Product Reviews

January 2023

FlexRadio Systems Tune Genius XL

West Mountain Radio RIGrunner 4005i

bhi DSP Noise-Canceliing In-Line Module

Product Review

FlexRadio Systems Tuner Genius XL

Reviewed by Bill Axelrod, K3WA
bill@axelrods.org

The FlexRadio Systems Tuner Genius XL (TG XL) is a 2000 W automatic antenna tuner with continuous frequency coverage from 1.8 MHz to 54 MHz. It is designed to match an antenna system with an SWR of up to 10:1 automatically.

All TG XL functions are controlled either from the front panel of the tuner or from a Windows computer software application. Using the Windows application allows the TG XL to be installed away from your operating position or in another geographic location over the internet. Additionally, high-precision peak-responding RF power and SWR meter displays are provided.

The TG XL is tightly integrated with the Power Genius XL (PG XL) RF amplifier and all FLEX-6000 series HF transceivers. Integration is achieved using a standard LAN-based API and communications protocol. The API is published so you can write software applications for your tuner.

The TG XL is compatible with any modern HF radio on the market today. When used in conjunction with a PG XL and a FLEX-6600 or FLEX-6700 transceiver, you have a competitive, fully functional, single-operator two-radio (SO2R) contesting station. In addition, support for SmartLink and MultiFlex (trademarks of FlexRadio) operation provides for multi-client remote operation.

The PG XL is also available in an SO1R (1×3) version that includes programmable automated antenna switching among three antenna inputs. Please note that the reviewed unit was the SO2R version.

An antenna tuner does not actually tune an antenna; rather, it is a device in the RF signals path between the transmitter and its antenna to improve power transfers between them by transforming (matching) the impedance presented at the transmitter's antenna feed output to a compatible value. This impedance change protects the transmitter from the potentially damaging effects of high reflected power, allowing the transmitter to avoid reducing (folding back) power to protect itself.

It's important to understand that the tuner does not change the actual SWR of the antenna and feed line. Instead, it transforms the impedance presented to the transmitter.

Installation

Included in the box with the TG XL tuner, you will find a 6-foot (2-meter) dc power cord with connectors and pigtails, a 6-foot Ethernet cable, and the user's manual.

After I unboxed the TG XL, I placed it in its operating position. In my setup, I have my Power Genius amplifier and the TG XL in a separate room from my shack. You should leave 12 inches (30 centimeters) of open space in front of and behind the tuner for adequate ventilation.

Bottom Line

At the time of this writing, FlexRadio Tuner Genius XL is one of the only auto-tuning, single-operator two-radio (SO2R) tuners available on the amateur radio market. It is a legal-limit tuner covering 160 – 6 meters and can match up to a 10:1 SWR.

You will need to provide at least two antennas for SO2R operations, and antenna switching for more. If you have the 1×3 Power Genius XL, you can connect up to three antennas, which are selected in setup, directly in the amplifier.

If you are installing the TG XL in the Flex ecosystem, installation is relatively simple. It took me about 30 minutes to unpack the tuner, install it in place, hook it up, and turn it on. I spent most of that time running the CAT5 cables from my shack to the room where my amplifier and tuner live.

In Figure 1, you will see the SO2R version of the rear panel. Connect 12 – 15 V dc power to the **15V DC MAIN** jack in the lower right-hand corner of the rear panel, and connect your ground to the grounding post, and your Ethernet cable to the **LAN** jack. Connect the coaxial cables from your transceiver or amplifier 1 (**A**) output to the **TX A** coaxial input jack, and the cable from your transceiver or amplifier 2 (**B**) to the **TX B** coaxial input jack.

Connect the coax from your antenna or antenna switch (antenna 1) to the **ANTENNA A** jack, and the coax from antenna 2 to the **ANTENNA B** jack. Connect your dc power and ground. The Tuner Genius can also be used with other transceivers/amplifiers from almost any manufacturer.

The simplest method to do that is to use the RF Sense ability of the TG XL. Connect the coax from radio or amplifier 1 (if you use only one) along with the PTT line to the radio A **TX** and **PTT A** jacks, and do the same for radio or amplifier 2 to the appropriate B jacks. The TG XL will sense the frequency when either radio 1 or radio 2 is keyed, and react accordingly.

You may choose to use either CAT or band data from your radios to provide frequency information to the TG XL. There are appropriate jacks for those inputs available, along with **CI-V** jacks for Icom radios.

My only quibble is with the really small **ON/OFF** switch on the back, immediately adjacent to the dc power input jack. If you can't easily see the back of the TG XL, it can be frustratingly difficult to find to turn your TG XL on or off. But keep in mind that the TG XL is fully bypassed internally while in standby, and very little current is consumed; it is similar to having your TV in an off position.

The Desktop App

You can set up, configure, and operate the TG XL using the Windows utility app provided with your TG XL (see Figure 2).

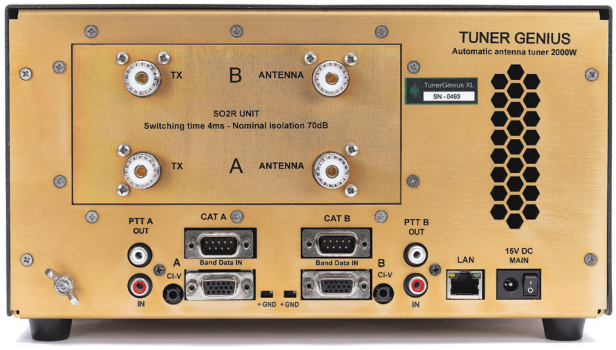

Figure 1 — FlexRadio Tuner Genius XL rear panel (SO2R version).

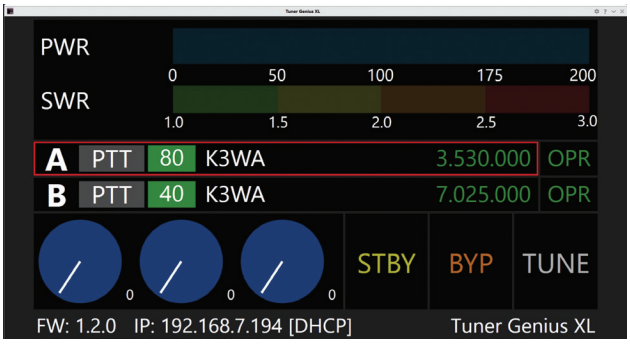

Figure 2 — Tuner Genius XL desktop application.

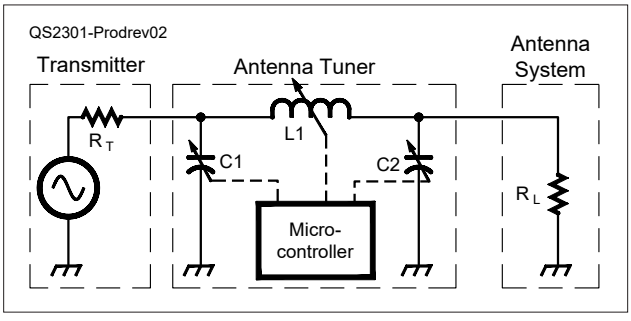

Figure 3 — Tuner Genius circuit. [Courtesy of FlexRadio]

The desktop application becomes handy — it is available anywhere you can connect to your LAN. I like to sit on my back porch and operate. I connect to my radio, amplifier, and tuner with a laptop computer, using my home network Wi-Fi.

The TG XL can operate fully automatically, or you can manually tune it. Meters show the output power and SWR for radio A (1) and radio B (2) when transmitting on either. When transmitting, the PTT block light shows which one is transmitting. The blue circles show the position of the TG XL components and can be used to manually adjust them.

Next to the component controls you will see the **STBY**, **BYP**, and **TUNE** buttons. The **STBY** button puts the

TG XL in standby. The **BYP** button bypasses the tuner and allows you to measure the native SWR of your antenna system. Clicking on the **TUNE** button will cause the TG XL to tune. Caution: If you are not operating in the Flex ecosystem, remember to put your amplifier in standby and set your transceiver for low power (20 W recommended) before tuning.

Circuit Description

From a high-level view, the TG XL circuit (shown in Figure 3) looks just like any pi network antenna tuner. The two capacitors and the variable inductor actually are a large number of individual components that are controlled by a microcontroller. And that's where the magic happens. The microcontroller determines the combination of the LC components that best matches the antenna system to the transmitter. There are 16,581,375 possible matching combinations. The first time you tune the TG XL to a new frequency, it will tune in 2 – 12 seconds and store the settings in memory. The next time it will recall the settings from memory and tune in less than 20 milliseconds.

Setup

You can set up the TG XL using the screen on its front panel or using the desktop app (Windows utility program). I find it much easier to use the desktop app. You need to configure the TG XL to work with your transceiver or transceivers that will drive it.

When you start the desktop app, it will automatically discover your TG XL if you are on your LAN. Once you connect to the TG XL, you can configure the tuner. Clicking on the gear icon in the upper right-hand side of the desktop app opens the **TUNER GENIUS CONFIGURATION** window (see Figure 4).

There are five tabs. The first allows you to give your TG XL a unique name and set up your network.

The second tab, **CAT / CI-V**, is used to enable a CAT or CI-V connection, sets the serial port or CI-V settings, and specifies what model radio you are using for ports A (radio or amplifier 1) and B (radio or amplifier 2, if you have the SO2R TG XL).

The third tab is used for enabling and setting up your TG XL for use with FlexRadio units.

The fourth tab provides for the setup of a FlexRadio Antenna Genius (AG). The AG is an SO2R antenna switch that integrates seamlessly into the Flex ecosystem.

The final tab is **OTHER**. It adjusts the backlight on the TG XL front panel display, allows the configuration of

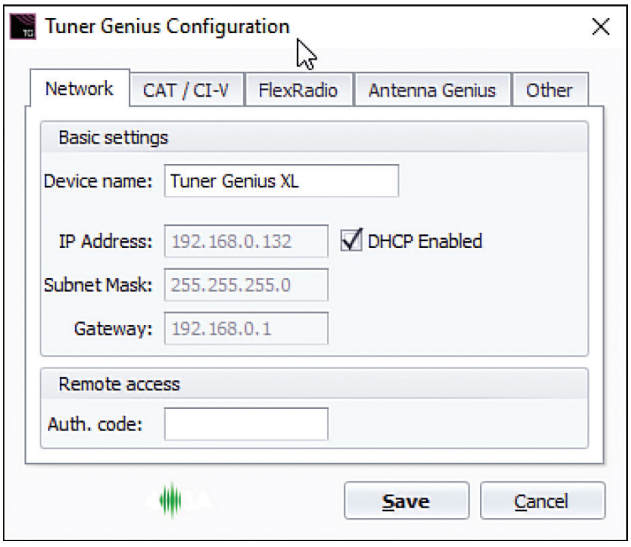

Figure 4 — Tuner Genius Configuration window. [Image courtesy of FlexRadio]

the minimal acceptable SWR band by band, and enables you to bypass the tuner while receiving.

The TG XL user manual provides detailed instructions for setting up and configuring the tuner for the FLEX-6000 series, Kenwood, Icom, and Yaesu transceivers. You can download the manual via the following link: **www.flexradio.com/documentation/tuner-genius-xl-user-guide**.

Operation

The tuner has two operating modes: automatic and manual (see Table 1). In the automatic mode, you initiate a tuner operation by changing the frequency of your radio. The TG XL reads the frequency via your LAN or CAT/CI-V connections. Although the Power Genius amplifier is not needed to use a Tuner Genius XL in your station, if you own the PG XL, when you key your radio the PG XL adjusts for the best match for that frequency. If no match is found in memory, the PG XL measures your antenna's native SWR. If it is under 10:1, it tells the PG XL to tune. In the manual mode, you adjust the tuner component settings using the three knobs on the TG XL front panel or on the desktop app until you find the best match. I have never found a need to do that.

You can also set the acceptable maximum SWR level for automatic tuning; the default is 1.25:1.

When operating in the Flex ecosystem (with a FlexRadio unit), pressing the **TUNE** button on the TG XL's front panel or the desktop app puts your FlexRadio amplifier in standby (if you have one) and tells your FLEX-6000 transceiver to apply the appro-

Table 1
FlexRadio Systems Tuner Genius XL

Manufacturer's Advertised Specifications (not tested by the ARRL Lab)	
Tuning	Fully automatic and manually tuned operation
Frequency Range	1.8 – 54 MHz continuous
Radio Interface	Works with all radios using FlexRadio LAN, CIV, BCD, Pin-to-Band (PTB), or built-in frequency counter
Alarms and Warnings	Low drive, frequency out of range, wrong band, and high power
Matching Range	Up to 10:1 SWR; resonant antenna frequency range measurements will bypass the tuner automatically
Tuning Time	2 – 12 seconds and stored in memory automatically; stored memory switching is 20 ms
Tuning Power Requirement	10 – 200 W
Nominal Impedance	50 Ω unbalanced
Normal Operating Power	Up to 2000 W
Duty Cycle	100% ICAS
Protection	Intelligent SWR and power derating
Required Power Supply	12 – 16 V dc at 2 A via an external 110 – 240 V ac power supply (not included)
Size (height, width, depth)	5.9 × 11.8 × 13.8 inches (30 × 35 × 15 centimeters)
Weight	15.4 pounds (7 kilograms)
Temperature Range	–4 °F (–20 °C) to 122 °F (50 °C)
Humidity	Up to 98% (non-condensing)
Altitude (ASL)	Up to 10,000 feet (3,050 meters)
RF characteristics for each available Tuner Genius XL version *1×3 Version*	
Inputs and Outputs	1×3 matrix (1 in, 3 out)
Switching	Matrix, manual or automatically by frequency/band
SO2R Version	
Inputs and Outputs	2 in, 2 out — each input is paired with one output
Switching	Non-matrix SO2R, manual or automatic by frequency/band
Connector Type	UHF/PFTE (SO-239A)

priate tune power (20 W or more). It then determines the transmitted frequency and measures the antenna SWR. If the SWR is under 10:1, it will tell the TG XL to tune.

If you are not using the TG XL in the Flex ecosystem, you must put your amplifier in standby, apply tune power from your transceiver (20 W recommended), and then press the **TUNE** button. The TG XL then follows the same process as it does in the Flex ecosystem.

If the TG XL measures the antenna system's SWR to be greater than 10:1, it will not tune. That's a protection feature, because a higher SWR can produce high voltages inside the tuner and can be destructive.

The TG XL's microcontroller executes an algorithm that quickly varies the value of each element of the matching section of the tuner. It repeats until an acceptable match is realized. The tuner then stores the matching network's element values in nonvolatile memory. The next time you go to a frequency within 10 kHz of a stored solution, it recalls the stored solution and applies these values to the circuit.

Impressions

I have used FlexRadio Systems equipment since the FLEX-6000 series was introduced. Although I have no business relationship with FlexRadio (other than being an enthusiastic customer), I have been a member of FlexRadio's Alpha Test Team for all of their products, including the TG XL. On the other hand, owning the complete Flex ecosystem is essential to operating this unit at its full potential.

When the TG XL was announced, I had a competitive SO2R contest station with towers, effective low-band antennas, and receiving antennas. I had a FLEX-6600 radio, a Power Genius amplifier, and the Antenna Genius antenna switch. This setup allowed me to do SO2R contesting with just one radio and one amplifier.

Between the time I pre-ordered the TG XL and when I received it, my wife and I realized that we had run out of youth and decided to downsize. We now live in a much smaller home with a homeowners association. Call it "NoAntennaVille." As fate would have it, it turned out to be an optimal QTH for testing this antenna tuner.

My main antenna now is a 20-foot flagpole. It doesn't resonate anywhere. The tuner matches my flagpole on all bands — 80 through 6 meters. It will not match the flagpole on 160 meters (I never expected it to). The native SWR of the flagpole is above 10:1, and the TG XL protective circuits will not allow tuning.

It tunes the flagpole on the other bands quickly, without any drama, and memorizes the settings. I can now change frequencies from one band to the other, and by the time I reach my key to transmit, the tuner has switched in the correct elements for the new band and frequency.

In SO2R operation, the switching between radios 1 and 2 (*slices A* and *B* in FlexRadio terminology) is seamless and rapid, and fully supports SO2R contesting.

I also tested the TG XL using the FLEX-6600 transceiver for one radio and a Yaesu FT-991 for the second radio. I connected the FlexRadio unit using the LAN interface for frequency and keying, and set the TG XL to RF Sensing and a PTT cable for the FT-991. That also worked well.

Conclusion

The TG XL is an excellent buy for anyone — whether a relentless SO2R contester, a single radio DXer, or an everyday ragchewer needing a 160 – 6-meter auto-tuning, legal-limit antenna tuner.

Manufacturer: FlexRadio, 4616 W. Howard Ln., Suite 8-860, Austin, TX 78728, **www.flexradio.com**. Price: 1×3 version, $2,199; SO2R version (reviewed unit), $2,499.

bhi DSP Noise-Canceling In-Line Module

Reviewed by Paul Danzer, N1II
n1ii@arrl.net

From the very beginning, radio amateurs have been trying to pull weak signals out of the accompanying noise. The designs used depended on the technology and parts available at the time. As an example, clipping peaks and reducing the bandwidth were initially all that were available. Later, more sophisticated (and complicated) circuits were used, such as the current approach used for some units that sample the noise alone, usually through a second antenna, so the noise is captured before it enters the receiver. This noise is then subtracted from the combined signal and noise from the main antenna. The expectation is that some, or hopefully most, noise will be subtracted out.

Another way to reduce, or hopefully eliminate, the noise is to place an outboard circuit in line with the audio output of the receiver. The bhi DSP Noise-Canceling In-Line Module is designed to be used this way — inserted between the receiver audio output and an external speaker or headphones.

Packaged in an enclosure whose face is approximately 1.8 × 2.5 × 5.3 inches (46 × 65 × 135 millimeters), it occupies very little space on the operating table or desk (see Figure 5). Today's availability of complex integrated circuits results in a weight of approximately 10.6 ounces, excluding interconnecting cables.

Installation Takes Only a Few Minutes

The back of the enclosure has four jacks (see Figure 6). The white label is a warning that opening the box results in voiding the warranty. The top left jack accepts a standard 3.5-millimeter monaural plug. Enclosed with the unit is a cable that has this mating plug on both ends — one end for the In-Line Module and the other end for the external speaker output of your receiver. Just below, on the left, is a 2.1-millimeter barrel connector for

Bottom Line

The bhi DSP Noise-Canceling In-Line Module works well and is good for noise suppression, in most cases without distortion on strong incoming signals.

Figure 5 — Only one front panel control, the DSP Filter Level, might have to be touched during normal operation and then rarely thereafter.

Figure 6 — Input, output, and power — these are the only needed connections. You can choose an output to a speaker or headphones.

10 – 16 V dc to power the unit. A mating cable is included, with the connector on one end and tinned wire leads on the other. The monaural speaker jack at the top right and the headphone jack just below it are also standard 3.5-millimeter jacks. The power lead includes a fuse, and dc current requirements are specified as 500 mA. There is a warning not to ground any part of the headphone jack. Four small rubber feet are included to protect the operating table or desk.

Installation time is, therefore, short. Disconnect your speaker from your receiver, connect the bhi module to the receiver speaker jack, and plug your speaker cable into the unit. Connect the dc lead to your power source, and you are ready to go.

The controls and LED indicators are on the front panel, with one more rotary knob on the right side. This knob controls output volume level.

Control Settings and Indicator Lights

The three-position miniature slide switch on the top of the panel controls power and processing state. Slid far left, the unit shuts off and no audio is sent out. In the center position, indicated as **ON**, amplified audio is sent out but there is no processing. In the far right position, the **DSP** (digital signal processor) circuit is turned on. The DSP level is controlled by the center rotary switch, with position **1** the least processing and position **8** the maximum processing. Noise-canceling levels, corresponding to the switch positions, are specified up to 40 dB. Heterodyne tone reduction is specified up to 65 dB.

Your selections and the results are echoed by the left LED (**STATUS**) and the right red LED (**OVERLOAD**). The **STATUS** LED goes red when power is applied, and turns green when the noise cancellation is active. When the input audio is too high, and the circuit goes into overload, the right-hand LED goes on. This indicates that you should reduce your receiver audio output level. The internal 5 W audio amplifier output level is adjusted by the small knob on the right-hand side of the enclosure.

What's Inside?

The small instruction book doesn't provide much insight into the contents of the module. But you will find the details on the manufacturer's website. Here's a summary: The In-Line Module has a powerful programmable DSP audio-processing chip in conjunction with a 10 W mono class D audio power amplifier chip. The high-performance audio DSP chip delivers exceptional sound quality and incorporates a full audio signal chain with 16-bit analog-to-digital (A/D) converters and digital interfaces to accept the signal through the fully flexible digital processing architecture to analog line level.

Today, a DSP for an audio application usually consists of an A/D converter on the input, followed by a digital processor, and finally a digital-to-analog (D/A) converter on the output, most often then feeding a standard audio amplifier. Some DSPs use a general-purpose microprocessor, while others take advantage of either chips designed specifically for DSPs or general-purpose programmable chips. The programming details of this unit are driven by a set of equations, most likely proprietary to the manufacturer (bhi) and the result of extensive testing.

The 100th edition of *The ARRL Handbook for Radio Communications* contains a good deal of information on DSPs. As faster processing chips (and faster A/D and D/A converters) became available, more DSPs were designed and incorporated in amateur radio equipment. Dave Hershberger, W9GR, is credited as the first designer of an audio in/audio out DSP published in an ARRL publication. It used an early DSP chip. For more information on DSP designs, see the sidebar, "More About DSPs."

On-the-Air Results

A set of tests were run during daylight hours on an Icom IC-7300 with an LDG tuner and an 80-meter dipole. On 40 meters there was a Parks on the Air® (POTA) station with an S-8 signal and a background of S2 – 3 noise. With the slide switch turned to **ON** (no processing, audio through the unit's amplifier), the output volume was the same as it was with the switch set to **OFF**. This indicates that the small volume control on the right-hand side of the enclosure was set properly. Then with the DSP Filter Level control advanced to the **2** position, the POTA station popped out of the noise; alternatively, the noise was well suppressed.

As an experiment, the filter level was advanced to **4** or **5** when distortion on the signal was noticeable. Past that, the signal was too distorted to be usable. The result was that a setting of **2** was sufficient to suppress noise in this case.

The POTA station had a lot of activity. For the stations calling, ranging from S-3 to S-9, the unit was hands-off. A dial setting of **2** or **3** was good for noise suppression, in most cases without distortion on strong incoming signals.

While I was listening to a few other stations, the volume on the IC-7300 was turned up until the red **OVERLOAD** LED lit. By the time the LED went on, the volume was louder than you would want in your shack. There also did not seem to be any difficulty in tuning in a station with the DSP active. The instruction book warns that in some cases there will be a slight delay in the received signal when the unit is switched from **ON** to **DSP**. This delay did not seem to occur in these tests, but there was often a delay when switching from **OFF** to **ON**.

During a coincident RTTY contest, the unit was tested to see if it changed, or perhaps improved, reception or decoding of a few RTTY signals. No particular effect was seen.

More About DSPs

The 100th edition of *The ARRL Handbook for Radio Communications* devotes an entire chapter (Chapter 8) to DSPs and their functions. Among the examples included are software-defined radios (SDRs). The chapter begins by pointing out that the mathematical basis for digital signal processing dates back to well-known mathematical names in the 17th, 18th, and 19th centuries. It was not until after the digital revolution in the early 1990s, with the widespread availability of digital processing — especially fast processing — that many applications moved from the theoretical to the practical. The chapter includes a full page of references and other material. There are also several online files supplementing this chapter.

In the same *Handbook* edition, Chapter 10, titled "Analog and Digital Filtering," contains several sections devoted to digital filter design. This chapter is supplemented by more than a dozen downloadable files and a full page of references and other lists of helpful materials.

Newer approaches, such as "Deep Learning," are also used to design various filters. A demonstration of one such approach is posted by MathWorks at **www.mathworks.com/solutions/deep-learning/deep-learning-signal-processing.html**. They also offer a free online book on the topic. Other new approaches can be found under the general topic "artificial intelligence" on the web.

A second set of tests were run in the evening on the 75-meter phone band, with the expectation that the noise spectrum or other characteristics would be different. The noise level was different, running S-6 to S-7. There was generally no difference in performance. A few stations were barely discernable at this higher noise level. Some could be pulled out by changing the DSP Filter Level. Other barely discernable signals popped out of the noise, but they were unintelligible. At this location, many stations on the 75-meter phone band tend to have signal strengths of S-9 plus 30 dB; some of the noise around the weak stations may be splatter of some sort from one of these strong stations.

Finally, a number of listening tests were run on 20 meters during the day. Results were the same as on 40 meters. No S-9 plus 30 dB close stations were encountered on either 40 or 20 meters.

In Summary

The most interesting characteristic noted in these tests was that on a weekend afternoon, when the POTA contest was very active, operation was primarily hands-off.

The DSP Filter Level was set to **2** and left there, except for a few occasions when the level was turned up just to see what would happen. However, the noise was uniform and consistent; there were no thunderstorms within range. Results might be different with burst noise sources added into the situation.

Manufacturer: bhi Ltd, 22 Woolven Close, Burgess Hill, West Sussex RH15 9RR, UK, **www.bhi-ltd.com**. Price: $246. Available in the US from several amateur radio equipment dealers.

West Mountain Radio RIGrunner 4005i

Reviewed by Rus Healy, K2UA
k2ua@arrl.net

Over the course of the past 20 years or so, the amateur radio world has gravitated strongly toward Anderson Powerpole® connectors for dc power connections. Before that, we had a mishmash of mostly difficult-to-find or difficult-to-assemble connector standards, many of which are now quite hard to find. Today, with rigs and power supplies widely supporting Powerpoles directly, and a strong accessory market for power connectivity, the typical ham needs a stock of only inexpensive connectors and the right crimp tool to make all radio-related power connections reliably.

West Mountain Radio caught onto the Powerpole trend early on, with a series of products that support Powerpole connectivity. With the RIGrunner 4005i and its big brother, the RIGrunner 10010i, West Mountain Radio adds functionality to basic Powerpole distribution. The 4005i supports Ethernet connectivity and hosts a web server for remote control and monitoring the 4005i model with Wi-Fi (which is built in with an external antenna). The model number indicates capacity and number of ports: The 4005i supports 40 A total and five ports. The 10010i supports 100 A total and 10 ports. The 4005i is built for the desktop, and the 10010i is a rack-mount unit. This review focuses only on the 4005i.

Packaging and Connections

The 4005i is packaged in a metal box with a two-line backlit LCD and a series of buttons and LEDs on the front panel. The back panel includes the Powerpole input and output connectors, an Ethernet port, and an expansion port (see Figure 7). The box fits neatly into my shack between a power supply and a tabletop.

The LCD offers a simple menu that allows you to quickly move through it. It includes input voltage, output status and current drain on a per-port basis, network connection status and details such as IP address, and the configurable http port number where the web server is listening. It also shows the firmware version, which in the review unit is 4.08. When the unit is idle, the LCD rolls through the output settings, showing each one for about 3 seconds before moving on to the next. You can also see the RIGrunner status via its web interface (see Figure 8).

The five Powerpole connectors on the rear panel offer plenty of space around them for making connections. The rear-panel Ethernet port includes LEDs for connec-

Bottom Line

The RIGrunner 4005i is a great station accessory, providing control and monitoring for up to five 13.8 V nominal loads, in a nice package and at a reasonable price. For those building a remote shack, the 4005i can provide the crucial glue needed for remote power control using a web interface.

Figure 7 — The RIGrunner 4005i rear panel.

tion status and network activity. An eight-pin mini-DIN connector provides for future expansion; the manual indicates that it includes a serial port and pulse-width modulated dc outputs and analog inputs, including a dc power output pin.

Features and Operation

Operating the 4005i is simple and intuitive right out of the box. Connect your power supply to the input connector and your loads to the rear-panel ports, and you're ready to go.

The front-panel buttons labeled 1 – 5 allow you to turn on and off each rear-panel load port. An LED for each port indicates port status — green for on and unlit for off. The LCD displays the output name (**NODE 1** through **NODE 5** by default, but you can rename these in the web interface — see Figure 9), as well as the current being drawn by that load. You can cycle through the status of each port on the LCD using the **NEXT** button on the front panel. The LCD has configurable backlight intensity and sleep time after the last key press.

In addition to its simple manual operation, the 4005i provides a web interface for control and monitoring. The web server listens on TCP port 80 by default, but you can configure any desired port number for the TCP listener through the web interface (more on this later).

One of the unique features of the 4005i is its ability to set what West Mountain Radio calls "soft fuses" for each port. The total current capacity of the box is 40 A, but you can individually configure each port to allow a specified maximum current, such as 25 A for an HF rig

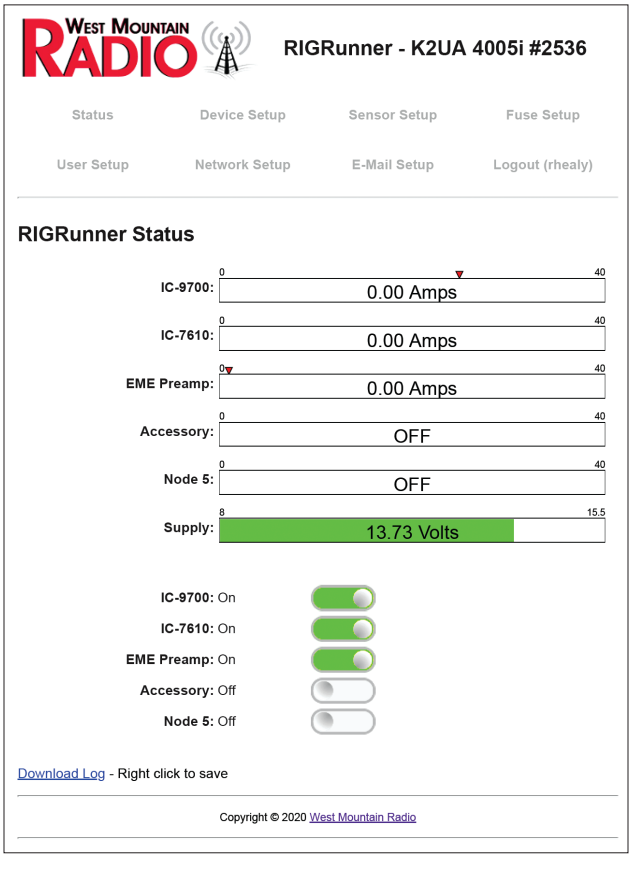

Figure 8 — The RIGrunner 4005i status menu shows the current output state, current drain for outputs that are enabled, supply voltage, and configured name of each port.

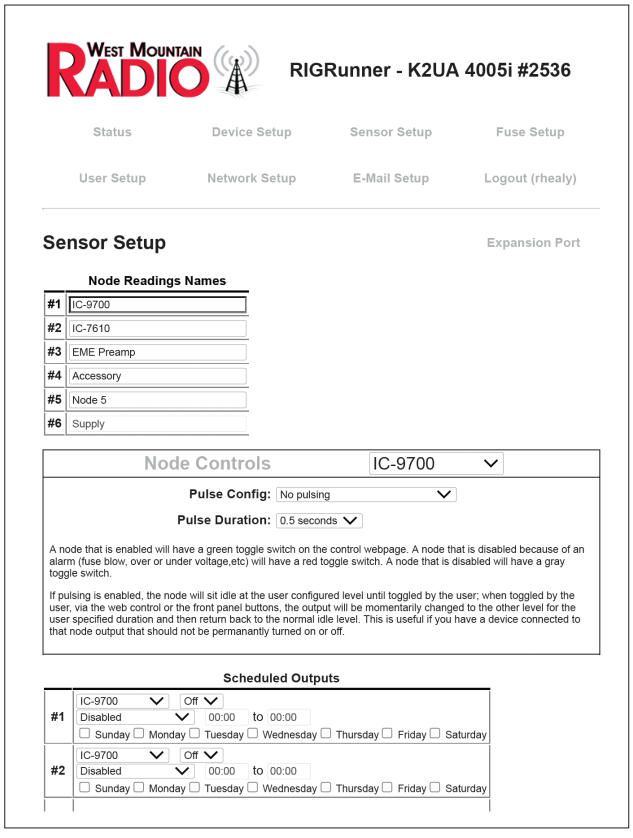

Figure 9 — The RIGrunner 4005i allows you to reconfigure the node (output) names, schedule output operations, and configure pulsed operation for an output using its **SENSOR SETUP** screen.

Table 2
West Mountain Radio RIGrunner 4005i

Manufacturer's Advertised Specifications (not tested by the ARRL Lab)	
Overall Dimensions (maximum, w/o cables): RIGrunner 4005i	1.625 × 8 × 5.25 inches
Overall Dimensions (maximum, w/o cables): RIGrunner 4005i with Wi-Fi	1.625 × 9.5 × 5.25 inches
Weight: RIGrunner 4005i	16 ounces
Weight: RIGrunner 4005i with Wi-Fi	16 ounces
Maximum Total Current	40 A
Maximum Single Individual Outlet Current	40 A (electronic fuse protected)
Input Voltage Range	Minimum 8.0 V / maximum 15.5 V
Electronic Fuse Range	Minimum 0.01 A / maximum 40 A
Environmental Temperature	–10 to 85 °C
Current	
Maximum Total Continuous	40 A
Maximum Port Continuous	40 A
Maximum Port at 1 minute	40 A
Operating with Backlight	80 mA
Operating without Backlight	70 mA
Monitor	
Voltage Accuracy	±2.5%
Voltage Resolution	0.01 V
Current Accuracy	±2.5%
Current Resolution	0.01 A
Minimum Current Reading	50 mA

or 10 A for a VHF rig. When the load hits that configured limit, the port shuts down and the LED for that port changes to red, as a visual indication of the current limit function engaging. Resetting the port requires pushing the corresponding button twice. Regardless of whether you configure the soft fuses, you should still fuse each load at a rating that protects the circuit in case of a fault.

A handy feature of the 4005i is that, after you remove and reconnect power to it, it recalls the states of each output. That is, if you cycle power when ports 1 and 5 are off and ports 2 – 4 are on, when the unit reboots it will set the ports to those same settings. It takes several seconds to do this.

The 4005i by itself, with no outputs enabled, draws about 66 mA with the backlight enabled and 60 mA with it disabled. With all outputs enabled and the backlight on, it draws about 75 mA (see Table 2).

Web Interface

The web interface supports http only, not https (secure connection). Modern browsers may refuse to connect to an http web server by default, and those that don't refuse will warn you of an insecure connection. By default, the 4005i listens on port 80. I recommend changing the default TCP port to a high-numbered port so anyone who might get access to your network won't be able to determine where it's listening. You should also do this if using the box with port forwarding as part of a remote network behind a firewall — each device with a web interface needs to listen on a different TCP port and have web traffic directed to that port by the router or firewall. The web server feature could do with a security update to enable https support.

In addition to the soft-fuse functionality, the 4005i lets you rename the outputs to reflect what's plugged into each one. It has event logging and email alerting functionality that you can enable using the web interface, and it can periodically collect log data and send it to you based on specified events, like a soft-fuse limit being reached. For advanced IP network operators, the 4005i also supports SNMPv1, v2, and v3, so if you are connecting it to a network with an enterprise network management system or another piece of software that can capture and alert on SNMP traps, you can direct them to that server. You can also control the unit using its SNMP MIB if you're using an SNMP management platform.

The network configuration supports Network Time Protocol (NTP), so the 4005i can keep its event log synchronized accurately to an NTP source. The default is **www.pool.ntp.org**, and you can enter up to two NTP servers. The time zone is also configurable, so you can set it to UTC or your local time zone.

If you have an application that requires it, you can configure the ports to operate on a schedule. The 4005i supports 16 discrete timed events, each of which is tied to a particular output port. Each event has a configurable start and end time, selectable days of the week, and a port that can be turned on or off during that interval. There's no function for enabling or disabling all ports through the schedule interface.

From a security standpoint, the web interface offers the ability to configure user accounts and privileges, as well as the privileges of a user who is not logged in. It also allows you to lock the front-panel buttons so that you must operate the controls using the web interface — useful if the box is physically located where unwanted fingers may attempt to push the buttons.

The 4005i includes the ability to send emails, as well as SNMP traps, when an event occurs in the event log. It can also periodically email you status messages. This may be useful if you're monitoring a remote location for the presence of dc power.

Remote Station Support

Using the web interface, appropriately directed through a firewall in your network, you can use the 4005i as part of a remote station to enable and disable outputs and monitor the associated loads for appropriate current drain from a single web page. In addition, you can set up helpful email alerts to keep you informed of status changes and the current system state, both of which are very helpful to a remote operator.

In addition to its web interface, the 4005i can be controlled as part of a broader remote solution using platforms such as Node-RED. Dave de Coons, WO2X, has built a project to add a 10010i to his station dashboard and use that to control and monitor loads connected to it. The 4005i supports the same kind of remote automation. In addition, Node-RED can provide functionality that the 4005i doesn't natively support, such as shutting down all ports simultaneously in the event of nearby lightning. Node-RED is but one of many automation platforms that hams are using for remote station control, but it is one of the most accessible and low-lift platforms to use.

Dave's YouTube video can be found at **https://ytube.io/3WYG**

Manufacturer: West Mountain Radio, 1020 Spring City Dr., Waukesha, WI 53186, **www.westmountainradio.com**. Price: $279.95; 24V model, $284.95; Wi-Fi model, $329.95.

Quicksilver Radio Deluxe Coax Crimp Kit

Reviewed by Pascal Villeneuve, VA2PV
va2pv@arrl.org

Most hams will consider buying specialized tools at some point. A few years ago, I bought a crimper for the Anderson Powerpole power connections and replaced all of my dc connections in my radio station. This proved to be a good investment, because now all of my connections are compatible.

I've looked at coax crimper tools often, but because I was able to do my connectors with my soldering station (and most of them lasted a long time without any issues), buying crimpers was always bumped down my priority list. But at the 2022 Dayton Hamvention® I decided to purchase the Quicksilver Radio Deluxe Coax Crimp Kit, along with a few PL-259 connectors for RG-58, RG-8 (RG-213), and RG-8X coax.

Crimping Versus Soldering

In my humble opinion, crimping and soldering are equivalent if the connector is installed correctly with the appropriate tools. On the other hand, certain situations are best suited to one attachment method versus the other.

With both methods, the tip needs to be soldered; fortunately, this is the easiest part. The main difference between the two is the way you connect the coax shield; this is also the part that ensures that you have a solid connection.

Bottom Line

The Quicksilver Radio Deluxe Coax Crimp Kit has everything you need in one case to easily install connectors on coax of all types and sizes. The result is a professional-quality, solid connector.

With the soldering method, the results depend on the melting point of the coax dielectric, and the soldering iron you use. Here, the critical step is heating the coax shield properly, along with the connector, for the solder to bond correctly. If you overheat it, it will melt the

Figure 10 — PL-259 installed using the Quicksilver Radio Deluxe Coax Crimp Kit. At the top is RG-213 coax, and at the bottom is RG-58 coax.

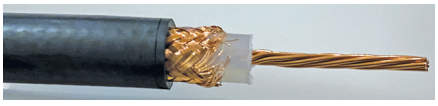

Figure 11 — Precise cut on RG-213 coax using rotary two- and three-blade cable stripper.

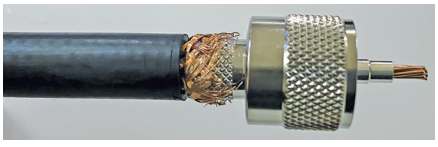

Figure 12 — Inserting a PL-259 at the end of the stripped coax, with the coax shield above the bottom part of the connector.

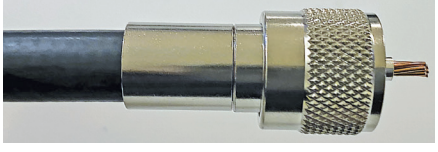

Figure 13 — The connector ring moved over the coax shield and ready to be crimped.

dielectric, which can affect the feed-line impedance. Therefore, this needs to be done quickly with a good soldering iron, and a large tip is recommended. This technique took me many years to master. If the coax shield and connector are not bonded correctly, the connector may get loose and break or, worse, fall under the coax weight of the suspended dipole. High-quality coax and high-quality connectors make it easier, but it's still a critical operation.

There are two common types of solder: lead and silver. Silver is stronger but requires more heat, and this makes the task even more difficult. Personally, I use only lead soldering for my connectors.

The crimp method ensures a good, solid connection between the connector and the coax (no matter what the coax material is). I had to replace a PL-259 connector on my mobile HF installation. It was cold outside, and soldering the shield would have been difficult because of the temperature. Using the crimper tool was the best option for this job, and it saved me a lot of time. It's fast and easy, and it can be done anywhere. Plus, I think that crimped connectors look more professional (see Figure 10).

In the Box

Quicksilver Radio sells different crimper kits. The one that I have is only for coax, but you can combine a kit to do Anderson Powerpole connections. In the Deluxe Coax Crimp Kit, all the tools are stored in a sturdy ABS case. You will find a full-cycle ratchet crimper to install coax connectors. It can crimp RG-8, RG-213, RG-8X, RG-58, RG-174, RG-316, RG-59, RG-11, LMR-400, LMR-240, 9913, and others. Two stripper tools are included for most types of coax, like RG-8, RG-213, RG-8X, RG-58, LMR-400, LMR-240, 9913, among others. Also included is a high-grade cutter for clean, square ends. There are two interchangeable dies for the crimper. You can replace the one preinstalled on the crimper with the other included dies, depending on the needed coax size. This can be done easily with the included Phillips screwdriver. There are three one-page manuals — one showing the step-by-step crimping method, one for the rotary two- and three-blade cable stripper for large coax (like RG-8), and one for the rotary coax stripper for smaller coax (like RG-58) with an adjustable size insert (orange).

Using the Tool Kit

So far, I've only installed PL-259s on RG-213 and RG-58 coax (see Figure 10 for the end results). Although the installation seemed intuitive, reading all the documentation while closely reviewing the tools is essential before you attempt to install your first connector. If you follow the instructions, it won't take you much practice to end up with a perfectly precise cut for your connector (see Figure 11).

First, insert the connector ring on the coax. Use the appropriate stripper for the coax size. Next, adjust the blade depth with the included Allen wrench for a perfect cut on your working coax. Then, install the PL-259, ensuring you're using the proper size, and the shield of the coax is above the bottom part of the connector (see Figure 12). Move the ring over the shield toward the connector (see Figure 13). Crimp the ring in place, ensuring that the crimp portion is closest to the end of the connector (see Figure 10). Lastly, solder the tip and you're done.

In Conclusion

I'm very happy with this coax crimping tool kit. It's easy to use, and it makes high-quality, solid connectors.

Manufacturer: Quicksilver Radio, 47-7 Billard St., Meriden, CT 06451, **www.qsradio.com**. Price: $99.73.