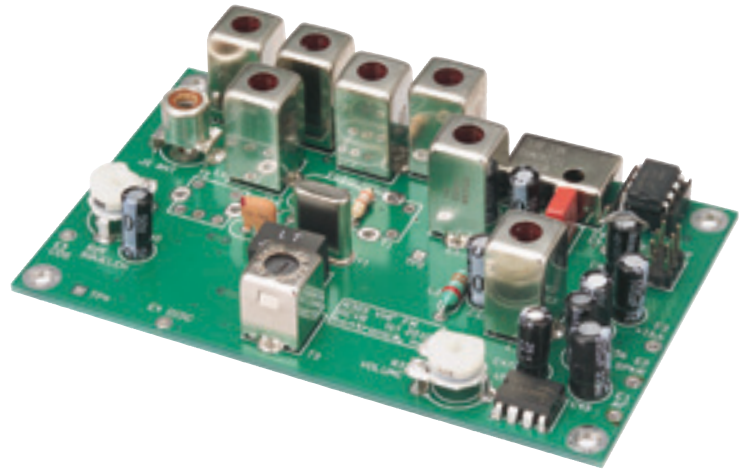
Hamtronics R303-137 Weather Satellite Receiver Board



Reviewed by Mark Spencer, WA8SME
ARRL Educational and Technology Program Coordinator

I have been a user of the NOAA polar orbiting satellites sending *automatic picture transmission* or *APT* imagery for years. Additionally, during the ARRL Teachers Institutes, I encourage teachers to use these NOAA satellite signals and their imagery in their classrooms. A number of TI graduates have installed satellite ground stations at their schools and share imagery and weather observations across the county.

For hams interested in exploring the satellite facet of the hobby, the NOAA satellites are an excellent resource because their VHF signals at 137 MHz are relatively strong. They are easy to receive with basic equipment, and a variety of computer software packages (many freely available) make the display of the imagery from space a snap. The typical received image is illustrated in Figure 2, which was produced during this review. Though you can receive the NOAA signals with a regular 2 meter FM radio or police scanner tuned to the 137 MHz channels, quality reception of the APT signals requires a wider receiver bandwidth than FM voice. A receiver designed for APT reception gives far better results.

Overview

The Hamtronics R303-137 receiver is a replacement for the successful R139 weather satellite receiver that I have used for many years. It's is a weather satellite adaptation of the Hamtronics commercial-grade VHF FM receiver. The R303-137 has four frequency synthesized channels that cover the NOAA satellite frequency plan and it has an IF bandwidth that is optimized to receive APT imagery.

The receiver is not a plug-and-play unit and comes as a circuit board only. The user installs and solders interconnecting cables and wires to connect the board to a 12 V power source, antenna, speaker and computer sound card. (You can mount it in a suitable enclosure if desired, but that's not necessary.) Putting the receiver on the air requires only basic soldering skills and would be a good first project for those interested in hands-on construction.

The Review Setup

I tested the receiver using two antenna systems. The first was a high end antenna system that consists of a homemade eight element, right hand circularly polarized Yagi with an antenna mounted preamp and low loss hardline coax from the antenna to the shack.[1] The antenna is mounted on a computer controlled azimuth/elevation (az/el) rotator system that automatically tracks the satellite. This antenna system has been developed over the years and gives consistent horizon to horizon, noise free imagery.

The second antenna was a starter system that consisted of a homemade turnstile antenna with a run of 75 feet of RG-8X coax with and without an antenna mounted preamp.[2] The display software was *WXTOIMG* running on a typical laptop computer.[3]

From the Box to First Image

The review receiver came with the optional power supply cube and a few pages of documentation. The documentation, though it appears Spartan, is well written and contains all the information you need to set up and connect the receiver to the external parts required for operation. Following the directions, it doesn't take long to solder the required wires to the through hole solder pads and make connections to the power supply, speaker, computer sound card and antenna.

Channel selection is made by jumper-

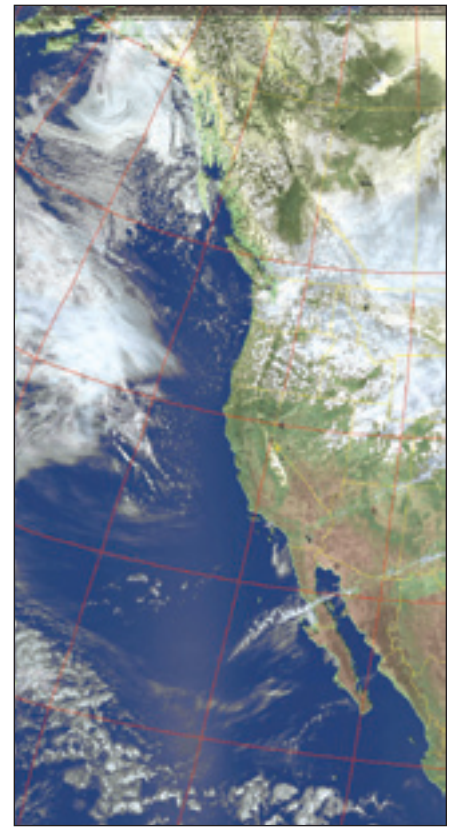


Figure 2 — This image was received with the R303-137 connected to a Yagi antenna and mast mounted preamp.

[1]The eight element Yagi antenna is detailed online at **www.arrl.org/ariss-tracking-interface**. Though the dimensions are for 2 meters, the antenna is easily scalable for 137 MHz. Contact WA8SME at **mspencer@arrl.org** if you would like the dimensions for the weather satellite version of the antenna.

[2]The documentation refers to the turnstile antenna design as published in the *ARRL Weather Satellite Handbook* (unfortunately this excellent resource is no longer in print). If you would like the details of the turnstile antenna referenced and used in this review, contact WA8SME at **mspencer@arrl.org** and request an extract that includes the information.

[3]The display software used in the review can be downloaded from **www.wxtoimg.com**.

Bottom Line

With a little work, the R303-137 weather satellite receiver board offers a great way to receive fascinating weather satellite images.

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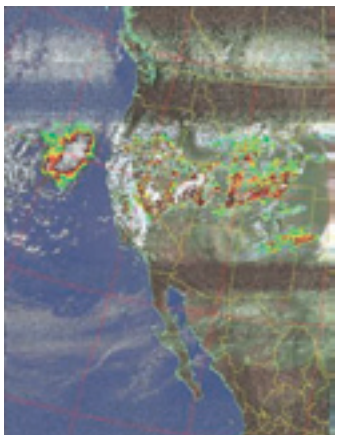

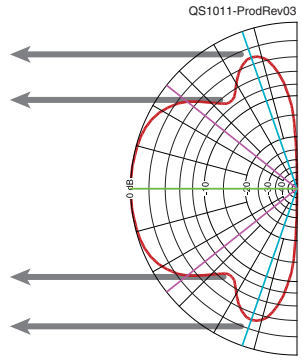

Figure 3 — Image received using a simple turnstile antenna with no preamp. Note how noise bars in the image correlate with nulls in the antenna pattern.

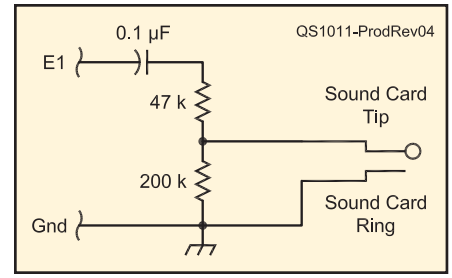

Figure 4 — Schematic of the pad used to reduce the receiver audio output for better compatibility with computer sound cards.

Table 2
Hamtronics R303-137 Weather Satellite Receiver

Manufacturer's Specifications	*Measured in the ARRL Lab*
Frequency coverage: 137.9125, 137.620, 137.100, 137.500 MHz.	As specified.
Power requirement: 13.6 V dc at 38-100 mA.	Full volume, no signal, 90 mA.
Minimum operating voltage: Not specified.	6.9 V dc.
Mode of operation: FM.	As specified.
FM sensitivity: 0.2 µV.	For 12 dB SINAD, 9 kHz deviation: 137.100 MHz, 0.27 µV; 137.5-137.9125 MHz, 0.23 µV.
FM adjacent channel rejection: Not specified.	100 kHz offset, 46 dB.
FM two-tone, third-order IMD dynamic range: Not specified.	100 kHz offset, 46 dB.*
Squelch sensitivity: 0.15 µV.	137.5 MHz, 0.12 µV.
Speaker audio output: 1 W, 8 Ω load.	Full volume, 926 mW at 7.6% THD. THD at 1 V_{rms}, 2.1%.
Size (width, depth): 4.0 × 1.5 inches; weight, 3 ounces.	
Price: R303-137 PC board, $229; ac adapter, $9.50, LNK-137 preamp, $99.	

*Measurement was noise limited at the value indicated.

ing the appropriate pads to ground. The documentation suggests using a rotary wafer switch connected to the frequency select pads through 1N914 or similar switching diodes. During my satellite operations, I use only the newest birds (N19 and N18) of the constellation, requiring only two frequencies. Therefore an SPDT switch is all that's required.

The receiver SQUELCH and VOLUME controls are mounted on the circuit board and there is no scan function. This may seem like a limitation, but in reality it is not. In practice, the only time I listen to the audio during a satellite pass is while I am giving a demonstration; otherwise the speaker is switched out or the volume turned down so that it is not audible. Likewise, since I am not monitoring the satellite audio, I leave the squelch wide open. Finally, there are times when multiple satellites are within range at the same time, so a scan function might cause the receiver to lock on the wrong satellite. Consequently, on my R139, which does have a scan function, I leave the scan off and manually select the desired frequency.

Once wired up, I connected the R303-137 to the antenna and waited for the first pass. The receiver worked the first time and the results were identical to those obtained with my old R139 receiver as illustrated in Figure 2. Throughout the day I jumpered the frequency selection pads to the other three channels and captured similar results from the other birds. The only surprise was that the audio out of the COMPUTER INTERFACE port, E1, was at too high a level to be controlled by the *Windows* sound card control panel. The receiver produced more than adequate audio to drive the speaker and the squelch functioned as advertised.

Next I connected the receiver to the temporary turnstile antenna. The receiver produced acceptable results, consistent with the limitations of the antenna, as illustrated in Figure 3. I modeled the turnstile and displayed the elevation plot (rotated 90°) next to the imagery. There is remarkable correlation between the nulls of the antenna and the bars of noise in the image.

I inserted an antenna mounted preamp, but there was little improvement in the image quality. The preamp may help with coax line loss, but it does little to make up for marginal antenna performance. There is ample sensitivity in the R303-137 to compensate for reasonable coax line losses.

The simple turnstile antenna offers respectable results and I know of schools that produce excellent quality images with these fixed antennas (though it takes some tweaking to optimize the installation).

I Wish They Had...

In working with the R303-137 receiver, I found a few things that would improve the product.

- The documentation mentions that the power cube positive and negative leads are identified by ribbing on the positive lead (both leads are white). These ribs are a bit subtle and could be easily missed. If the power leads happen to be connected backward, the receiver will not work and there is a good possibility that the audio amplifier IC will be damaged by the reversed voltage. I wish that there were a protective diode installed in the positive voltage line to prevent damage.
- The through hole pads used to make off board connections are well marked and easy to get to. There is, however, a lack of convenient and easily identifiable ground pads for completing the interconnections. I wish that there were ground through hole pads right next to the off board connection pads to make ground returns more convenient.
- The documentation addresses two ways to feed the audio from the receiver to the computer sound card — connecting to the speaker audio output line, or connecting to a dedicated audio line that samples the audio before the audio output IC. The audio

level to the computer is critical for quality imagery. If you elect to use the speaker audio, any change in speaker volume will affect the imagery. Therefore I prefer to use a dedicated computer audio connection that is independent of the speaker volume.

The output level of the dedicated audio line, however, is fixed and at too high a level to be handled by the *Windows* sound card VOLUME control. The voltage divider circuit depicted in Figure 4 was inserted between the E1 pad on the receiver board and the computer sound card. I wish the receiver provided a way to adjust the audio output for the computer sound card connection.

■ The antenna connector mounted on the receiver board is a phono jack, I would prefer a more traditional coax connector such as a BNC jack. The phono jack works, but I found that the plugs that I had on hand in the shack would not seat all the way into the connector. Hamtronics sells an optional phono plug that probably fits just fine.

Conclusion

The last of the NOAA series of APT satellites was launched a few months ago (N19). Once the existing four birds go silent, we will lose a wonderful resource. However, I estimate that the birds will last for another 12 to 15 years, so any investment in accessing these birds is well worth the effort. The R303-137 receiver works well and is a good choice. In my view, not being plug-and-play is a plus and will encourage the development of construction skills.

Manufacturer: Hamtronics, Inc, 65 Moul Rd, Hilton, NY 14468; **www.hamtronics.com**; e-mail **sales@hamtronics.com**.