

## Product Review

# FlexRadio Systems

## Power Genius XL Amplifier



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FlexRadio Systems, best known for pioneering work in the software-defined radio (SDR) field, has added a maximum-legal-power, solid-state linear amplifier to its product line. Solid-state amplifiers have become mainstream as vacuum tubes have become more difficult to acquire and solid-state power capabilities have increased. The costs and safety issues associated with vacuum tubes are a burden, such as high voltages and multiple power supplies for plates, grids, filaments, and other components. Now it is commercially feasible for amateur radio amplifier manufacturers to provide maximum legal output power plus headroom using solid-state devices. Currently, comparable tube amplifiers are still less expensive, but that may not be the case for much longer.

### First Impressions

The Power Genius XL (PGXL) is a fairly compact unit. This is especially true considering that it is capable of

maximum legal power output and includes an internal power supply. It weighs about 40 pounds and is fairly easy to move around the station. In comparison, my Emtron DX-3 tube amplifier is more than twice as large and weighs 160 pounds. There is a handle built into the PGXL front panel that makes carrying the unit easy, compared to holding it like a box.

The amplifier power switch is *not* on the front panel, but the operate/standby switch is. I prefer to have the power switches on the front panel of equipment, along with the microphone, the headphones, the key, or the

### Bottom Line

The Power Genius XL amplifier from FlexRadio Systems effortlessly delivers 1,500 W on 160 through 6 meters. It includes a number of clever features, including built-in support for full single-operator, two-radio (SO2R) operation.

**Table 1**  
**FlexRadio Power Genius XL, serial number 1-50/18-0074,**  
**firmware v3.4.10, updated to v3.4.16**

**Manufacturer's Specifications**

Frequency range: All amateur frequencies in the range of 1.8 to 29.7 MHz and 50 to 54 MHz.

Power output: 1,500 W, 2 kW capable.

Driving power required: 50 W (US version) for 1,500 W RF output.

Harmonic and spurious suppression:  
 Not specified.

Third order intermodulation distortion (IMD):  
 Not specified.

Keying time: At least 10 ms.

Primary power requirements: 90 – 250 V ac.

Size (height, width, depth): 6 x 20 x 14 inches; weight, 39.6 pounds.

\*Reminder: US amateurs must observe a limit of 200 W PEP output on the 30-meter band, and 100 W PEP relative to a  $\frac{1}{2}$ -wave dipole on 60 meters.

**Measured in ARRL Lab**

160, 80, 60, 40, 30, 20, 17, 15, 12, 10, 6 meters.\*

Tested up to 1,500 W RF output.

Drive level needed for 1500 W PEP output: 1.8 MHz, 40 W; 3.5 MHz, 41 W; 7 MHz, 43 W; 14 MHz, 46 W; 18.1 MHz, 42 W; 21 MHz, 57 W; 24.9 MHz, 72 W; 28 MHz, 50 W; 50 MHz, 53 W. See Figure A.

1.8 MHz, 80 dB; 3.5 MHz, 71 dB; 5.3 MHz, 71 dB; 7 MHz, 67 dB; 10.1 MHz, 61 dB; 14 MHz, 67 dB; 18.1 MHz, 61 dB; 21 MHz, 61 dB; 24.9 MHz, 70 dB; 28 MHz, 64 dB; 50 MHz, 76 dB. Exceeds FCC requirements.

14 MHz, 3rd/5th/7th/9th order IMD products:  
 At 1,500 W PEP, 34/39/49/56 dB below PEP;  
 At 1,000 W PEP, 36/42/52/61 dB below PEP;  
 At 500 W PEP, 38/43/53/66 dB below PEP.

Unkey to key, 13 ms; key to unkey, 17 ms.

Tested with 234 V ac. Limited to 700 W with 120 V ac line.

paddle jacks. Other connections should be on the rear panel.

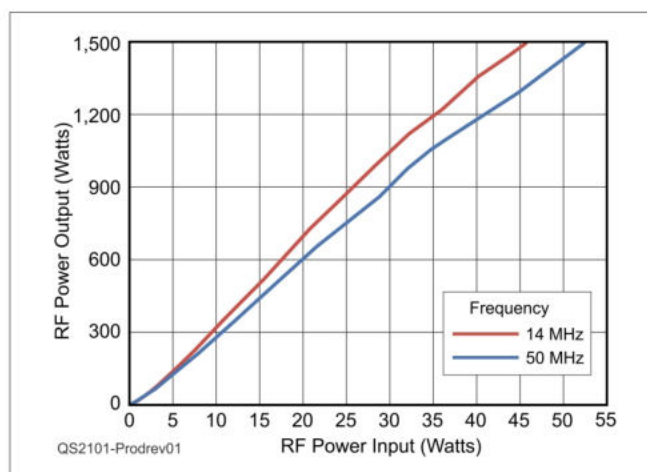
The amplifier operated as expected without any quirks. It provides pure, powerful RF output on any frequency with about 50 W of drive.

## Important Features

The Power Genius XL RF deck and power supply are housed in a single desktop enclosure. It covers all amateur bands from 160 through 6 meters, and Military Auxiliary Radio System (MARS) operation is possible with the standard firmware. The amplifier uses a pair of MRF-1K50H LDMOS power transistors and had no trouble making 1,500 W output on all bands with about 50 W of drive.

Band switching is automatic, controlled via transceiver interface or by sensing the frequency of the RF input signal. Integration with the FLEX-6000 series transceivers is seamless, but the manual includes detailed setup information for integration with transceivers from Elecraft, Kenwood, Icom, and Yaesu. There are appropriate connectors on the rear panel, and transceiver type and communication parameters are set from a menu.

The PGXL can be set up for use with two transceivers and antenna systems for SO2R (single-operator, two-

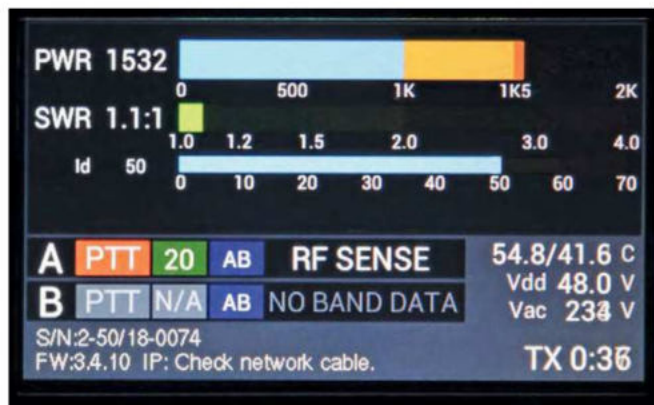


**Figure A** — FlexRadio Power Genius XL RF input versus RF output.

radio) operation. (This includes SO2R operation with the FLEX-6600M and other FLEX transceivers that are capable of SO2R operation with one radio.) Isolation between the two transceiver inputs is about 70 dB.

The operator interacts with the amplifier via a color LCD touchscreen on the front panel (see Figure 1). The LCD provides meters and other information about operating conditions, as well as access to various menus and control buttons. Meter settings include RF power output, SWR, temperature, ac line voltage, and





**Figure 1** — The colorful PGXL display shows operating conditions at a glance. The amplifier output is 1,532 W into an ARRL Lab dummy load with a 1.1:1 SWR. The lower bar display is drain current. Drain voltage and ac line voltage are shown at the lower right. The lower half of the display indicates that radio A is connected, PTT is engaged, the band is 20 meters determined by RF sensing, and the PGXL is operating in class AB. No radio B is connected. If the PGXL were connected to a LAN, the IP address would be shown at the bottom. Amplifier serial number and firmware version are shown as well.

LDMOS power transistor drain voltage and current. You can also communicate with the amplifier using *Power Genius XL Utility* software. Directions for downloading and installing the software are found in the manual and easy to follow.

The *PGXL Utility* software can also be used for upgrading the amplifier firmware. Download the firmware ZIP file from the FlexRadio website, extract the contents, and then use the *PGXL Utility* to upgrade the firmware. As with other FlexRadio products, new firmware is released periodically to add features, improve operation, or fix bugs. During the review period, we received firmware version 3.4.16, along with a revised manual as a PDF and another PDF with details of what had changed.

Separate bias settings can be used for linear modes and nonlinear modes to increase efficiency when possible. Class AAB (more linear, less efficient) is intended for AM, SSB, and PSK modes, while class AB (less linear, more efficient) is intended for FM, CW, RTTY, and other digital modes. Bias selection is automatic when the amplifier is paired with a FLEX-6000 series transceiver. It can be selected manually from the front panel or using the *PGXL Utility* software.

A maximum efficiency algorithm (MEffA) can be selected for class AB operation to maximize efficiency, while maintaining signal quality. According to the manual, the MEffA adjusts drive voltage and bias settings based on the type of input signal. MEffA operation requires a simple setup procedure to establish the best drive level for the desired RF output.

The PGXL offers excellent harmonic suppression. In addition to the low-pass filters typically found in amateur radio amplifiers, the PGXL uses additional high-pass filters to direct unwanted harmonic energy into an internal 400 W resistive dummy load, called the *harmonic load*. This technique removes unwanted energy from the output stage, improving linearity and thermal management and allowing the transmitter to achieve the same fundamental power output with lower peak drain voltage. The harmonic load is mounted on a dedicated heatsink, with a temperature sensor and fan controller.

The Power Genius XL features a predistortion sampler output for transceivers that can use that signal for predistortion processing to reduce transmitted intermodulation distortion products. There are separate predistortion samplers for the two transceiver inputs.

The PGXL will operate at full power with an antenna system SWR up to about 2:1. Output power folds back between 2:1 and 3:1. Above 3:1, the amplifier stops transmitting. The unit does not include an antenna tuner.

## Setup

For this review, I used the Power Genius XL with the FLEX-6600M transceiver reviewed in the February 2020 issue of *QST*. I also used an MFJ-998 automatic antenna tuner for antennas that exceed the amplifier's SWR limits. My antennas include Yagis for 40 through 10 meters and wires for 160, 80, and 60 meters. I am a US Air Force MARS operator, and I used the amplifier with an Icom IC-756PROIII to test operation using RF-sensed band selection on MARS frequencies.

Installation is very easy and straightforward. For best results with the PGXL (or any legal-limit amplifier), plan to use a 240 V ac line capable of 20 A or more. The amplifier includes a detachable power cord, and the user must install the appropriate connector for their station outlet. PGXL firmware version 3.4.16 improved support for operation from 120 V ac. Maximum power output is limited to 700 W, and the power meter scales change to reflect this. Drive power is also attenuated to minimize the possibility of overdriving the amplifier.

Figure 2 shows the PGXL rear-panel connections. A unique feature of the PGXL is the ability to operate with two transceivers in single-operator, two-radio (SO2R) configuration. Two transceivers can share the amplifier using two separate inputs, outputs, and PTT controls (all labeled for radio A or radio B), but only one at a time can transmit. RF input and output connectors are SO-239 types. For non-FlexRadio trans-





**Figure 2** — The PGXL rear panel. RF input and output and predistortion sampler connections are in the upper center, with band data/CAT and PTT connections below. [Photo courtesy of FlexRadio Systems]

ceivers, connect the PTT control to the appropriate PTT phono connector. Connect the transceiver CAT cable to the appropriate amplifier DB-9 CAT connector (optional if you plan to use RF sensing). That's it.

Note that the manual indicates that your transceiver should be set to delay RF output for at least 10 milliseconds after PTT output contact closure to allow the PGXL to switch to transmit. This setting is often available in a TX delay or similar menu. (The ARRL Lab measured this keying time at 13 milliseconds for the review unit.) If a TX delay adjustment is not available, you can use a foot switch to key the amplifier, and then key the transceiver from the PGXL's **PTT OUT** jack. The PGXL does not support full-break-in (QSK) CW operation.

Like the FlexRadio transceivers, the PGXL has an RJ-45 ethernet jack for connection to a local area network. If you're using a FLEX-6000 series radio that is also connected to the network, the amplifier will find the radio on the LAN. Of course the ethernet connection means that the amplifier can be used as part of a remote station as well as locally.

I found setup to be relatively simple for the amplifier, just configuring the interface screen for the transceivers I wanted to use. This was my first time using the FLEX-6600M transceiver, and that required some reading of the manual. You can view the contents of the amplifier LCD screen on your computer using the *Power Genius XL Utility*.

## Operational Experience

I used the Power Genius XL on all bands from 160 through 6 meters and all modes except digital. I have no doubt that it would work well there, too. Most of the time, I used the FLEX-6600M with the amplifier, and

got excellent reports during regional and transglobal contacts. I used the amplifier with my Icom IC-756PROIII on the MARS frequencies from 2.0 to 30 MHz on a dummy load, and it easily produced 1,500 W output. (Note that the 26.0 and 27.9 MHz MARS frequencies are locked out per FCC regulations because of proximity to the citizens band.)

When using the FLEX-6600M, the amplifier tracked the band using the ethernet connection. When using the IC-756PROIII, the amplifier sensed the frequency and selected the proper band. This required a brief pulse of RF from the transceiver, then release of the PTT, VOX, or CW keyer, and then the amplifier would operate normally following a band change. Virtually any transceiver that provides a PTT output to control an amplifier will work with the PGXL. The PTT control is optically isolated and very low voltage and current, so it will work with any transceiver.

The PGXL has fans in the power supply unit, the RF deck, and the filter compartment. The firmware manages the fans independently based on information from sensors in each compartment. As with other solid-state, legal-limit amplifiers, fan noise is higher than with typical comparable tube-type amplifiers. To help manage that, the PGXL offers several user-selectable fan profiles. In standard mode, recommended for casual SSB, CW, and digital operation, the fans run at low speed, increasing speed with temperature, but optimized for lowest fan noise. Contest mode is recommended for contesting or other operating activities with a lot of transmissions. The fans run at a higher initial speed than in standard mode, increasing with temperature and turning off when the amplifier cools down. In broadcast mode, the fans run continuously at high speed, regardless of temperature. This mode is intended for extended high-power RTTY and



digital-mode operation, high-duty-cycle SO2R contesting, or situations in which the amplifier is located away from the operating position.

In standby mode, the PGXL fan is quiet after it cools down. In operational mode and receiving, the fan is only moderately noisy. As with other solid-state, legal-limit amplifiers, after a lengthy full-power transmission, it does get rather loud as it tracks the internal temperature and more cooling is needed. I did some informal testing with a sound pressure level meter and measured 40 dBA in standby mode (but perfectly quiet when the fans are not running), 70 dBA in operating mode with light transmissions, and 85 dBA under full power. My Emtron DX-3 tube amplifier is slightly quieter with the stage 1 fan operating at 66 dBA, although stage 2 is much more.

## Summary

The FlexRadio Power Genius XL is a great solid-state, maximum-legal-limit amplifier for 160 through 6 meters. It integrates seamlessly with FLEX-6000 series radios, but it also works well with other transceivers with or without band data connections. It effortlessly produces 1,500 W output on any band with about 50 W drive, something that cannot be said about just any amplifier. MARS operation from 2 to 30 MHz is also available. Although not inexpensive, it has outstanding performance. The manual and other documentation is available from the FlexRadio website.

*Manufacturer:* FlexRadio Systems, 4616 W. Howard Lane, Suite 1-150, Austin, TX 78728; [www.flexradio.com](http://www.flexradio.com). Price: \$6,999.

# PreciseRF HG3 Stepper Magnetic Loop Antenna

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In the June 2019 issue of *QST*, I reviewed the PreciseRF HG-1, a small magnetic loop antenna that has the option of being tuned remotely. PreciseRF recently released the HG3, a stepper-controlled magnetic loop antenna that includes remote tuning only, as well as additional features. The stepper motor provides an accurate and repeatable tuning system.

## Description

The HG3 covers 7 to 30 MHz. Maximum power ratings are between 25 W and 100 W depending on operating mode (duty cycle) and frequency (see Table 2). Optional 80-meter and 60-meter high-voltage/high-current resonating capacitors, or a new 60/80-meter tunable resonating capacitor may be purchased for operation on those bands. However, the maximum power rating on 80 and 60 meters is reduced to 10 W PEP.



## Bottom Line

The HG3 is designed for both portable and fixed station operation. The remote-tuned stepper-controlled tuning results in precise, repeatable operation.