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Product Review

FlexRadio Systems Tuner Genius XL

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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).

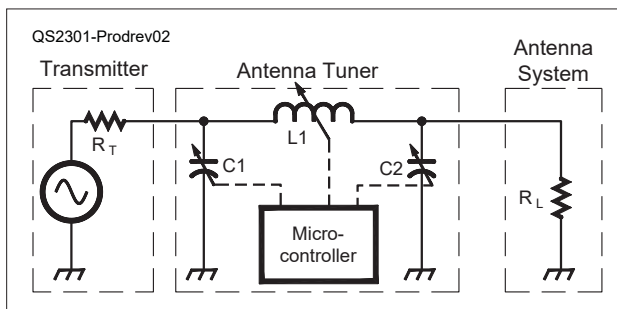Figure 2 — Tuner Genius XL desktop application.

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
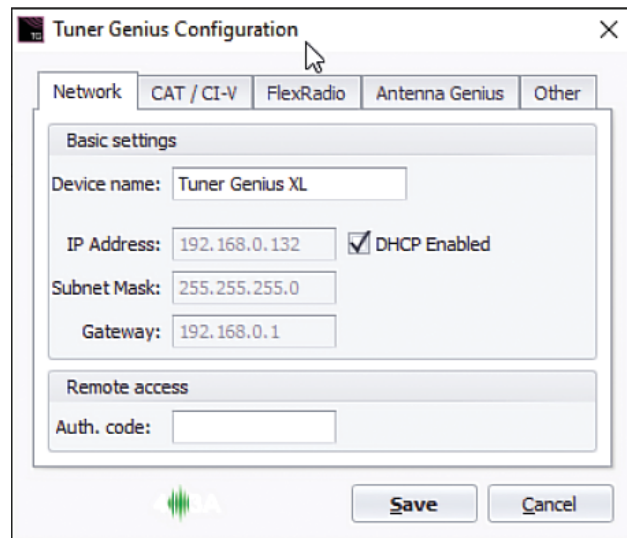

Figure 4 — Tuner Genius Configuration window. [Image courtesy of FlexRadio]

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-

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 volt-

ages 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 non-volatile 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.