, the question of when and how we might use this scope arises. I wondered how strong of a signal is required in order for it to appear in the spectrum scope. I hooked up my HP 8640B signal generator and put it on 144.100 MHz. I was able to hear a signal at –145 dBm on the IC-7000. I put the band scope on in both fast and slow and found that it took a signal of about –95 dBm before it showed up on the band scope. I have yet to test if this is an absolute or relative value. In other words, if I use a preamplifier that provides significant gain, would this improve the abilities of the spectrum scope? For example, if I have a 25-dB preamp, will I only need a –120-dBm signal before the signal appears in the band scope? This is simple to test, but I've just not had the opportunity.

The question here is if you are meeting someone on 2304 and they're not exactly on channel, would you be able to jump over to the band scope and quickly find them. The received signal would need to be well above the noise for you to spot it on the scope, so conditions and the received signal level will dictate whether you will be able to use the band scope for this purpose. You can also use the band scope as a mini spectrum analyzer for work under 470 MHz.

## The DSP

ICOM has moved the DSP functionality from after the AGC to inside the AGC loop. For a mobile VHFer this has the poten-

(Continued on page 76)



the tower, I noticed the kink in the wire, about 5 feet above the ground. I thought, "I'll twist a jumper wire around the kink to strengthen the wire." Of course, I forgot to do this in my excitement in trying out the new antenna system.

The SWR and resonant frequency had not changed noticeably from the tuning that was done with the beam near ground level, and several new 6-meter beacon signals were heard that could not be heard on my  $\frac{1}{4}$ -wave vertical.

About a week later, an evening storm came in from Lake Michigan, with winds up to 70 mph. I watched out the window and observed the feedline whipping vigorously as it disappeared up into the darkness. Suddenly, the feedline went slack!

Sadly, I took a flashlight and went out into the howling storm. On the ground lay my tower and beam; the back guy wire had broken at the kink. The wooden boom was undamaged, but the three copper-pipe elements were bent beyond repair.

Using the dimensions that were recorded when the original beam was tuned up, new copper-pipe elements were cut and installed. Special care was taken when the repaired beam was erected to ensure that none of the guy wires became kinked. The new beam has weathered several wind and ice storms over a period of a year with no problem. A concern that the wooden boom would warp and throw the elements out of alignment has not been realized; the pressure-treated wood is very stable. The reconditioned rotor continues to work even in near-zero weather.

Ordinary solid-web 300-ohm TV line was used as a feeder on the original beam. During rainstorms the SWR went up to about 2:1. However, the SWR could be brought back to 1:1 by adjusting the antenna coupler. Three-hundred-ohm "window"-

type ladder line with stranded conductors was used on the repaired beam. Rain has no noticeable effect on this feedline.

## Performance

A Yagi with three elements spaced 0.2 wavelength apart typically has a front-to-back ratio of about 12 dB, but the front-to-side ratio can be as high as 20 dB. At my QTH a steady carrier at 50.12 MHz can be heard about S8 (apparently, it is not a 6-meter beacon, as I have heard no modulation or Morse identification). The carrier must be nearby, as it appears to be unaffected by propagation phenomena.

The "mystery" signal provides a convenient means to evaluate 6-meter antennas! Rotating the beam to place its back-side to the signal causes the signal level to drop nearly into the noise level. Off the sides of the beam, the signal completely disappears in sharp nulls.

## Postscript

An initial concern about the lack of durability of the wooden boom seems to have been unfounded at this point. From the ground, it does not appear to have warped despite the variable of the Michigan weather, and it is still aesthetically a pleasant sight to see.

In spite of its endurance and eye appeal, however, it has yet to perform during the big opening, the most recent one missed on December 19, 2005. Unfortunately, while my wife Norma KA8EHE, and I were at a movie, the locals were working hundreds of stations during our absence. Sadly, as of yet the beam has not been able to perform its magic on the Magic Band. □

## IC-7000 Review (from page 11)



*While the IC-7000 has a spectrum scope like the IC-756PRO radios, it is not as functional as the bigger rigs.*

tial to drastically reduce the effects of any sort of ambient noise on operation. For example, ignition noise, even when not on channel, can cause AGC pumping that can make reception of a weak signal very difficult. Once the noise has been moved out of the IF passband, this effect is gone, unlike with more traditional configurations

where the AGC would pump the receiver gain even from an off-channel signal.

Having said this, I have yet to have an opportunity to test the benefits of this. The IC-7000 also has many of the features of its big brothers, including twin digital passband tuning and dual manual notch filters. The 7000 is the first radio with dual

notch filters, which is pretty cool if used to reduce sideband images around a signal. By using the notch to eliminate sidebands that are pumping the AGC, the AGC is allowed to act directly on the signal you are trying to receive (this is a key benefit of having the DSP in the AGC loop). This dramatically affects the S/N ratio and causes a signal to just pop out.

## Overall

The IC-7000 has a significantly extended set of CI-V commands for remote programming of the radio. It will be interesting to see all of the software programs that emerge to control the IC-7000. Voice record and playback is a new feature for this size radio and one which should help all of us VHF+ rovers who aren't carrying big rigs with us in the field. A high-stability oscillator is now part of the standard radio, which should help out with digital modes.

Overall I'm very impressed with what ICOM has been able to pack into the IC-7000 chassis, and I'm looking forward to gaining more operating experience with such a fine radio. □