

# Product Review

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## Hamtronics R139 Weather Satellite Receiver

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People see satellite weather images every day. With coffee in one hand and a TV remote control in the other, they watch ominous storm fronts marching across the continent as they hurry through their morning rituals. Or, they take a more leisurely approach and surf the Web to find the weather images of their choice. Most folks realize that satellites provide these images, but the magic behind the technology remains a mystery (one they waste little time pondering).

For hams, however, the direct pursuit of knowledge and mystery is our *raison d'être*. If we cared only to *communicate* with people in other nations, we'd pick up our telephones or connect to the Internet. Only a lunatic in love with the magic of wireless attempts to accomplish the same goal by assembling a radio station and throwing him or herself upon the mercy of a fickle ionosphere. Hams are not content to merely communicate through the instruments of multinational corporations, we want to generate and receive signals ourselves—with equipment *we* control and operate.

That's why weather satellite image reception remains a vibrant subset of the Amateur Radio hobby. Rather than wait upon the images that TV stations and the Web can provide, we prefer to go directly to the source and see them in real time!

Weather satellites can be divided into two groups: those that zip around the Earth in low polar orbits, and those that appear to hover in distant geostationary orbits. The polar orbiters are the most popular among hobbyists. These satellites transmit strong signals on frequencies easily received by VHF radios.

Russia, the United States and China have launched polar orbiting weather satellites. As they circle the globe these satellites are continuously transmitting visible light and infrared images of the ground and clouds below. They beam the images to Earth in what is known as the



APT—Automatic Picture Transmission—format. It is a wideband (about 40 kHz) FM signal composed of sync pulses and varying audio tones. The Russian Meteor satellites transmit on 137.300, 137.400 or 137.850 MHz. The American NOAA birds transmit on 137.500 and 137.620 MHz.

If you have a 2-meter FM rig that can tune through the weather-satellite frequencies, you can often hear them. As they come into range you'll notice an odd tick-tock metronome-type sound. Unfortunately, most ham receivers don't have a sufficiently wide bandwidth to enable image reception. That's where the Hamtronics R139 comes in!

### Introducing the R139

The Hamtronics R139 weather satellite receiver is essentially a five-channel crystal-controlled scanner that sweeps through the APT satellite frequencies mentioned above. The R139 offers the necessary bandwidth while maintaining low noise performance and good sensitivity. (I should note that the R139 could also be used as an "IF"

for a microwave downconverter if you wish to capture images from the geostationary birds.)

Dual-gate FETs are at the heart of both the RF amplifier and mixer circuits. Five individual crystal oscillators are switched automatically (or manually) by a 4017 ring counter IC. Their signals are mixed to a 10.7 MHz IF, which is then processed all the way to low-level audio by a single IC (an MC3361). An LM380N provides the audio boost sufficient to drive a speaker.

The compact exterior of the R139 reflects the simplicity of the design. Sizeable **VOLUME** and **SQUELCH** controls dominate the front panel. Between and below the controls are five red LEDs numbered one through five. Small toggle switches select **POWER** and **AUTO** (scan) or **MANUAL** channel selection.

The rear panel offers a BNC antenna connector. The power, audio output, demodulator output and tape recorder controls are provided via a DB-9 socket. The choice of the DB-9 is a bit odd, but it's probably less expensive than installing separate connectors. It would have been helpful if Hamtronics had included a prewired DB-9 plug, but this is a minor nit to pick.

### Setting up the R139

The Hamtronics R139 comes with an excellent manual, which makes installation and setup a breeze. The receiver requires 12 V dc and a small wall-module power

Table 2  
Hamtronics R139

#### Manufacturer's Claimed Specifications

Frequency coverage: Receive, 137.3, 137.4, 137.5, 137.62, 137.85 MHz with supplied crystals.  
Modes of operation: WFM.  
Power requirements: 0.12 A (max volume), 10-15 V dc.  
Size (HWD): 2.3x4.9x4 inches; weight, 14.2 ounces.  
FM wide sensitivity (12 dB SINAD): 137 MHz, 0.2  $\mu$ V.  
FM adjacent channel rejection: Not specified.  
FM two-tone, third-order IMD dynamic range: Not specified.  
Spurious and Image rejection: Not specified.  
Squelch sensitivity (threshold): Not specified.  
Audio output: 1 W<sup>1</sup> into 8  $\Omega$  (THD not specified).

#### Measured in the ARRL Lab

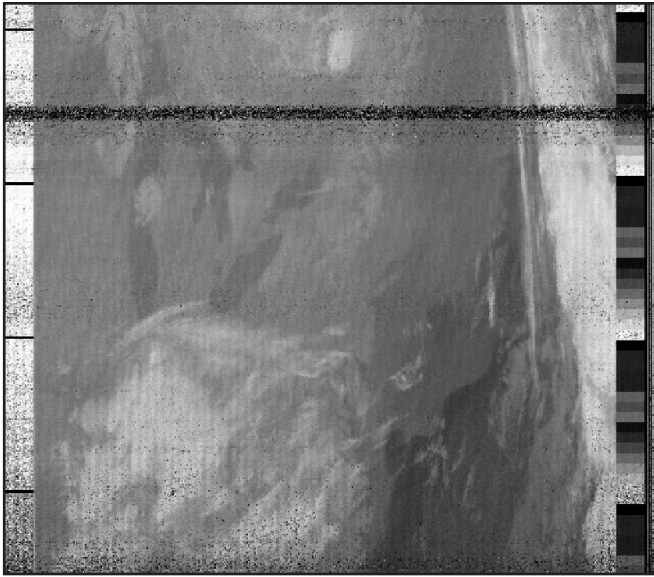
As specified.  
As specified.  
0.1 A (max volume, no signal), tested at 13.8 V dc.  
137 MHz, 0.18  $\mu$ V.  
100 kHz spacing, 137 MHz: 48 dB.  
100 kHz spacing, 137 MHz, 48 dB.\*  
IF: 137 MHz, 105 dB; image, 53 dB.  
At threshold: FM, 137 MHz, 0.05  $\mu$ V.  
300 mW at 3.5% THD (max volume) into 8  $\Omega$ .

\*Measurement was noise-limited at the value indicated.

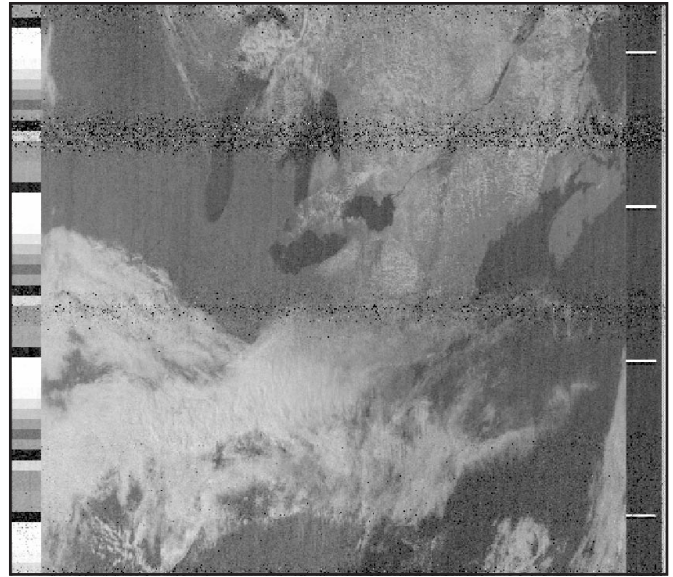
<sup>1</sup>Maximum rating of the audio amplifier used in the circuit.

### Bottom Line

The R139, a simple antenna, some software and a sound card equipped PC is all that's required for receiving real-time images directly from a variety of orbiting weather satellites.



NOAA-14 at 3:21 AM. Night still blankets the upper Midwest and east coast, so this image was captured in infrared automatically while I slept! The satellite was passing behind my attic Yagi, which accounts for the noise in the signal. Even so, the image is fairly clear.



NOAA-12 crossed almost directly through the primary pattern of my antenna for this image. The Great Lakes and a large part of the Canadian Maritimes are clearly visible.

supply is provided. You must wire the supply to the included DB-9 plug, which could be a problem for those unaccustomed to soldering wires onto small, multipin connectors. Just make sure you follow the manual diagram carefully. The same holds true for wiring the other DB-9 connections.

The first thing I did was to simply wire up a speaker and listen to a satellite pass. I used my satellite-tracking software to pinpoint the next NOAA-12 appearance and, sure enough, there it was—beeps, tick-tocks and all. Although my antenna was a small 2-meter Yagi in my attic, the satellite's signal was loud and clear. For most of my experiments with the R139, I used NOAA-12 and NOAA-14. Each satellite provides two overhead passes every 24 hours.

For the next NOAA-12 pass the following morning, I squelched the R139 and put it in the scanning mode. As NOAA-12 climbed to about 20° above the horizon, the R139 suddenly locked onto channel 3 (137.500 MHz) and the squelch opened to the rhythmic sound of the satellite.

### Receiving and Demodulating Images

In the old days (prior to about 1996 or so) the only way to demodulate a weather satellite signal and display the resulting image on a computer was to use a stand-alone demodulator. Usually this took the form of yet another box that you placed beside your satellite receiver. And if you wanted to record images while you were away from home, you needed to have the means to store the signals, typically by using an audio tape recorder.

The R139 is equipped with a demodulator signal output line for those who still own hardware demodulators. It even includes a

nifty tape-recorder control that “closes” a transistor switch whenever the squelch opens.

But for those of us who own PCs with sound cards—and that is most PCs sold today—there is a much easier method. Everything the external demodulators and tape recorders used to do can now be accomplished with software. The program of choice, and the one that I use, is *WXSAT* by Christian Bock. You can find *WXSAT* on the Web at <http://ourworld.compuserve.com/homepages/HFFax/toc20.htm>. This ingenious piece of software uses the DSP power of the sound card and PC to demodulate weather satellite images. *WXSAT* displays and analyzes the images for you. It will even do sophisticated automatic image processing and storage of both the images and the audio files.

The Hamtronics R139 and *WXSAT* are a superb combination. Connecting the two was as easy as running a shielded audio cable between the R139 and my sound card input. I was able to leave *WXSAT* and the R139 running almost continuously, grabbing satellite images whenever the birds came within range. Since *WXSAT* is *Windows* software, you can multitask, too. Believe it or not, as I was typing the previous paragraph in *Word97*, *WXSAT* was receiving an image from the Meteor 3-5 satellite!

### But how well does it work?

My meager station is far from ideal for monitoring weather satellites. Not only is my antenna in the attic, it is a fixed Yagi. This is a liability because my reception is limited to only that portion of each satellite pass that travels through my Yagi's pattern. Unless you can track the satellite through-out a pass using an azimuth/elevation rota-

tor, a beam antenna does more harm than good. You are probably better off with an omnidirectional antenna such as a turnstile (Hamtronics sells these), eggbeater or quadrifilar.

My other liabilities include the fact that my antenna is close to my PC (enough birdies to make Alfred Hitchcock envious), and that fact that I don't have a receive preamplifier. Despite all this, the R139 did a remarkable job (see the sample images).

### Conclusion

If you want to receive APT weather satellite images with your bare hands, you can't go wrong with the R139. It is a good receiver at an economical price. If you enjoy building, you can purchase the kit version of the R139 and save even more money.

Teachers should take note. The R139 is probably the least expensive means possible to expose your students to the awe and wonder of satellites. With the R139, the *WXSAT* software, a simple antenna and a desktop or laptop PC, students will be treated to an astronaut's view of their home planet. It's important to emphasize that the image they are seeing is not a stored picture that's hours or days old—it is a real-time snapshot taken from a spacecraft at the very moment that it's streaking over their heads! Radio doesn't get much more impressive than this. Ask any ham.

*Manufacturer:* Hamtronics Inc, 65 Moul Rd, Hilton, NY 14468; tel 716-392-9430; fax 716-392-9420; [jv@hamtronics.com](mailto:jv@hamtronics.com); <http://www.hamtronics.com>. Manufacturer's retail price, assembled with cabinet and 115 V ac adapter: \$239; in kit form with cabinet and ac adapter: \$189; in kit form less cabinet and ac adapter: \$159.