



Tuner Genius XL User Guide



Tuner Genius XL Firmware Version 1.1.16
Tuner Genius XL Windows Utility Version 1.1.16
January 2023

Contents

1	Important Notice	5
2	Product Description	7
3	What is an Antenna Tuner?	7
4	Circuit Description	7
4.1	Directional Coupler.....	8
4.2	Tune	9
4.3	Transmit.....	9
4.4	Receive.....	9
4.5	Bypass.....	9
4.6	Standby.....	9
5	Features of the Tuner Genius XL.....	9
5.1	Front Panel	10
5.2	Back Panel.....	12
5.2.1	1x3 Antenna Switching Option.....	12
5.2.2	SO2R Antenna Switching Option.....	13
6	Tuner Genius XL Setup, Configuration, and Testing.....	16
6.1	Unpacking and Setup.....	16
6.1.1	1x3 Switch Model.....	16
6.1.2	SO2R Switch Model.....	16
6.1.3	All Models	16
6.2	Basic Configuration.....	20
6.2.1	Connecting the Tuner Genius XL Windows Utility program	20
6.2.2	Network Tab: Set a Custom Device Name.....	22
6.2.3	Network Tab: Configuring the Network.....	23
6.2.4	FlexRadio Tab: Configuring for a FLEX-6000 Series Transceiver.	25
6.3	Advanced Configuration	27
6.3.1	Required RF Output Delay (TX Delay)	27
6.3.2	Interfacing with Other Exciters	29
6.3.3	Interfacing with the Power Genius XL (PGXL)	40
6.3.4	Interfacing with Other Amplifiers	40
6.4	Antenna Genius Integration	43
6.4.1	Enable Integration.....	43
6.4.2	Using the Antenna Genius User Interface.....	44

6.4.3	Additional Slots per Band.....	44
6.5	Testing.....	46
7	Operating the Tuner Genius XL.....	48
7.1	Changing Modes.....	48
7.1.1	Bypass and Operate Modes	48
7.1.2	Standby Mode	48
7.1.3	Receiving	49
7.2	Tuning.....	49
7.2.1	What is a successful match?	49
7.2.2	Tuning Errors	49
7.2.3	Automatic Tuning.....	50
7.2.4	Manual Tuning.....	51
7.3	Transmitting.....	52
7.3.1	Power Meter (PWR)	52
7.3.2	SWR meter	52
7.3.3	PTT, Band, and Frequency Data	53
7.3.4	Additional Information.....	53
8	The Tuner Genius XL Windows Utility.....	54
8.1	Tuner Chooser Screen.....	54
8.2	Windows Utility Front Panel Display	55
8.3	Tuner Configuration Dialog.....	55
8.3.1	Network Tab	56
8.3.2	CAT/CI-V Tab	58
8.3.3	FlexRadio Tab	58
8.3.4	Antenna Genius Tab	60
8.3.5	Other Tab.....	60
8.4	User Interface Elements	62
8.4.1	STBY Button	62
8.4.2	BYP Button.....	62
8.4.3	TUNE Button.....	62
8.4.4	Manual Tuning Controls	63
9	Remote Operation	64
10	Firmware Upgrade Procedure.....	64
11	Factory Reset the Tuner Genius XL	65

12	Alarms, Warnings, and Messages	65
12.1	Alarms	65
12.2	Warnings	65
12.3	Messages	66
13	Specifications	67
14	FCC Statement	67
15	Appendix.....	68
15.1	Installing the Tuner Genius XL Windows Utility.....	68
15.2	Power Derating Table.....	70
15.3	Connection Information and Pin Out Diagrams	71
15.3.1	Power Connector.....	71
15.3.2	Ground Connection	71
15.3.3	Push to Talk (PTT).....	71
15.3.4	RS-232 Serial Connector Pinout	71
15.3.5	CI-V Connector	72
15.3.6	LAN (Ethernet) Connector	72
15.3.7	PTB/BCD Connector Pinout.....	73
15.4	Firmware Recovery Procedure.....	74

Table of Figures

1 Important Notice

WARNING!

This Radio Frequency (RF) antenna tuner is designed to operate on frequencies designated for amateur radio service. You are required to have a valid amateur radio license to transmit on these frequencies.

Please operate this RF tuner only by following the quick start guide's instructions and this user guide. The unit must only be opened or serviced by a qualified technician.

RF energy from transmitters can interact with some electronic devices, such as cardiac pacemakers and defibrillators. Please refer to the pacemaker or defibrillator manufacturer's instructions concerning the precautions taken near an amateur radio transmitter. If any interaction or interference with a pacemaker or defibrillator is suspected, **STOP** transmitting immediately.

! - WARNING!

▲ - Caution

i – Information

! – This unit is not designed for use outdoors or in indoor environments that exceed the designed environmental limits.

! – This unit is NOT A TOY. It must not be handled by children nor placed/operated within reach of children.

! – Do not leave packing material for this unit unattended. It may be harmful to children if misused.

! – This unit contains small parts that could be a choking hazard to small children. Do not leave accessories unattended.

! – Do not operate this unit in potentially explosive environments.

! – Never attempt to insert wires or any tools into the interior of this unit during operation. This may cause fire, electric shock, or death!

! – This unit must only be operated with the electrical power described in this User Guide. Doing otherwise may cause a fire, injury, or electrical shock.

! – Never connect or disconnect antennas while in TRANSMIT mode. This may cause electrical shock or RF burns and damage to the unit.

! – This unit operates with high levels of Radio Frequency (RF) energy. Therefore, use caution and observe proper safety practices regarding your system configuration. In addition, when attached to an antenna, this tuner can induce RF electromagnetic fields, which require evaluation according to

your national law to provide any necessary isolation or protection required concerning human exposure.

▲ - This unit must only be opened and serviced by a qualified technician. Opening the unit may void the manufacturer's warranty.

▲ - Do not operate this unit in areas of extreme humidity.

▲ - Avoid operating this tuner in direct sunlight or other areas of extreme heat, excessive vibration, or mechanical force.

▲ - If this unit is intended for use in ICAS commercial applications, special safety regulations and cautions may apply to prevent accidents.

▲ - If any defect, abnormal result, or other observations are not covered by this User Guide, immediately cease operation and contact FlexRadio Support or the local distributor for operational advice or repair of the unit.

i – No physical modification of this tuner is allowed. Any other use or modification (including software changes that affect operational characteristics) will void the manufacturer's warranty.

i – Ensure proper ventilation around the tuner; This includes 30 cm (12 inches) clearance in front and back.

i – The Tuner Genius XL should be located at least 1 meter (3 feet) from any device that transmits 2.4GHz Wifi.

i – Please study the complete User Guide. This document contains important information regarding the safe operation of this unit. If you have any questions, please contact the manufacturer or local distributor for details.

2 Product Description

The Tuner Genius XL™ (TGXL™) is a 2000W automatic antenna tuner with full 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. The tuner is built to “broadcast industry” commercial standards with a 1500W 100% Intermittent Commercial and Amateur Service (ICAS) power rating. The absolute maximum peak power handling capability is 2000W.

All Tuner Genius XL functions are controlled either from the front panel of the tuner or from a Windows computer software application. The Windows application allows the TGXL 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, eliminating the need for a separate Power/SWR meter device in your shack.

The Tuner Genius XL is tightly integrated with the Power Genius XL™ (PGXL™) 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.

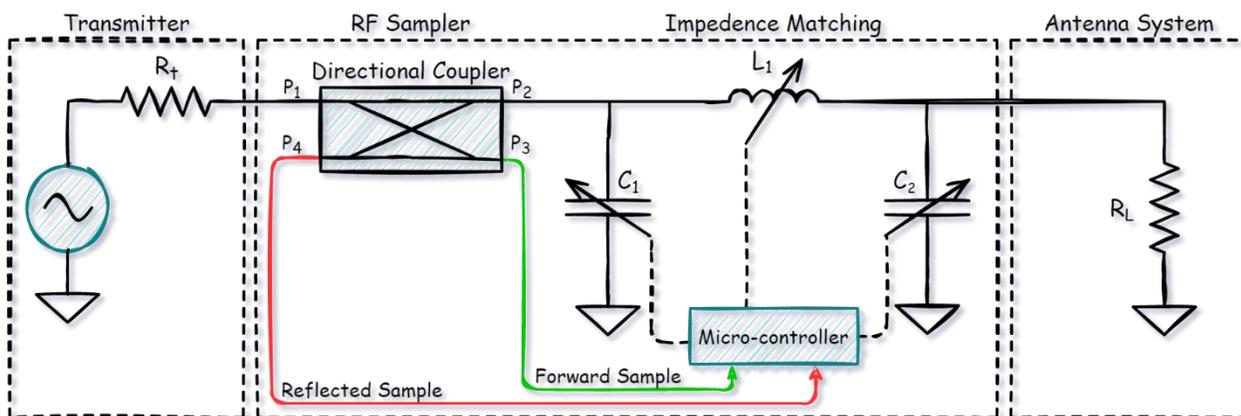
The Tuner Genius XL is compatible with any modern HF radio on the market today. When used with a Power Genius XL and a FLEX-6600 or FLEX-6700 transceiver, you have a competitive, fully functional SO2R (single operator, two-radio) radiosport station. In addition, support for SmartLink and multiFLEX™ operation provides frustration-free multi-client remote operation.

3 What is an Antenna Tuner?

An antenna tuner is a device in the RF signal path between the transmitter (or transmitter + amplifier) and its antenna to improve power transfer by transforming the impedance presented at its 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. An antenna tuner is especially useful when the antenna and feedline impedance is unknown and complex.

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

4 Circuit Description



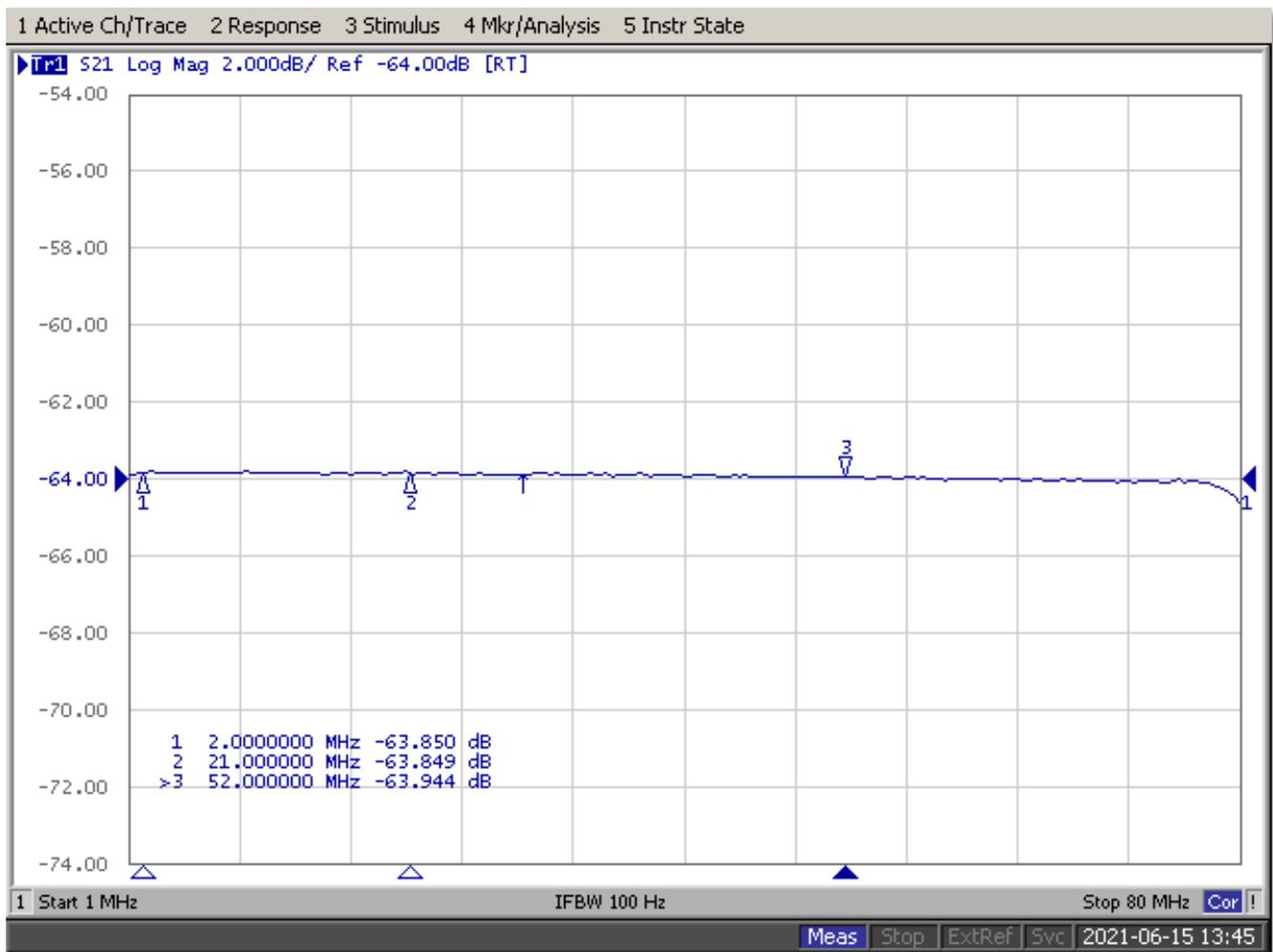
Tuner Genius is electrically implemented as a *pi-network* tuner with three variable elements; a series inductor with two capacitors to ground: one at the input and the other at the output. A pi network is ideal for matching a transmitter's relatively low 50Ω impedance and relatively high and unknown impedances antenna system present for a current operating frequency. Furthermore, the matching circuit also forms a low-pass filter; it provides beneficial harmonic suppression beyond the filters in the exciter and amplifier.

The tuner is a system of discrete LC components which are switched into and out of the matching circuit by a microcontroller. The combination of discrete L or C components determines each network element's value. Each element can be one of 255 possible values. This highly granular stepped approach provides 255^3 (16,581,375) possible matching combinations.

4.1 Directional Coupler

The RF directional coupler or RF sampler is a critical accuracy component in a tuner or RF power meter. A flat spectral response is desirable because it eliminates requirements to perform additional compensation – which can negatively impact performance and accuracy.

The integrated TGXL sampler is remarkably flat - to just one-tenth of a dB throughout its operational spectral range, and it remains flat up to 80MHz.



4.2 Tune

When instructed by the operator, the microcontroller keys the transmitter and executes an algorithm that quickly varies the value for each element of the matching network. For each value, the output of a directional coupler is sampled and used to search for a target impedance match.

Once a match solution is found, the frequency and data necessary to recall the matching network's element values are stored in a non-volatile memory location. When the operator next transmits on a frequency within 10kHz of a stored solution, the values required to reconstitute the pi network element values are recalled and applied to the circuit.

4.3 Transmit

The microcontroller samples the directional coupler to present accurate forward power and calculated SWR during transmissions.

4.4 Receive

During receive, the tuner can optionally bypass the tuned matching circuit.

4.5 Bypass

4.6 Standby

5 Features of the Tuner Genius XL

DC Power	+12 to +20VDC - < 2A via 2-conductor 5.5mm x 2.1mm plug
Antenna Switching options:	SO2R (70dB input isolation) 1x3 Matrix
Control:	Windows application
RF Power:	1500W ICAS with headroom for 2000W (all modes)
Tuning:	Fully automatic and manual Over 16.5 million possible solutions using C-L-C (Pi) matching circuit First-time solution time (2 to 12 seconds) – solution stored in memory Next time solution time < 20ms – solution recalled from memory 20 to 200W input power required during tuning (20W recommended)
Matching:	50-ohms (nominal) input impedance Up to 10:1 SWR (.5 to 5k-ohms)
Frequency Ranges:	1.8MHz to 30MHz 50 MHz to 54MHz
Exciter Band Data Interfaces:	Ethernet (includes PTT) for FlexRadio Systems transceivers CAT via RS-232 CI-V

	BCD Pin-to-Band (PTB)
Legacy Exciter Interface	Built-in frequency counter
PTT (In)	Opto-Isolated Open Collector (10ma max to ground)
BCD, PTB	Opto-Isolated Open Collector (10ma max to ground)
PTT (out)	Relay contact (1A @100V max)
Alarms	Frequency out of range Wrong Band High Power SWR > 10:1
Warnings	Low drive PTT Unkey
Messages	Manual Tuning Tuning Saved Memory Cleared Config Reset

5.1 Front Panel

Designed to be easy to use and intuitive, the front panel consists of nine elements:



Figure 5-1 Tuner Genius Front Panel

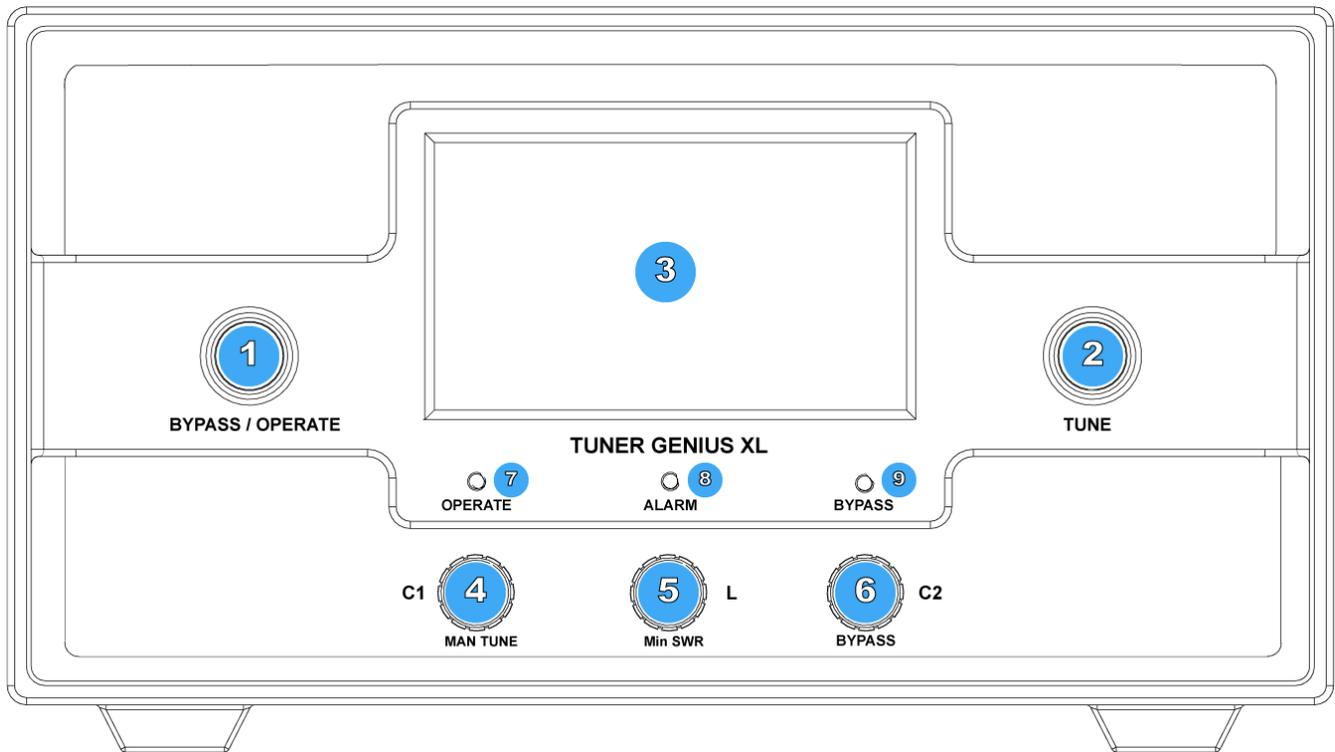


Figure 5-2 Tuner Genius Front Panel Drawing

1	Bypass/Operate Button: Toggles the TGXL between Bypass (Standby) and Operate mode.
2	Tune Button: Initiates the Automatic Tune sequence when an exciter is paired and connected to the tuner.
3	4.5" (110mm) Color LCD Touchscreen Display: Displays operational information (See display below)
4	Manual Tune (push toggle) / C1 Adjust: Push toggles between automatic and manual tune operations. When in manual tune mode, rotating the control will adjust the capacitance value for C1 (see schematic).
5	Minimum SWR / L Adjust – Toggles between the minimum (target) SWR setting for the current band and adjusting the inductance value for L1 (see schematic)
6	Bypass / C2 Adjust: Push toggles between tuner bypass and when in manual tune mode, rotating the control will adjust the capacitance value for C2 (see schematic).
7	Operate LED – Indicates operate mode.
8	Alarm LED – Indicates a fault or alarm condition.
9	Bypass LED– Indicates the tuner is in bypass mode.

5.2 Back Panel

Two back panel options are available.

5.2.1 1x3 Antenna Switching Option

The 1x3 back-panel option provides one input and three switchable antenna output connections. The tuner will tune the signal on the input (TX) to the currently selected output (ANT 1, 2, and 3). Only the port A connections are active, and the tuner can be controlled only by a single radio.

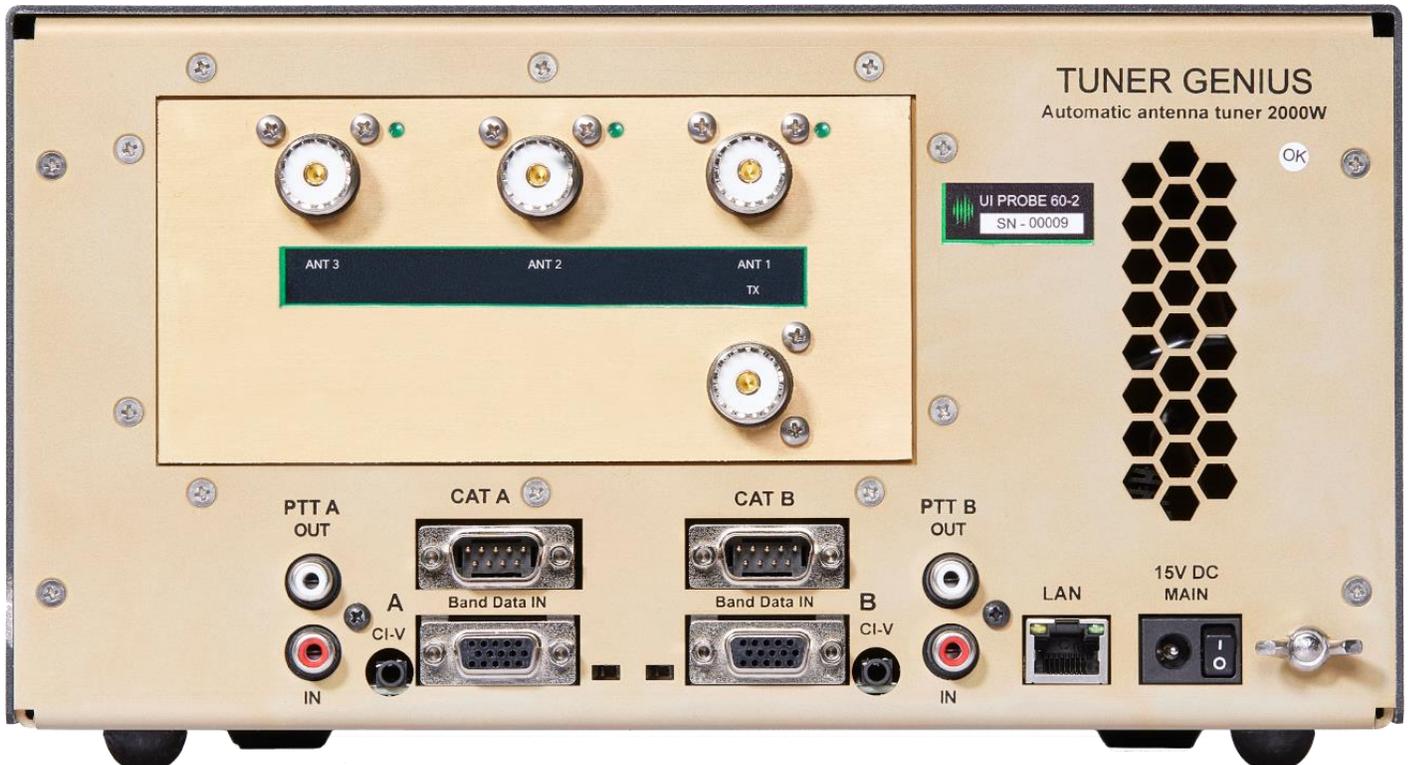


Figure 5-3 1x3 Antenna Switching Option

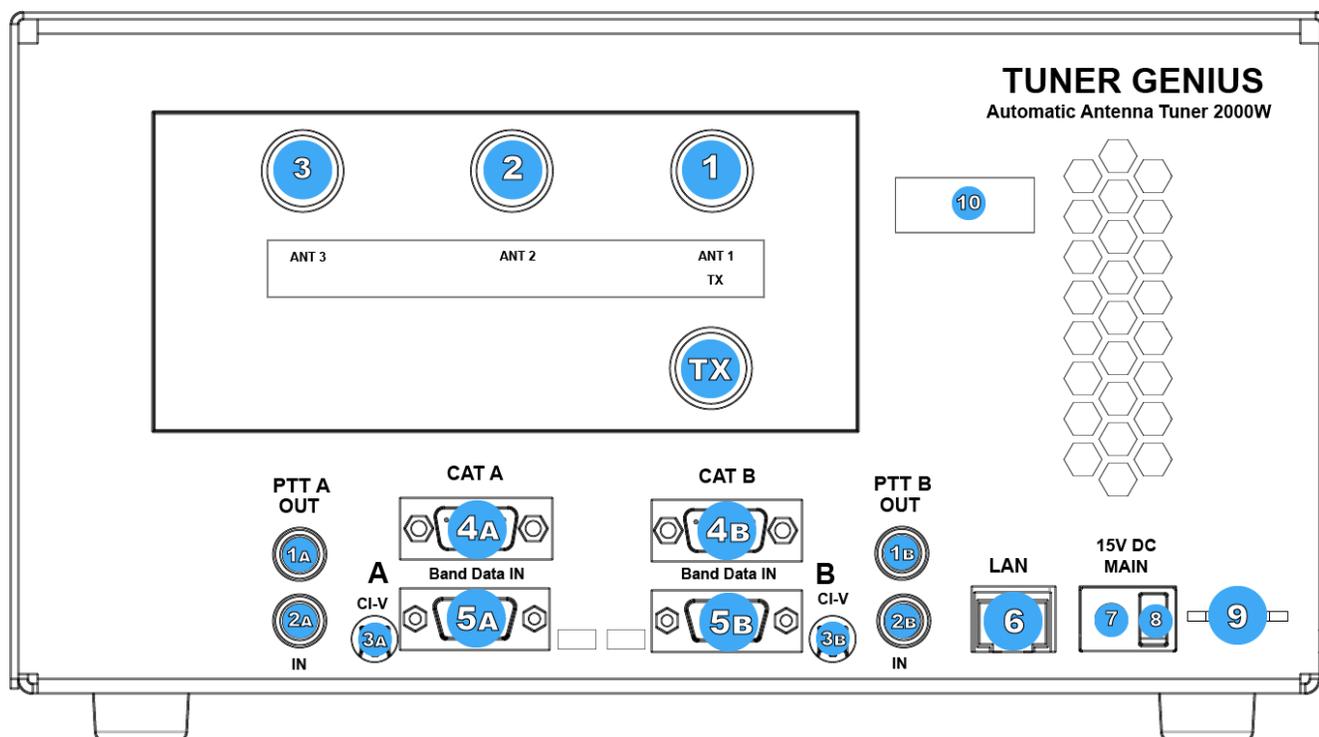


Figure 5-4 1x3 Switching Option Drawing

1a	PTT Output: Relay contact to female RCA connector. The center pin is shorted to the shield when section A of the tuner is keyed and ready to accept RF drive.
2a	PTT Input: Opto-isolated female RCA connector. Ground the center pin to the shield to engage PTT for the tuner.
3a	CI-V Input A: Opto-isolated 3.5mm female connector for Icom radio A band data
4a	CAT Input A: Opto-isolated male DB9 connector for radio A CAT command input
5a	BCD/PTB Input A: Opto-isolated DE-15 female connector for radio A band data
6	Ethernet connection: RJ45 Local Area Network Ethernet connection
7	DC Power input: Nominally 15 volts DC, center pin positive (5.5mm x 2.1mm)
8	Main Power Switch
9	Station Ground
B	B inputs: B inputs and output are intended for the SO2R switching option and are disabled for the 1x3 switching option.

5.2.2 SO2R Antenna Switching Option

The SO2R back-panel option provides specialized support for SO2R (single operator, two radio) radiosport operations. The connectors are logically divided into the Port A connectors and the Port B connectors. The tuner will tune the signal on the A input and output it on the A output, or it will tune the signal on the B input and output it on the B output. The A and B sections of the tuner can be controlled independently by two radios.

Separate A and B keying inputs (Push-To-Talk, PTT) and band data inputs are provided. At any point in time, either of the A or B sections can be keyed, but they cannot be keyed simultaneously.

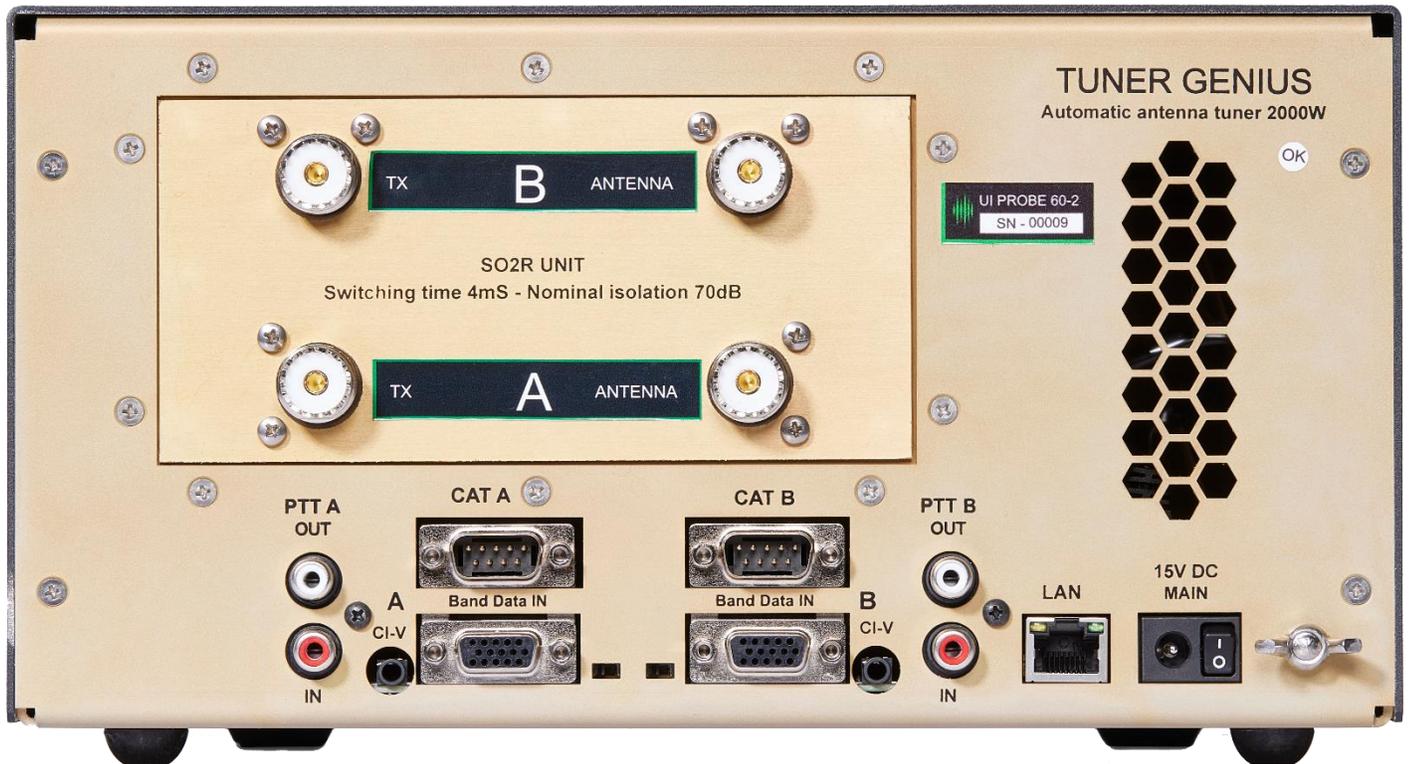


Figure 5-5 SO2R Switching Option

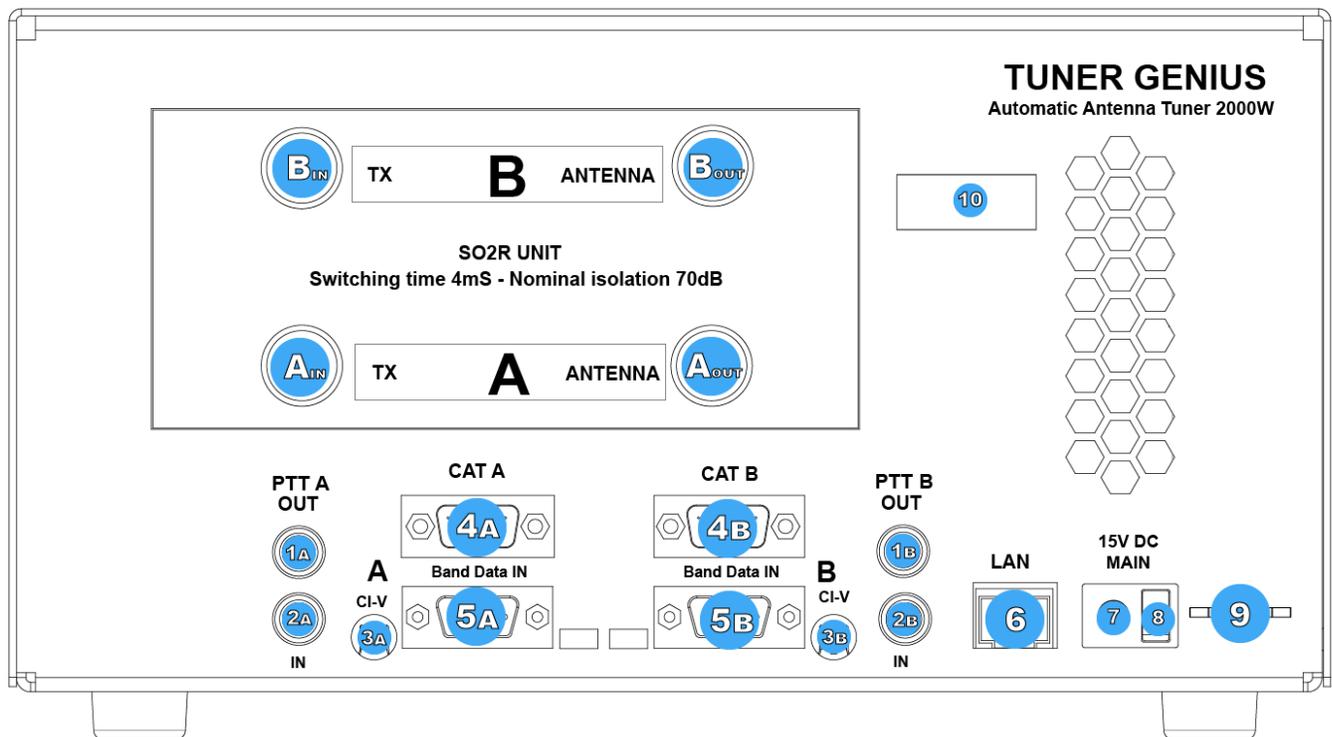


Figure 5-6 SO2R Switching Option Drawing

A_{IN}	Port A RF Input: From the transmitter
A_{OUT}	Port A RF Output: To Antenna
B_{IN}	Port B RF Input: From the transmitter
B_{OUT}	Port B RF Output: To Antenna
1_{A/B}	PTT Output: Relay contact female RCA connector. The center pin is shorted to the shield when the A or B section of the tuner is keyed and ready to accept RF drive.
2_{A/B}	PTT Input: Opto-isolated female RCA connector. Ground the center pin to the shield to engage PTT for the A or B section of the tuner.
3_{A/B}	CI-V Input: Opto-isolated 3.5mm female connector for Icom radio band data
4_{A/B}	CAT Input: Opto-isolated male DB9 connector for radio CAT command input
5_{A/B}	Band Data In: Pin-to-Band or BCD
6	Ethernet connection: RJ45 Local Area Network Ethernet connection
7	DC Power input: Nominally 15 volts DC, center pin positive
8	Main Power Switch
9	Station Ground

6 Tuner Genius XL Setup, Configuration, and Testing

6.1 Unpacking and Setup

The following accessories and materials are included with your Tuner Genius XL tuner. Carefully remove the tuner from its shipping container, unpack it, and identify the items listed below:

- One (1) Tuner Genius
- One (1) 2m (6 ft) DC power cord with connector and pigtails
- One (1) 2m (6 ft) Ethernet cable
- One (1) Tuner Genius XL Quick Start Guide

In addition to the above, the following are required for the initial setup of the tuner:

- HF or 6-meter transceiver and antenna system
- Suitable coax jumper cables for interconnection of the transceiver and tuner
- Windows™ PC with an ethernet connection, connected to a local area network (LAN).

Place your Tuner Genius XL on a flat, stable surface. Ensure the tuner has at least 30cm (12 inches) of open space in front and back to ensure adequate cooling. Then, follow these steps and refer to the following diagrams to connect your Tuner Genius XL. For connections to non-FlexRadio products, please see section **6.3, Advanced Configuration**.

6.1.1 1x3 Switch Model

- Connect the transceiver antenna output to the Port A **TX** socket on the tuner with a suitable 50-ohm coax jumper cable.
- Connect an antenna to the **ANT 1** antenna socket.

6.1.2 SO2R Switch Model

- Connect the transceiver antenna output to the Port A **TX** socket on the tuner with a suitable 50-ohm coax jumper cable.
- Connect an antenna to the PORT A **ANTENNA** socket.

6.1.3 All Models

- Connect the supplied Ethernet cable from the RJ45 socket on the tuner's back panel to an appropriate switch¹ port on your LAN.²
- Apply the DC power cord to the DC power input on the tuner's back panel. Connect the other end of the power cord to a suitable 12VDC to 15 VDC power source. Be careful to observe correct polarity.
- Turn the tuner on using the power switch on the back panel.

¹ Most home routers contain integral switches. While the use of a separate switch for your ham equipment is strongly encouraged, it is not a requirement. A LAN, however, is a requirement for configuring a TGXL.

² A Windows™ PC must be present in the LAN to complete the configuration of the tuner.

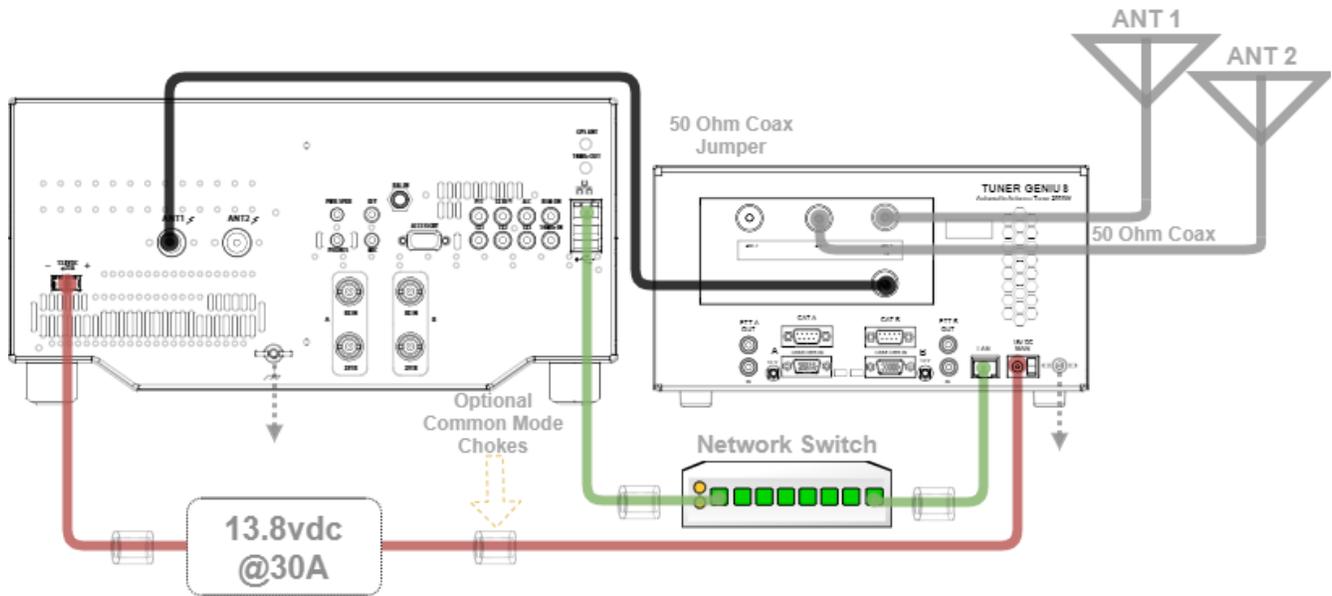


Figure 6-1 Basic 1x3 Connection Diagram

The typical wiring configuration for the 1x3 tuner is shown in the diagram above. The wiring for the SO2R tuner and using the tuner with the Power Genius XL are similar and depicted below.

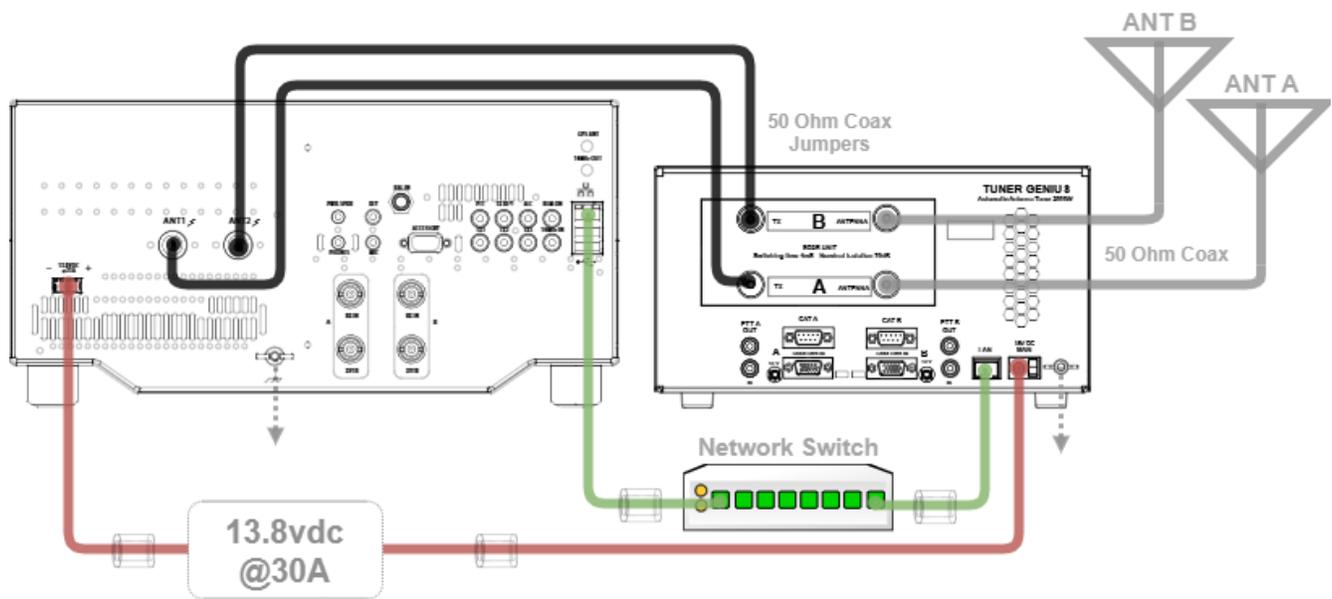


Figure 6-2 Basic SO2R Connection Diagram

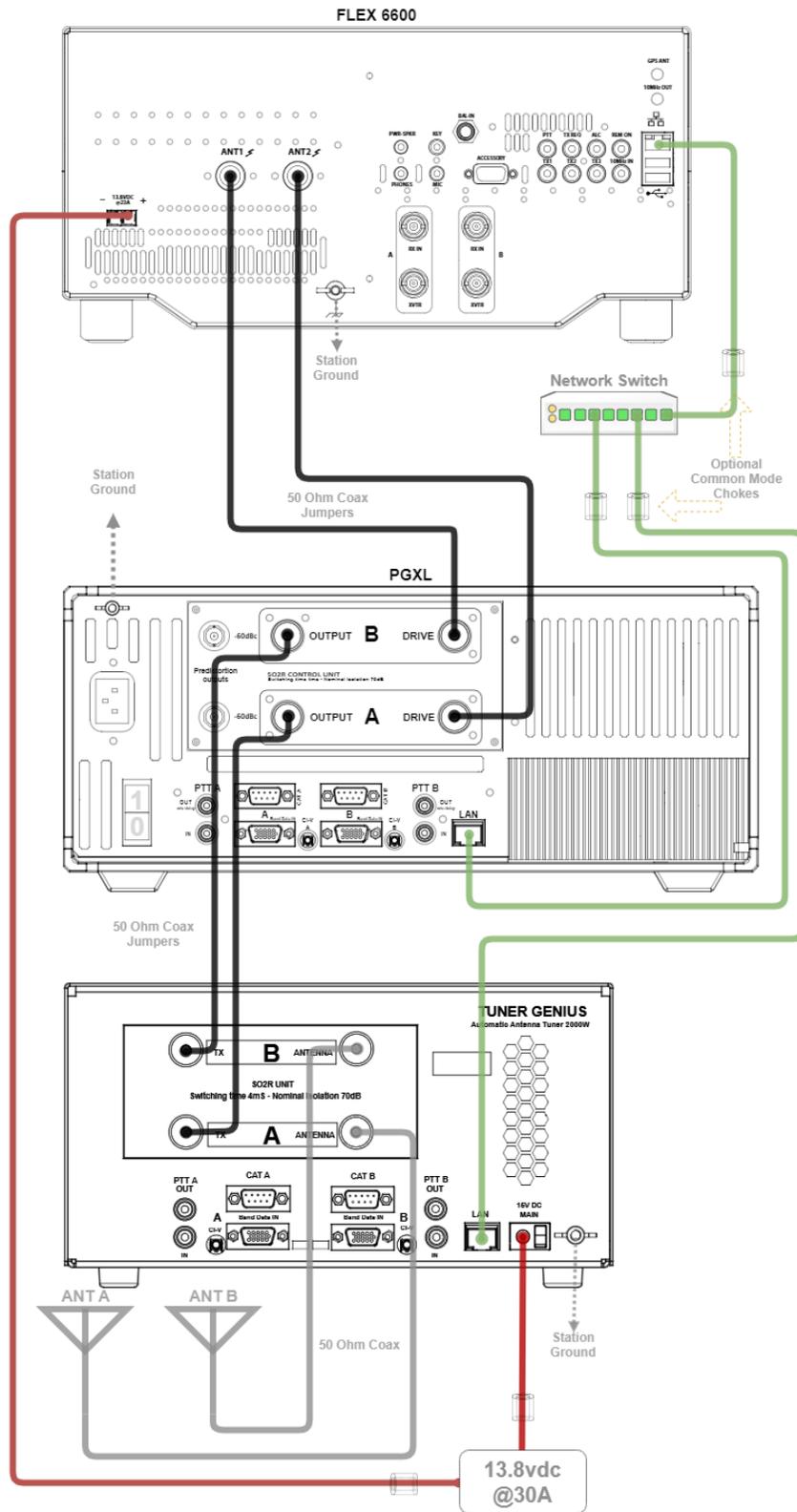


Figure 6-3 SO2R Plus PGXL Connection Diagram

During power-up, the display will briefly show a splash screen like the following:

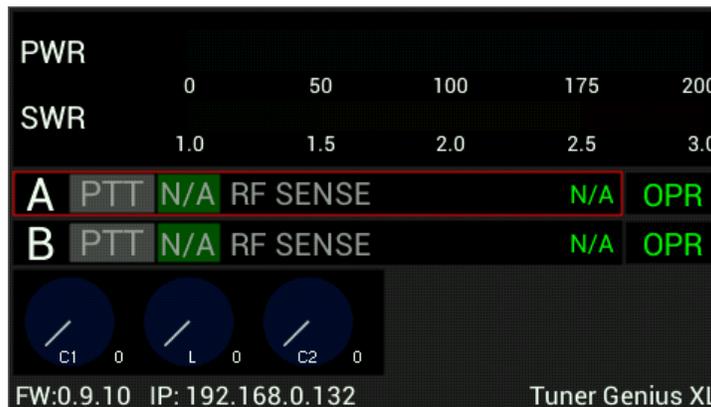


Figure 6-4 Front Panel Splash Screen

After the start-up sequence, the tuner will query your local area network DHCP service for an available IP address and automatically configure the network settings. If a DHCP service is not available or does not respond, the tuner will self-assign a Link-Local IP Address following the [RFC-3927](#) specification.

i – If the displayed IP Address begins with 169.254, the tuner self-assigned a Link-Local IP Address. Depending on your Local Area Network (LAN) configuration, this may indicate a network problem and prevent further setup. Contact FlexRadio Support for assistance.

When the start-up sequence completes and resolves an IP address, the tuner will enter Operate mode and announce its presence on your Local Area Network. The firmware version and IP address are displayed at the bottom of the screen.



Initial Operating Mode

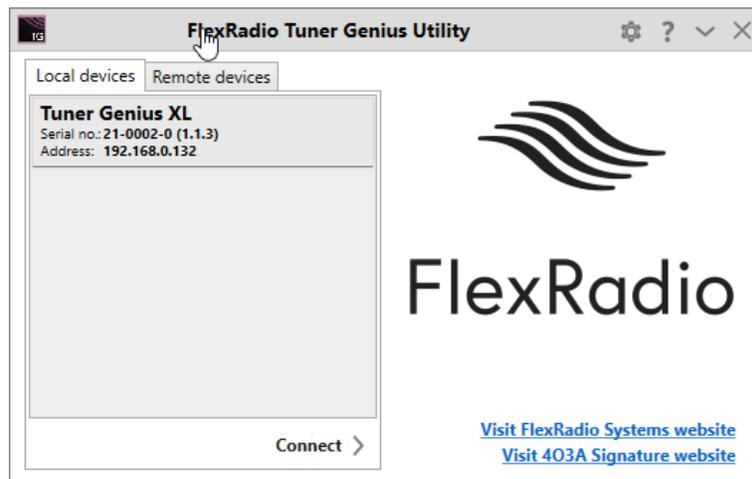
6.2 Basic Configuration

Please complete the following steps to configure your Tuner Genius XL for use.

6.2.1 Connecting the Tuner Genius XL Windows Utility program

The Tuner Genius XL must be configured to work with the transceiver or transceivers that will drive it. The basic configuration of the tuner is accomplished using the **Tuner Genius XL Windows Utility** program. Please see section 15.1, **Installing the Tuner Genius XL Windows Utility**, for installation instructions.

Start the **Tuner Genius XL Windows Utility** program. It will automatically discover your Tuner Genius XL tuner, and you should see something like this:

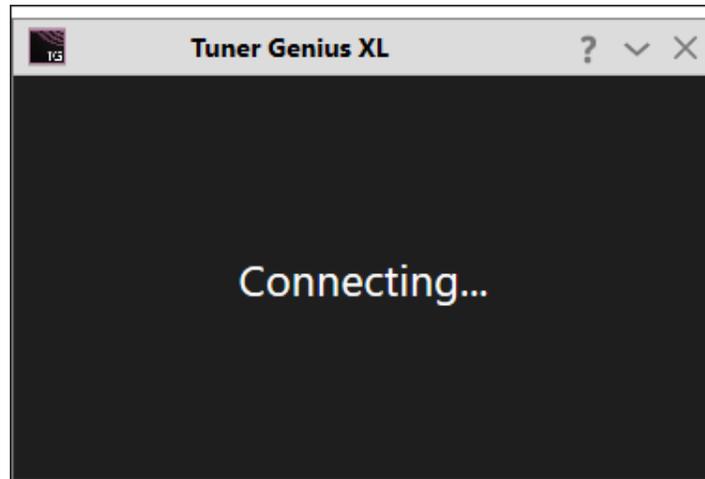


If you do not see your Tuner Genius XL in the Local devices list, please:

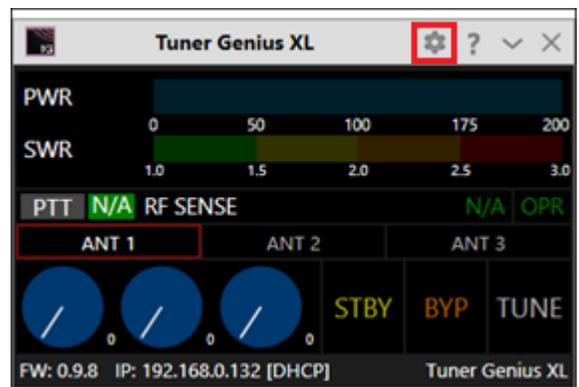
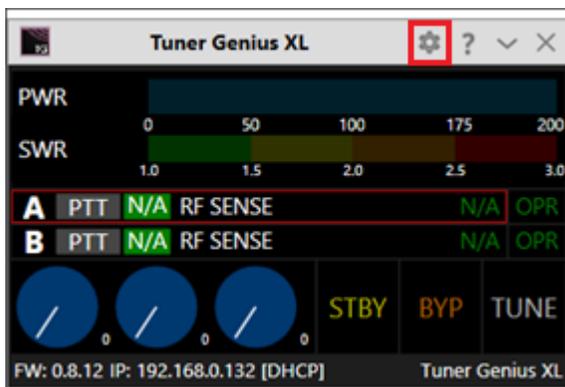
- Double-check your network connections and cables.
- Ensure the Tuner Genius XL is powered on and an IP address is displayed on the front panel.
- Check that the PC's firewall is configured to allow the **Tuner Genius XL Windows Utility** to communicate over your network. The firewall is usually configured during the utility installation process.
- Check that your PC and Tuner Genius XL share the same logical network. For example, the IP address of your PC and the Tuner Genius XL should be similar, although not identical.
- If you still have trouble, please submit a HelpDesk ticket for assistance.

Click on your tuner to select it, then click the **Connect** button.

You may briefly see the utility indicate it is connecting to the TGXL.

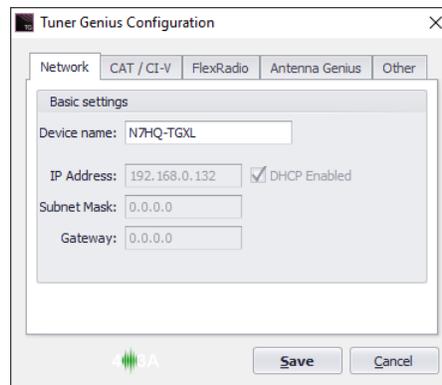


Once connected, a tuner status screen will appear, like the image below. Next, click on the configuration settings button (outlined in red) to open the tuner's configuration settings, then continue to the next section of this document to set the tuner's basic configuration.

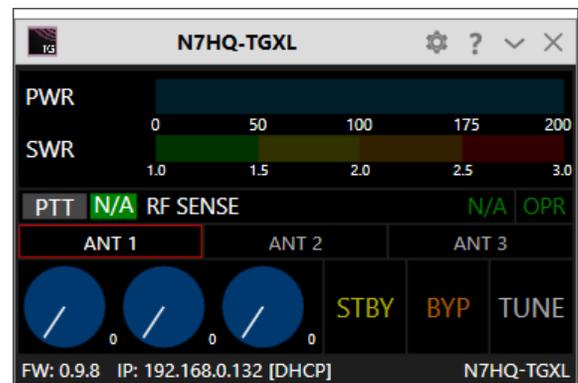
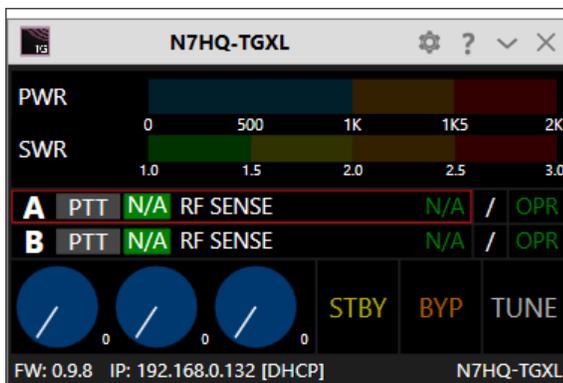


6.2.2 Network Tab: Set a Custom Device Name

You can customize your Tuner Genius XL by configuring a device name to identify your tuner. This name will appear on the tuner's front panel, in the utility's Available devices list, and in the utility's main window.



- Select the Network Tab on the Configuration screen.
- Enter an appropriate name in the Device name field.
- Click **Save**

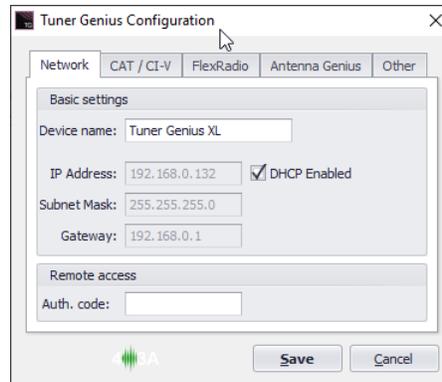


i – The tuner will reset when Save is clicked.

i – You do not need to click Save after every configuration change. You can postpone it until you have completed all the configuration steps, but you must click Save at some point to save the configuration for later use.

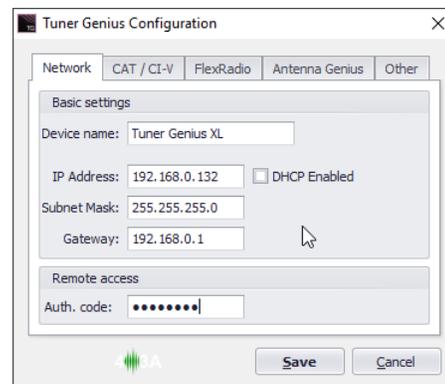
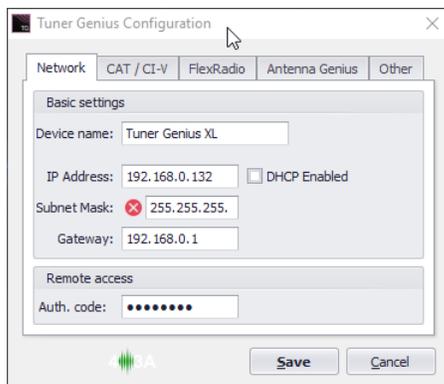
6.2.3 Network Tab: Configuring the Network

The Tuner Genius XL is configured at the factory (or after a factory reset) to use DHCP IP addressing and will automatically secure an IP Address appropriate for your network when it starts. This configuration should be sufficient for most situations.



You can use the Network tab to assign a static IP Address, a static Network Mask, and a Gateway address. Static IP addresses are desirable in some network configurations but require specific technical knowledge of the network. Most configurations will not require these steps. If you don't need any of these options, please proceed to the next section.

The network settings screen performs basic validation of the network settings. Note the red X next to an incorrectly formatted subnet mask below.



If you are not familiar with the rules of setting or using static IP addresses but believe you need to configure one, please submit a HelpDesk ticket for assistance.

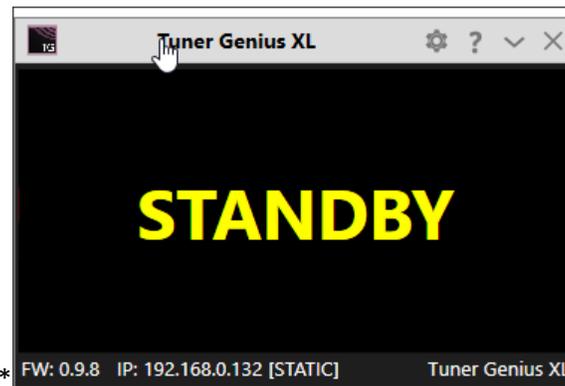
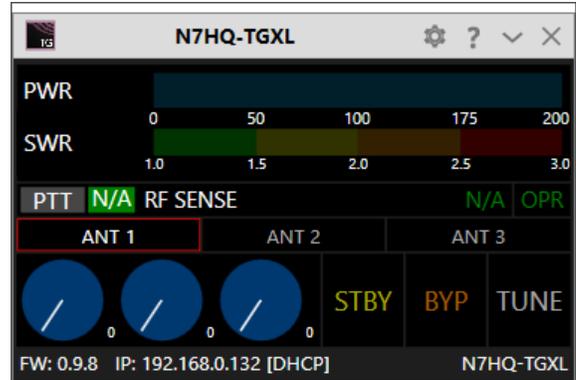
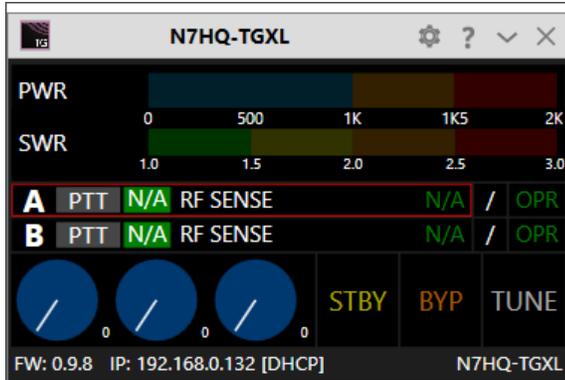
When you have completed the network configuration, click **Save** to instruct the Tuner Genius XL to save the configuration before performing the next step.

i – The tuner will reset when Save is pressed.

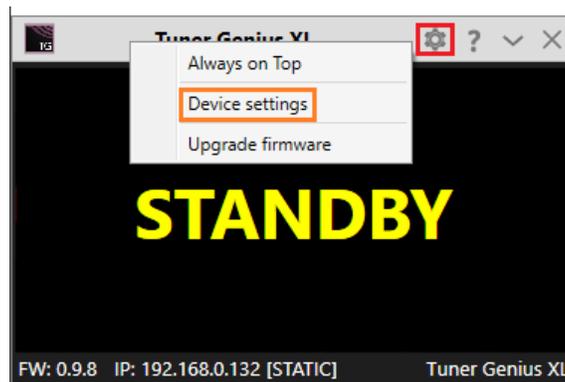
i – It is unnecessary to exit and restart the *Tuner Genius XL Windows Utility* after Save is pressed.

i – If incorrect network information was saved, please follow the instructions in section 11, *Factory Reset the Tuner Genius XL*.

Once you have pressed save, the configuration dialog will close, and the *Tuner Genius XL Windows Utility* will wait for the tuner to reset. The utility will reconnect to the tuner when it appears on the network.

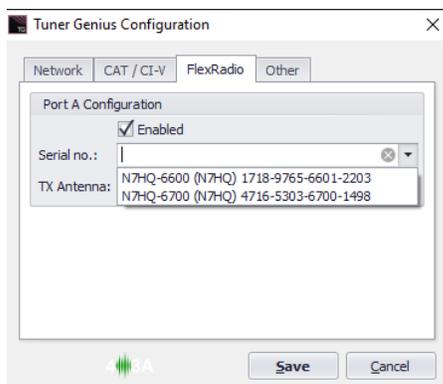


Before moving to the next step, please click the **configuration (gear) icon** then select the **“Device settings”** menu item.

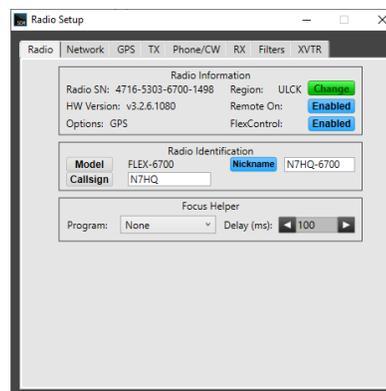


6.2.4 FlexRadio Tab: Configuring for a FLEX-6000 Series Transceiver.

To pair the tuner for use with a FLEX-6000 Series transceiver, turn the radio on, then click on the **FlexRadio** tab in the **Tuner Genius XL Configuration** screen. Make sure to check the **Enabled** box, then follow the instructions below:



Select the discovered radio S/N

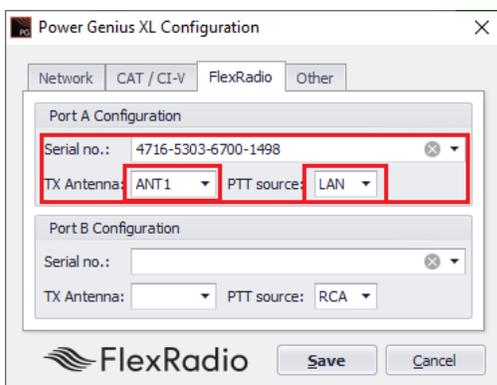


Location of the radio S/N

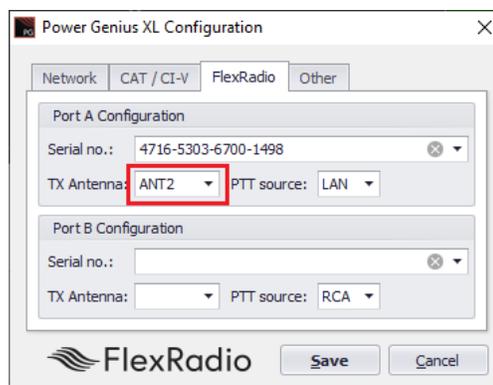
Serial Number: The utility program will detect your FLEX-6000 transceiver(s) automatically. If your radio is connected to Port A of the tuner, click on the Port A serial number drop-down list, and select your radio. You can find your radio's serial number on a sticker on the back panel of the radio or in the Smart SDR Radio Setup dialog, as shown above. If a FLEX-6000 transceiver is connected to Port B, make the Port B configuration settings similarly.

It **is not** required to connect ANT1 output on a FLEX-6000 series connect to Port A input on the tuner. Any FLEX-6000 antenna output can be connected to any TGXL Port. However, it **is** required that the configuration match the physical connections.

TX Antenna: This field configures the tuner to follow frequency changes in the radio on the selected antenna. The tuning solution for the indicated frequency is automatically switched in. For example, if ANT1 on a FLEX-6000 transceiver is connected to tuner Port A input, select ANT1 as the value for the **Port A Configuration** section. When ANT1 is selected for transmitting on a slice, the tuner will make the corresponding changes to its tuning solution. The selected band will appear on the tuner's front panel and the utility screen.



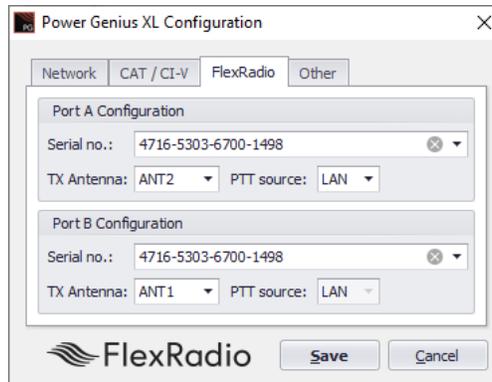
ANT1 is Connected to Port A, LAN PTT



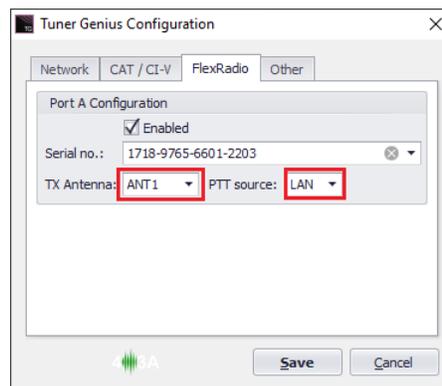
ANT2 is Connected to Port A, LAN PTT

When driven by a FLEX-6000 Series transceiver, the tuner can be keyed over the radio's LAN connection, which automatically manages all transmit delays and other details. This option is strongly recommended. However, you can use a PTT signal wire connected to the appropriate **RCA PTT Input** on the tuner back panel. Wired PTT connections require a twenty millisecond (20ms) TX delay in each Transmit profile that uses the Tuner Genius XL. Select the desired keying source in the **PTT Source** box on the configuration screen for each radio.

When the same FLEX-6000 transceiver is connected to both Tuner Genius XL ports (A and B), you must select the same serial number for Port A and B sections on the configuration screen. This configuration enables advanced Single Operator Two Radio (SO2R) operations using a single transceiver and tuner.



SO2R Configuration ANT2->Port A, ANT1->Port B



1x3 pairing with the ANT1 output on a 6600M

Click the **Save** button to record the configuration in the tuner. The Tuner Genius XL tuner is now configured for use by the FLEX-6000 Series transceiver. Please proceed to section **6.5, Testing**.

! – Do not connect another transceiver via RS-232 (CAT), CI-V, or BCD to the same tuner Port configured for a FlexRadio transceiver.

i – Do not connect a PTT line when interfacing with a FLEX-6000 transceiver. Unless some advanced need requires a separate PTT signaling wire, LAN signaling is all you need.

i – The LAN integration of the Tuner Genius XL tuner is supported in SmartSDR Version 2.0 and later versions. It is not supported in SmartSDR Version 1.

i – The tuner will reset when save is pressed.

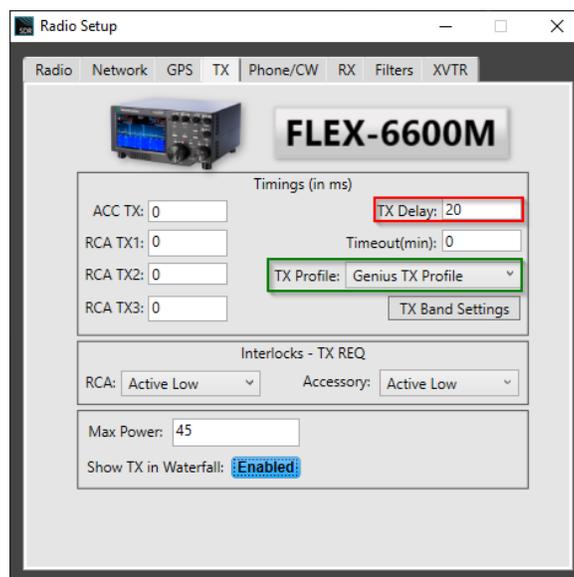
6.3 Advanced Configuration

6.3.1 Required RF Output Delay (TX Delay)

The Tuner Genius XL firmware manages all tuner state transitions. However, the Operate to Transmit transition requires that the exciter slightly delay emitting RF until the transition is complete. Therefore, the Tuner Genius XL requires a minimum delay of 20 milliseconds (20ms) between the time the keying signal arrives at the tuner and the arrival of the exciter RF signal. This time delay is necessary for the tuner to complete all preparations to accept a signal safely. The following sections provide detailed information about setting the delay.

6.3.1.1 FLEX 6000-Series

When keying the tuner with FLEX 6000 Series transceivers using LAN keying, a [TX Delay] value should be set to a minimum of 20 milliseconds to allow the tuner to select the correct tuning solution.



i – A best practice is to create a Tuner Genius XL TX Profile for your FLEX-6000 Series transceiver and load that when using the Tuner Genius XL.

6.3.1.2 TX Delay for Other Exciters

When keying the tuner with other than FLEX 6000 Series transceivers, you will need to use a radio configuration or setting to delay RF generation by at least twenty milliseconds (20ms) after the keying signal (PTT) is sent to the tuner by the exciter.

Please consult the manual for your transceiver or exciter to enable and configure the transmit delay.

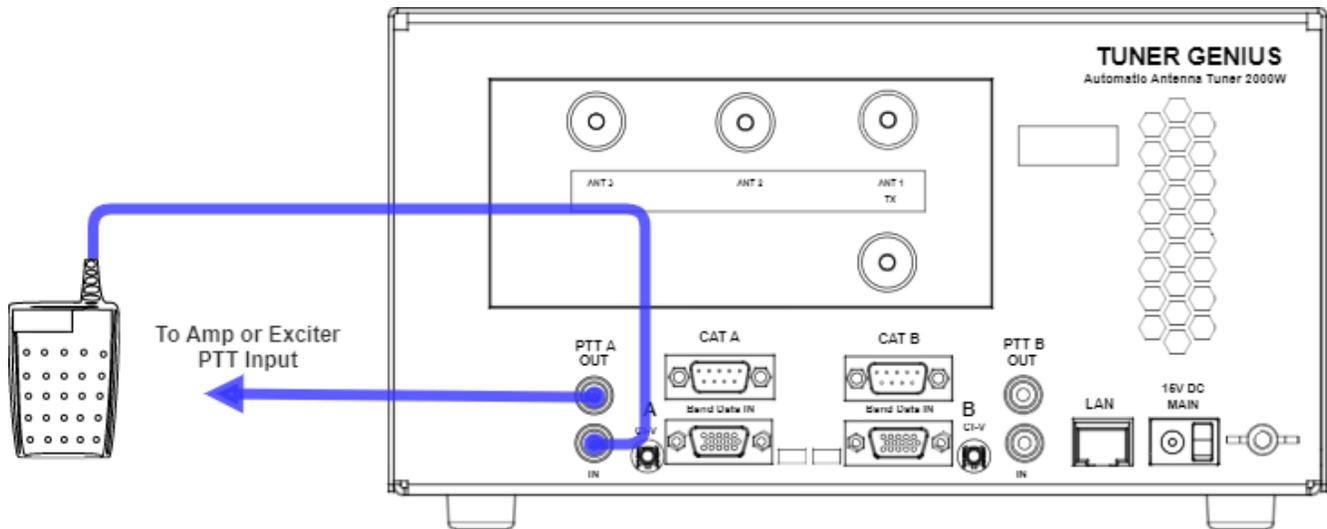
6.3.1.3 Exciters Without a TX Delay Adjustment

If the exciter does not support a transmit delay, then configure the tuner and exciter in the following way:

- Connect the keying device (mic PTT switch, foot pedal, etc.) to the appropriate Tuner Genius XL **PTT Input**. The appropriate input is the same tuner port (A or B) where the exciter output is connected.

- Connect the tuner's **PTT Output** (port A or B) to the exciter in place of the keying device.

When the tuner is keyed, the Tuner Genius XL will manage the output keying signal delay and assert PTT at the transceiver when the tuner is ready to accept RF.



Example: Footswitch PTT wiring for a transceiver connected to Port A that does not have a TX Delay adjustment.

6.3.1.4 Band Data and Frequency Measurement-based restrictions

In the following sections, we describe methods for supplying the tuner with band data information from exciter. When the data arrives at the tuner over a CAT connection, the frequency is provided to the tuner and the tuner records the tuning solution associated with the frequency. Up to 10 solutions, keyed by frequency can be stored for each band/antenna port combination.

When the exciter does not provide data via a CAT connection but does provide band information via a BCD or Pin2Band connection, the tuner finds a tuning solution on the exciter's frequency and then stores that solution for the entire band. Only one solution is stored per band. Significant changes in frequency within a band may require re-tuning. This also applies to Frequency Measurement configurations. If the tuner has no band data input but senses the RF frequency, it will store one solution per band.

6.3.2 Interfacing with Other Exciters

You can connect more than one radio type to a Tuner Genius XL, provided each radio is exclusively connected to one of the tuner ports (A or B). Though each port has multiple interfaces to receive band data and key the tuner, it does not support multiple radios on a single tuner port.

6.3.2.1 Elecraft

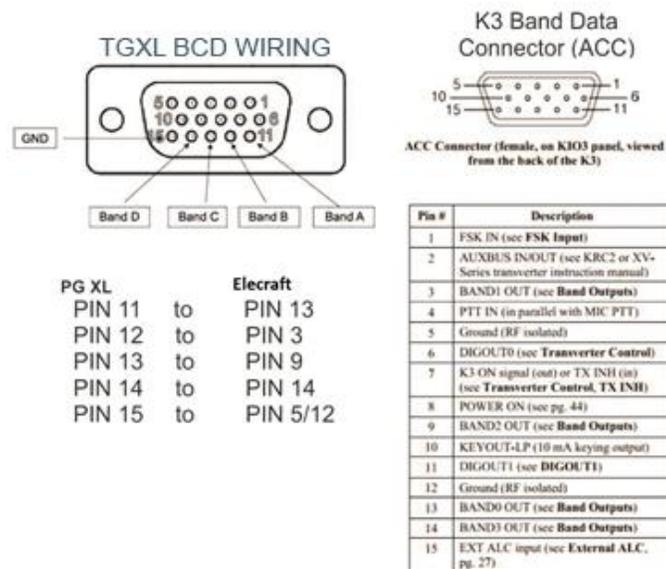
The tuner requires both band data and a PTT line from Elecraft radios. Band data is available using a custom wired BCD band decoder cable.

PTT

Connect an appropriate cable (RCA male terminated on both ends) between the radio's **Key output** and the **PTT Input** corresponding to the tuner Port used (A or B).

Band Data (BCD)

See the pinout diagram below for the cable configuration. The connection is the same for all Elecraft radio models.



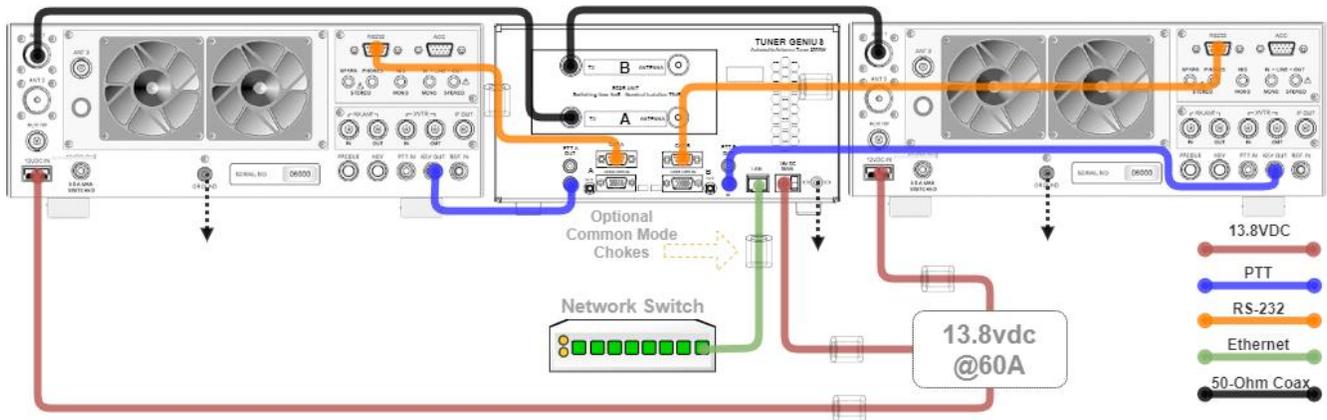
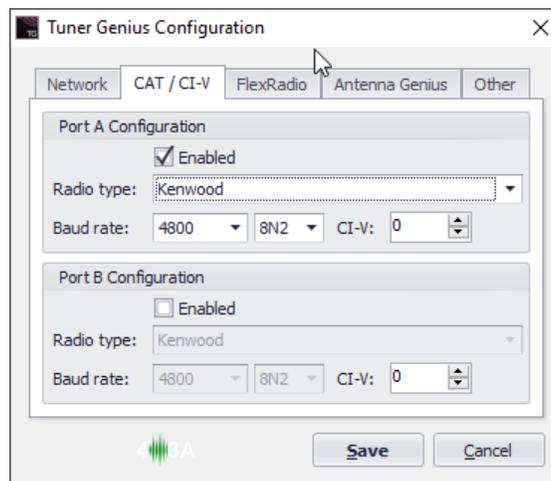


Figure 6-5 SO2R Elecraft K3 to TGXL Diagram

You can connect either the **BCD/PTB Input A** or **BCD/PTB Input B** connector on your tuner to the ACC connector on the Elecraft transceiver using a female-to-female DE-15 cable (DE-15 male connectors on both ends of the cable), customized as detailed above.

Configuration

To configure the tuner, click on the CAT/C-IV tab in the **Tuner Genius XL Configuration** screen, and check the Enable checkbox for the appropriate port.



Select the Kenwood CAT protocol from the **Radio type** drop-down menu for the tuner port (Kenwood CAT protocol is effectively a generic protocol supported by many makes of transceivers). Next, select the serial communication port speed and configuration parameters that apply to your radio. Finally, click the **Save** button to record the configuration in the tuner.

i – The tuner will reset when save is pressed.

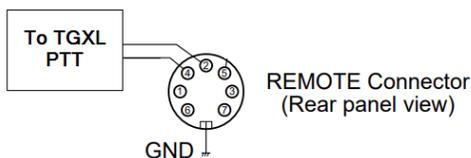
Please proceed to section **6.5, Testing**.

6.3.2.2 Kenwood

The tuner requires both band data and a PTT line from Kenwood radios. Band data is available using the CAT protocol via RS-232.

PTT

Connect an appropriate cable between the radio's PTT output and the **PTT Input** corresponding to the tuner Port (A or B). Some models may require a custom cable to access radio PTT from an accessory connector. Please consult your manual for the correct PTT output. Multi-band radios may have more than one, based on the band you are operating. Below is an example using the **REMOTE** connector on a **TS-2000**. In this case, [pins 2 and 4] would be connected to the tuner's PTT IN on PORT A or PORT B.

REMOTE Connector (Rear panel view)

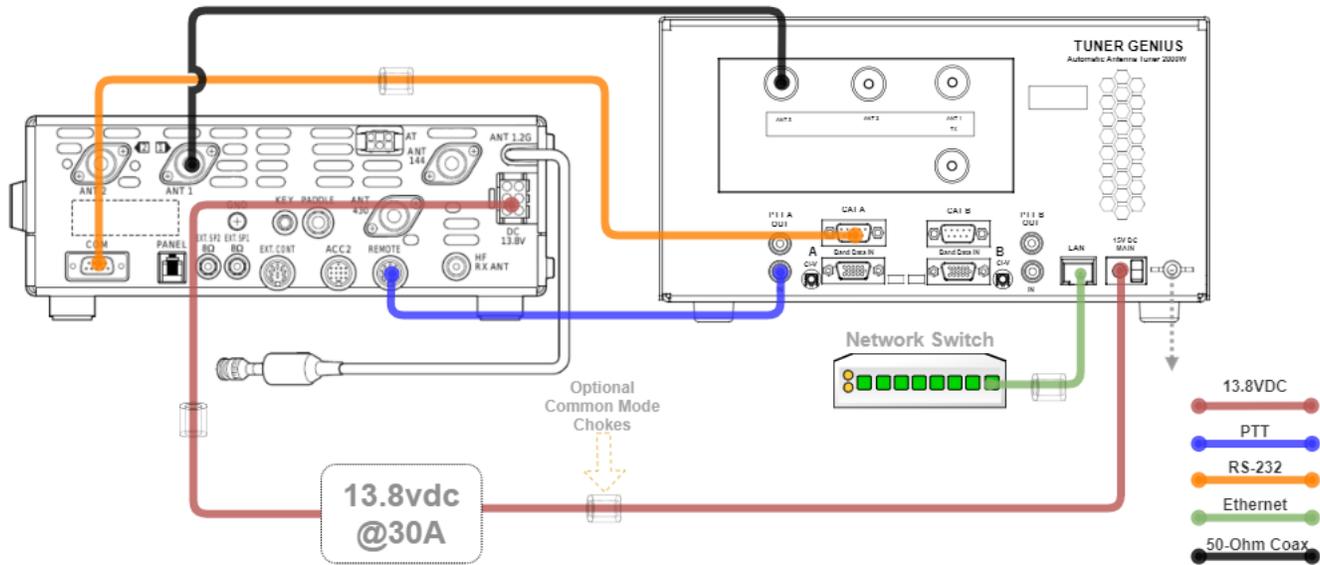
REMOTE connector	
Pin No.	Function
1	Speaker output
2	Common terminal
3	Standby; when grounded, the transceiver enters TX mode.
4	When connected with the common terminal, the amplifier enters TX mode.
5	When connected with the common terminal, the amplifier enters RX mode.
6	ALC input from amplifier
7	Approx. +12 V DC is output when in TX mode (10 mA max.).

Band Data (CAT)



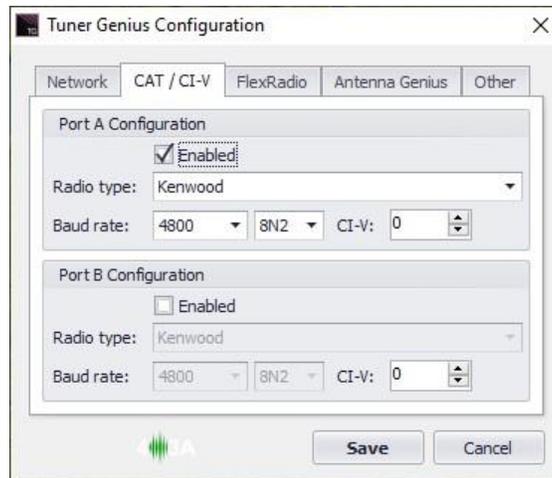
RS-232 (CAT) connections use a straight-through female-to-female DB9 cable.

Connect either the **CAT Input A** or **CAT Input B** connector on your Tuner Genius XL to the CAT connector on the Kenwood transceiver using a female-to-female DB9 cable.



Configuration

To configure the tuner, click on the CAT/C-IV tab in the **Tuner Genius XL Configuration** screen.



Select “Kenwood” from the **Radio type** drop-down menu for the tuner port where the radio is connected. Next, select the serial communication port speed and configuration parameters that apply to your radio. Finally, click the **Save** button to record the configuration in the tuner.

i – The tuner will reset when save is pressed.

Please proceed to section **6.5, Testing**.

6.3.2.3 ICOM

The tuner requires both band data and a PTT line from Icom radios. Band data is available using RS-232 (CAT) or CI-V depending on the model.

PTT

ACC 1	PIN No.	NAME	DESCRIPTION	SPECIFICATIONS
	1	RTTY	Controls RTTY keying	"High" level : More than 2.4 V "Low" level : Less than 0.6 V Output current : Less than 2 mA
	2	GND	Connects to ground.	Connected in parallel with ACC 2 pin 2.
	3	SEND	Input/output pin. Goes to ground when transmitting. When grounded, transmits.	Ground level : -0.5 V to 0.8 V Output current : Less than 20 mA Input current (Tx) : Less than 200 mA Connected in parallel with ACC 2 pin 3.
	4	MOD	Modulator input. Connects to a modulator	Input impedance : 10 kΩ Input level : Approx. 100 mV rms
	5	AF	AF detector output. Fixed, regardless of [AF] position in default settings. (see notes below)	Output impedance : 4.7 kΩ Output level : 100–300 mV rms
	6	SQLS	Squelch output. Goes to ground when squelch opens.	SQL open : Less than 0.3 V/5 mA SQL closed : More than 6.0 V/100 μA
	7	13.8 V	13.8 V output when power is ON.	Output current : Max. 1 A Connected in parallel with ACC 2 pin 7.
	8	ALC	ALC voltage input.	Control voltage : -4 V to 0 V Input impedance : More than 10 kΩ Connected in parallel with ACC 2 pin 5.

Connect an appropriate cable between the radio's PTT output and the **PTT Input** corresponding to the tuner Port (A or B). Some models may require a custom cable to access radio PTT from an accessory connector.

Create a custom cable connecting pins 2 (GND) and 3 (SEND) from the 8-pin DIN ACC 1 jack and a standard RCA plug from the PTT-IN RCA jack. Pin 3 connects to the center conductor of the RCA plug, and pin 2 to the outer conductor.

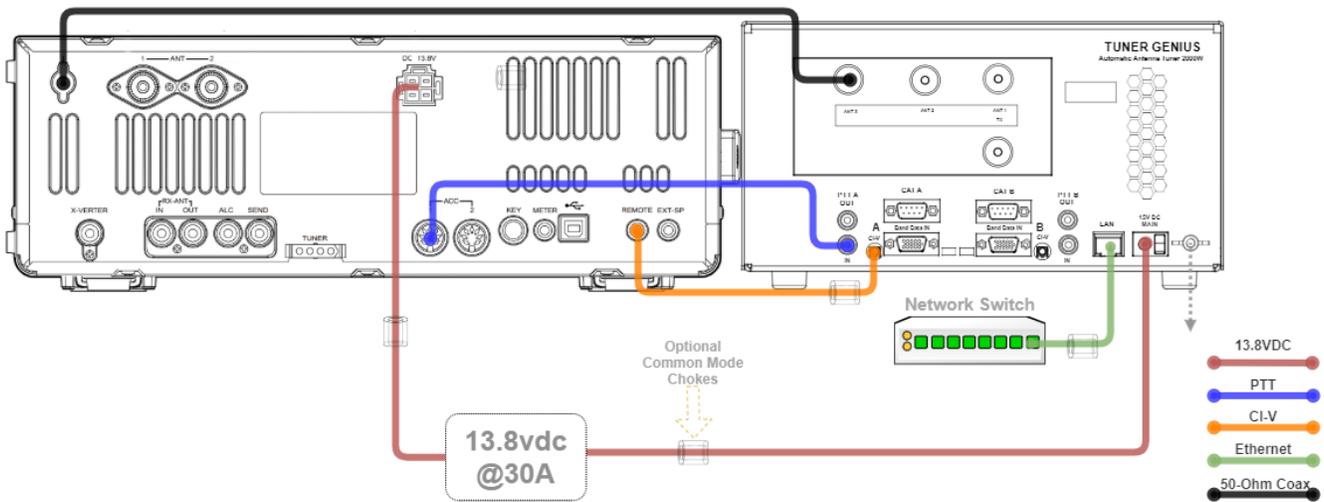
CI-V

Connect an appropriate 3.5mm CI-V patch cable between the radio's REMOTE output and the **CI-V Input** corresponding to the tuner Port used (A or B). Only two conductors are used (tip and sleeve). Three-conductor CI-V cables may be used, and models may require a custom cable. Please consult the user manual for your specific exciter.



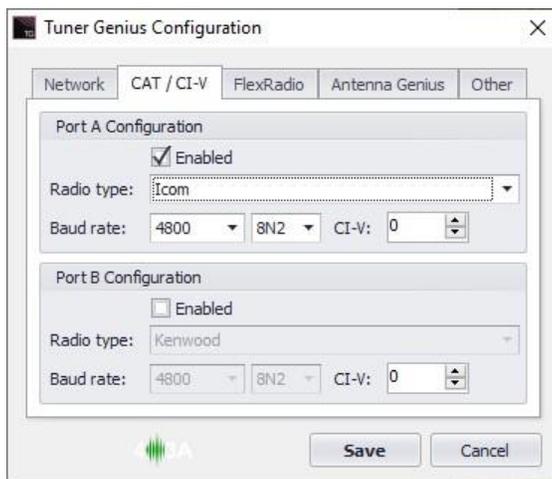
CI-V Patch Cable

Connect the REMOTE output from the transceiver to the appropriate **CI-V Input A** or **CI-V Input B** connector on your Tuner Genius XL.



Configuration

To configure the tuner, click on the CAT/C-IV tab in the **Tuner Genius XL Configuration** screen.



Select the Icom from the **Radio type** drop-down menu for the tuner port where the radio is connected. Next, select the CI-V communication port speed and configuration parameters that apply to your radio.

You will need to enter the hexadecimal value of the CI-V address configured for your Icom transceiver. Here are some common default values as examples, although any value from \$00 to \$FF can be used:

Icom Model	Default CI-V Hexadecimal Address
IC-775	46
IC-7000	70
IC-7800	6A

1. Change the CI-V address of the Icom radio to the value currently configured in your transceiver.
2. Connect a PTT cable between the radio and the appropriate port (A or B) on the tuner.
3. Set the details of the appropriate CI-V communication protocol as defined by your transceiver.

Click the **Save** button to record the configuration in the tuner.

Please proceed to section **6.5, Testing**.

6.3.2.4 Yaesu

The tuner requires both band data and a PTT line from Yaesu radios. Band data is available using either the CAT protocol via RS-232 or BCD band data from a DIN connector.

PTT

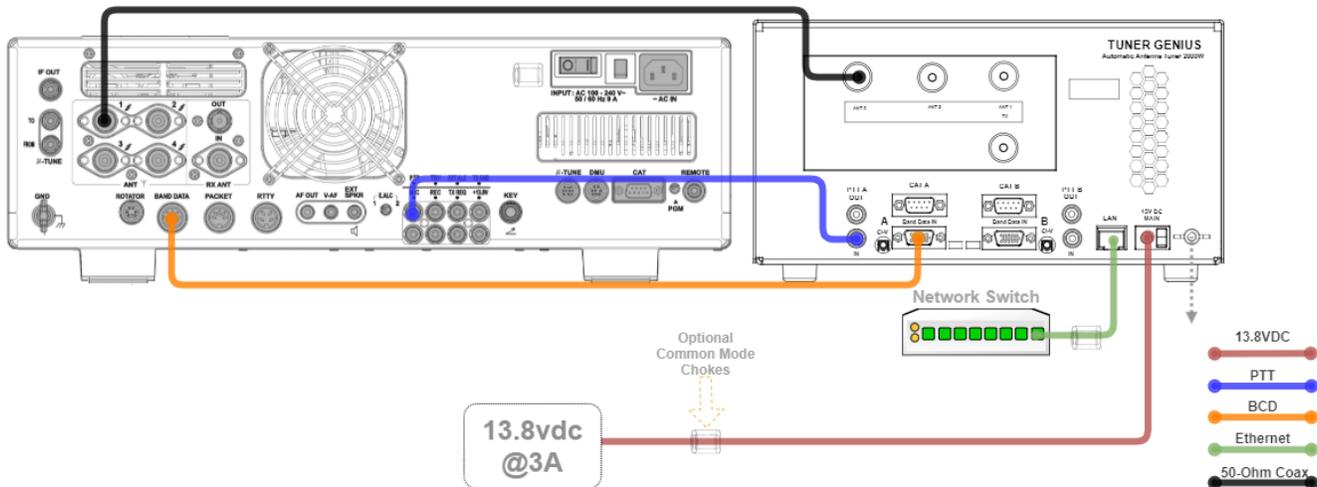
Connect an appropriate cable between the radio's PTT output and the **PTT Input** corresponding to the tuner Port (A or B). Some models may require a custom cable to access radio PTT from an accessory connector.

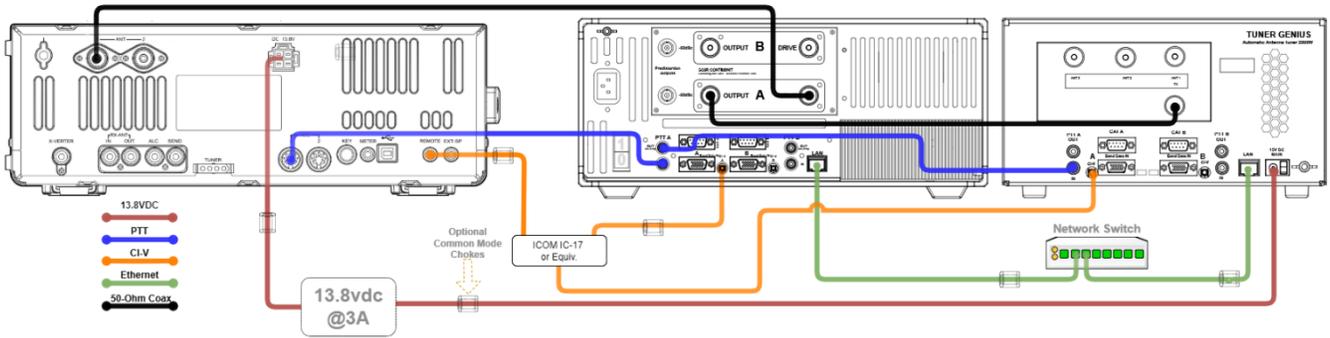
Band Data (CAT)



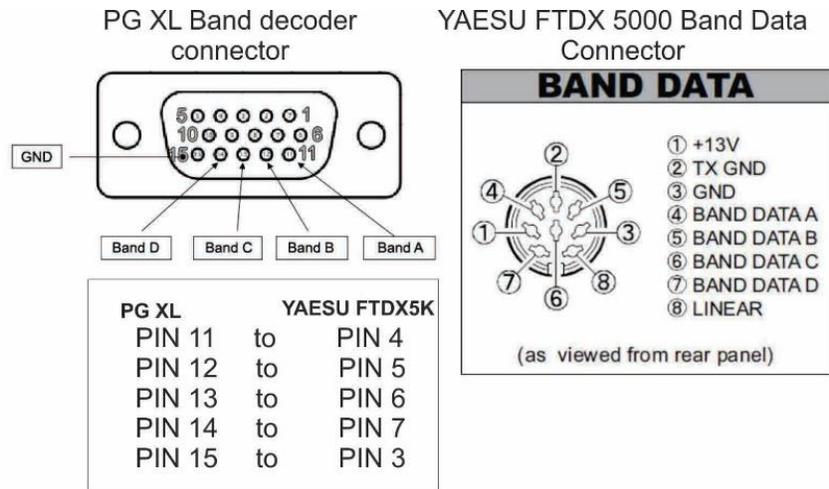
RS-232 (CAT) connections use a straight-through female-to-female DB9 cable.

You can connect either the **CAT Input A** or **CAT Input B** connector on your tuner to the CAT connector on the Yaesu transceiver using a female-to-female DB9 cable.





Alternatively, you can use a BCD connection between the eight-pin DIN (Band Data) connector on the Yaesu transceiver to the Band Data A or Band Data B (DB15) connector on the tuner. The restriction described in section 6.3.1.4, **Band Data and Frequency Measurement-based** restrictions, applies in this case.



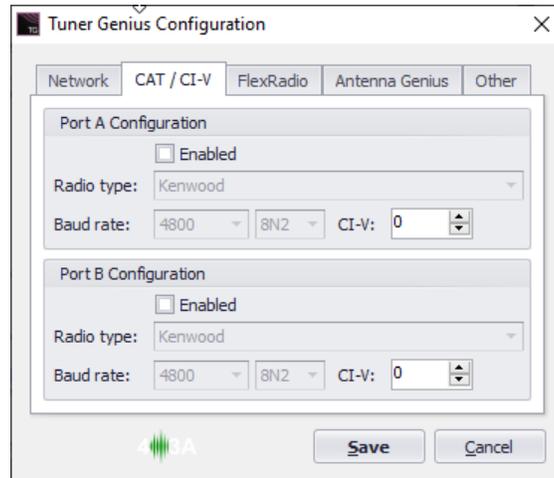
BCD connections use a custom cable configured as shown in this diagram.

i – Optocouplers protect all serial and digital inputs or outputs on the Tuner Genius XL

Configuration

No additional configuration is required for BCD mode. The tuner will detect the presence of a BCD or Pin-to-Band interface.

Click on the CAT/C-IV tab in the **Tuner Genius XL Configuration** screen.



Click the **Save** button to record the configuration in the tuner.

i – The tuner will reset when save is pressed.

Please proceed to section **6.5, Testing**.

6.3.2.5 Unlisted Exciters

PTT

Connect an appropriate cable between the radio's PTT output and the tuner's **PTT Input A** or **B** jack. Most radios have a PTT interface. However, it is essential to check your exciter manual to determine the keying voltage and current, especially with older radios. The Tuner Genius XL PTT lines are optoisolated, but they will not tolerate high voltages or an AC voltage. Therefore, be prepared to provide a keying buffer relay designed for the task, like the Ameritron™ ARB-704 amp to transceiver interface.

i – Some operators choose to use a keying buffer in all cases as “insurance” to prevent any possible damage to the exciter or tuner due to possible transient voltage spikes or RF ingress.

Band Data

Most radios use one of these protocols to send band data to external devices:

- **BCD / PTB protocol**

Connect your radio or band decoder to the **BCD/PTB Input A** or **BCD/PTB Input B** connector on the tuner. This connection requires no additional configuration and works automatically. Band data arriving on the BCD/PTB connection overrides other sources. See section **15.3.7, PTB/BCD Connector Pinout**, for additional information. Also see section **6.3.1.4, Band Data and Frequency Measurement-based** restrictions, in this case.

- **CAT protocol**

Connect your radio's CAT output to the **CAT Input A** or **CAT Input B** connector on the tuner. Then, configure the CAT protocol details using the ***Tuner Genius XL Windows Utility***.

- **CI-V protocol**

Connect your radio's CI-V output to the **CI-V Input A** or **CI-V Input B** connector using a 3.5mm TS or TRS connector. Configure the CI-V protocol details using the ***Tuner Genius XL Windows Utility***.

- **Frequency Measurement**

The Tuner Genius XL will measure an RF signal's frequency applied to one of its inputs and automatically switch to the appropriate tuning solution. This band-switching mode often requires that you double-key briefly before the first full transmission to allow the correct tuning solution to be set. Also see section **6.3.1.4, Band Data and Frequency Measurement-based** restrictions, in this case.

Please proceed to section **6.5, Testing**.

6.3.3 Interfacing with the Power Genius XL (PGXL)

The Tuner Genius is designed for interfacing with the PGXL and is straightforward. Please reference Figure 2-

- Connect a coax jumper between the Port A output of the PGXL and the Port A input of the tuner.
- Connect a coax jumper between the Port B output of the PGXL and the Port B input of the tuner.
- Ensure the PGXL is connected to the same LAN as the tuner.
- Ensure the PGXL is appropriately configured (see the Power Genius XL User Guide) and paired with the correct Flex 6000 transceiver.

That's it!

6.3.4 Interfacing with Other Amplifiers

You can connect most HF+6m amplifiers to a Tuner Genius XL. However, for SO2R switching models, each amplifier must be exclusively connected to one of the tuner **TX** ports (A or B). Though each port has multiple interfaces to receive band data and PTT the tuner, the SO2R version will work with two amplifiers, and the 1x3 version does not support inputs from more than one amplifier.

The most crucial element in interfacing any amplifier is not engaging the power amplifier during the Tuner Genius tuning operation. 20W is adequate in most cases to allow the tuner to calculate a proper match. In many cases, the amplifier will have no ability to know the difference between a signal used by the tuner and a signal intended to be radiated. Unless there are special station automation provisions, operators will need to manually place the amplifier into the **BYPASS** or **STANDBY** mode during tuning.

When using a PGXL and a FlexRadio transceiver, the tuner instructs the PGXL to switch to **STANDBY** while the TGXL searches for a match. Other combinations of amplifiers and exciters will not benefit from this. Operators must be aware of how their system functions in this regard.

Once a match is stored in one of the tuner memory slots, the tuner will switch to that solution if a frequency within the slot range is detected and band data is unavailable from the exciter. A short transmission while the amplifier is on standby should be used to ensure the Antenna Genius is adequately set for high-power operation.

6.3.4.1 PTT

PTT is easy to provide, generally requiring a single two-conductor cable. However, almost all amplifiers require exciters that drive them to delay emitting RF until the amplifier is ready to amplify it. The Tuner genius also requires a short delay of < 20ms when the frequency used already has a solution stored in memory. Therefore, please take the TX and PTT delay requirements of the entire TX chain into account.

6.3.4.2 Band and Frequency Data

Unless you are using frequency detection, it is usually the responsibility of the exciter to originate band or frequency data to the components in the TX chain that require them. Therefore, the restriction described in section **6.3.1.4, Band Data and Frequency Measurement-based** restrictions, may apply.

If an appropriate frequency memory is not stored, the SWR presented to the amplifier may be higher than can safely be used. Therefore, please take extra care to ensure a good tuning solution is active before transmitting, especially when you are QRO.

6.3.4.3 Ameritron

Ameritron (an MFJ company) offers a broad selection of HF amplifiers suitable for interfacing with a Tuner Genius. Many of these amplifiers follow traditional tube designs that require tuning before use. Some are solid-state designs that can be interfaced with your exciter to select output filters.

6.3.4.4 SPE

TBD

6.3.4.5 ACOM

TBD

Please proceed to section **6.5, Testing**.

6.3.4.6 Unlisted Amplifiers

PTT

Connect an appropriate cable between the radio's PTT output and the tuner's **PTT Input A** or **B** jack. Most radios have a PTT interface. However, it is essential to check your manual to determine the keying voltage and current, especially with older radios. The Tuner Genius XL PTT lines are optoisolated, but they will not tolerate high voltages or an AC voltage. Therefore, be prepared to provide a keying buffer relay designed for the task, like the Ameritron™ ARB-704 amp to transceiver interface.

i – Some operators choose to use a keying buffer in all cases as “insurance” to prevent any possible damage to the exciter or tuner due to possible transient voltage spikes or RF ingress.

Band Data

Most radios use one of these protocols to send band data to external devices:

- **BCD / PTB protocol**

Connect your radio or band decoder to the **BCD/PTB Input A** or **BCD/PTB Input B** connector on the tuner. This connection requires no additional configuration and works automatically. Band data arriving on the BCD/PTB connection overrides other sources. See section **15.3.7, PTB/BCD Connector Pinout**, for additional information. The restriction described in section **6.3.1.4, Band Data and Frequency Measurement-based** restrictions, may apply.

- **CAT protocol**

Connect your radio's CAT output to the **CAT Input A** or **CAT Input B** connector on the tuner. Then, configure the CAT protocol details using the *Tuner Genius XL Windows Utility*.

- **CI-V protocol**

Connect your radio's CI-V output to the **CI-V Input A** or **CI-V Input B** connector using a 3.5mm TS or TRS connector. Configure the CI-V protocol details using the *Tuner Genius XL Windows Utility*.

- **Frequency Measurement**

The Tuner Genius XL will measure an RF signal's frequency applied to one of its inputs and automatically switch in the appropriate inductor and capacitor values. This band-switching mode often requires that you double-key briefly before the transmission to allow the tuning solution switching to complete. Also see section **6.3.1.4, Band Data and Frequency Measurement-based** restrictions, in this case.

Please proceed to section **6.5, Testing**.

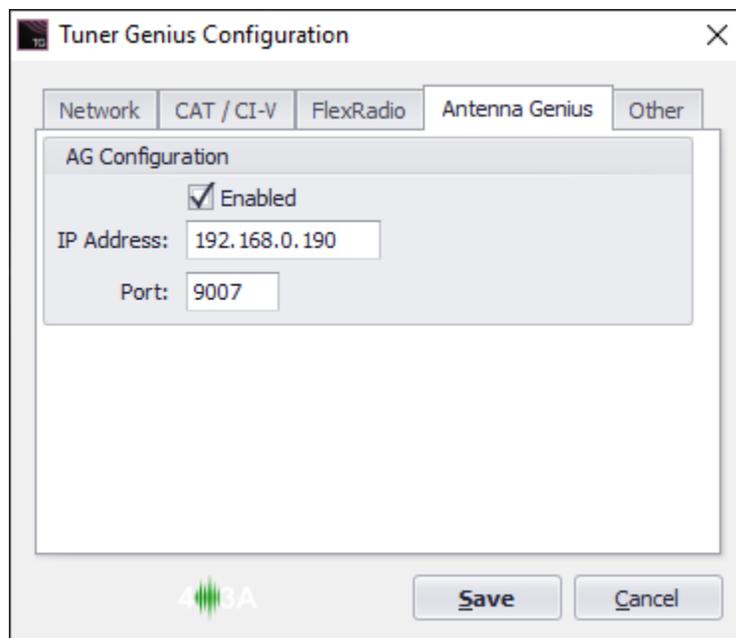
6.4 Antenna Genius Integration

The Tuner Genius XL will interface directly with an Antenna Genius (AG) 2x8 or 1x8 switch. Please refer to the Antenna Genius User Guide available {here} for instructions on setup and configuring that device.

Integrating an Antenna Genius (AG) will unlock additional solution memories in the Tuner Genius XL and automatically switch to an appropriate antenna for the frequency or band you are using.

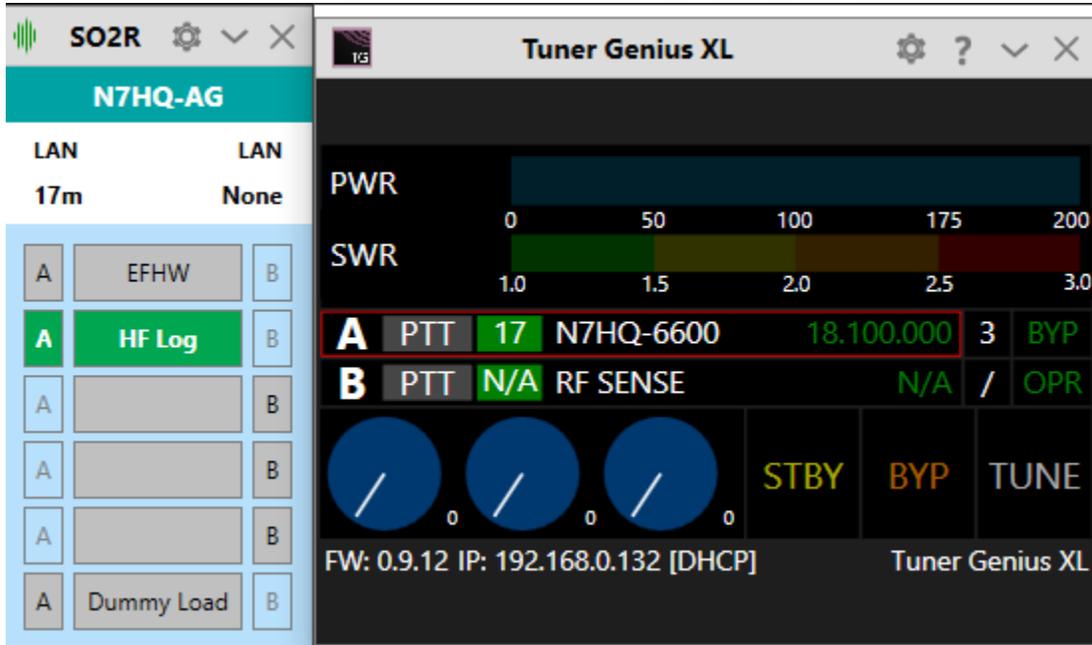
6.4.1 Enable Integration

To enable AG integration, you must enable it, and supply the network TCP/IP address and TCP port used by the Antenna Genius on the Antenna Genius tab of the Tuner Genius XL Windows Utility. For example, in the case below, the Antenna Genius is located at 192.168.0.190 and uses the default TCP port 9007 for communications. Click [Save] to confirm and store the configuration.



6.4.2 Using the Antenna Genius User Interface

Once the integration step is performed, the Tuner Genius XL and Antenna Genius will follow the band or frequency used by the exciter. You may use the Antenna Genius application to switch antennas if configured for the band you are using.



6.4.3 Additional Slots per Band

The Tuner Genius XL will add up to four Antenna Genius antenna slots per band and alter the Band Configuration dialog to match it. This powerful advanced but easy-to-use feature allows you to configure how

the Tuner Genius XL manages multiple antennas. Each antenna slot per band is capable of 10 frequency memories.

Tuner Genius XL Band Configuration

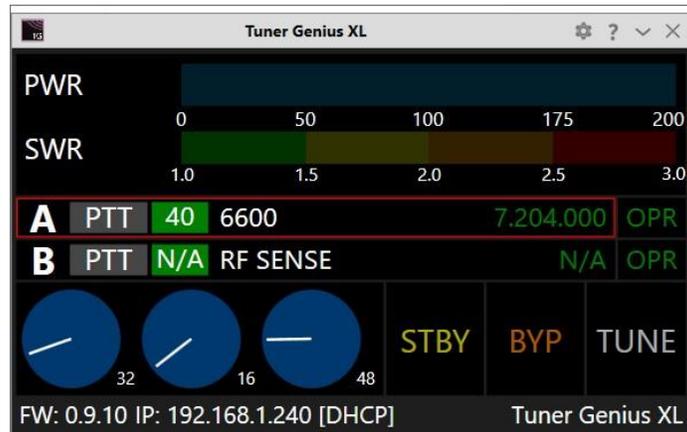
Bands

Band Name	Antenna	Minimal SWR	Enable Bypass	Bypass Start (KHz)	Bypass Stop (KHz)
160m	Inv V	1.10	<input checked="" type="checkbox"/>	1 800	1 820
	Dummy Load	1.10	<input type="checkbox"/>		
80m	EFHW	1.10	<input checked="" type="checkbox"/>	3 510	3 550
	Dummy Load	1.10	<input type="checkbox"/>		
60m	Inv V	1.10	<input type="checkbox"/>		
	Dummy Load	1.10	<input type="checkbox"/>		
40m	EFHW	1.10	<input type="checkbox"/>		
	Dummy Load	1.10	<input type="checkbox"/>		
30m	EFHW	1.10	<input type="checkbox"/>		
	HF Log	1.10	<input type="checkbox"/>		
	Inv V	1.10	<input type="checkbox"/>		
	Dummy Load	1.10	<input type="checkbox"/>		
20m	EFHW	1.10	<input checked="" type="checkbox"/>	14 020	14 040
	HF Log	1.10	<input type="checkbox"/>		
	Dummy Load	1.10	<input type="checkbox"/>		
17m	EFHW	1.10	<input type="checkbox"/>		
	HF Log	1.10	<input type="checkbox"/>		
	Dummy Load	1.10	<input type="checkbox"/>		
15m	EFHW	1.10	<input type="checkbox"/>		

Save Cancel

6.5 Testing

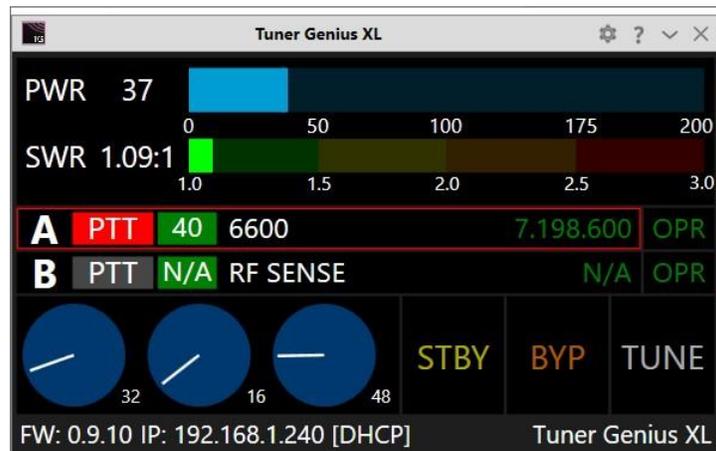
After following the instructions in section **6.2, Basic Configuration**, or **6.3, Advanced Configuration**, you should test the radio-tuner connection. First, turn the radio and tuner on and select a band on the radio. The tuner should start up in Operate mode, as shown below. The band information should appear on the tuner's front panel and the **Tuner Genius XL Windows Utility** for the port you have chosen.



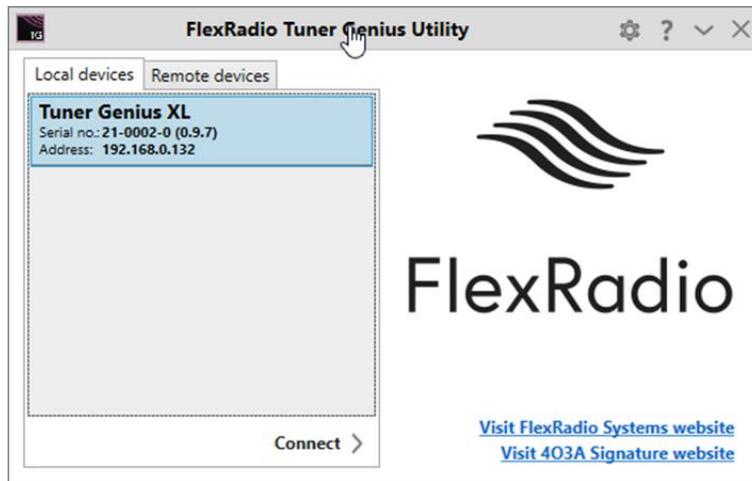
Make sure all RF connections are correctly attached and tightened and that an appropriate antenna or dummy load is attached to the appropriate tuner output.

Change to another band and verify the tuner follows the change.

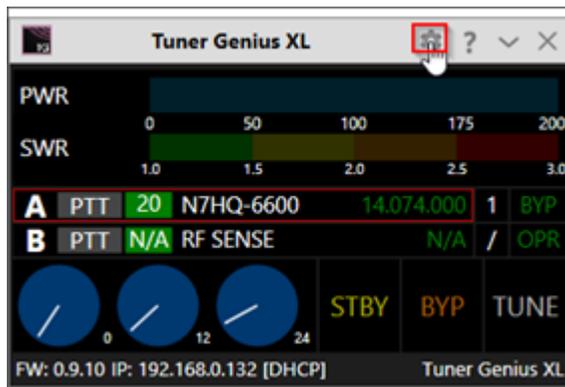
Set the drive power at the transmitter to about 20 watts and transmit a carrier. The tuner should switch into transmit mode.



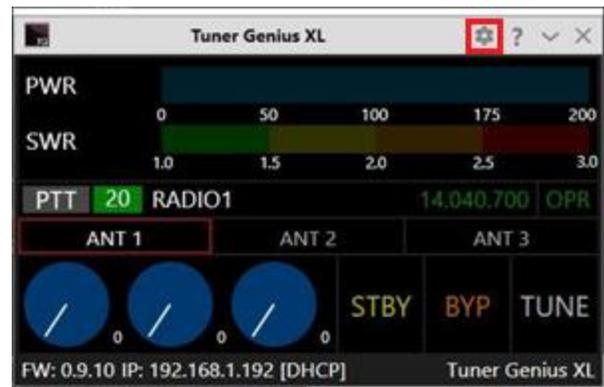
- The PTT indicator on the front panel display will be red.
- The input power and SWR will be displayed.
- Start the **Tuner Genius XL Windows Utility** program. It will find your Tuner Genius XL tuner automatically. Click on your tuner to select it, then click on the **Connect** button.



- The tuner status screen will appear as shown below. Next, click on the configuration settings button (outlined in red) to open the tuner's configuration settings dialog window.



SO2R Version



1x3 Version

7 Operating the Tuner Genius XL

7.1 Changing Modes

The Tuner Genius XL provides three operational modes: Standby, Operate and Bypass. In Standby and Bypass modes, the tuner does not modify incoming or outgoing signals. In Operate mode tuning solutions are applied to the incoming and outgoing signals.

7.1.1 Bypass and Operate Modes

There are two ways the tuner can be toggled between Bypass and Operate modes.

1. By pressing the **BYPASS/OPERATE** button on the front panel of the tuner.
2. By changing the mode using software such as the utility program.



Front panel "Hard" button



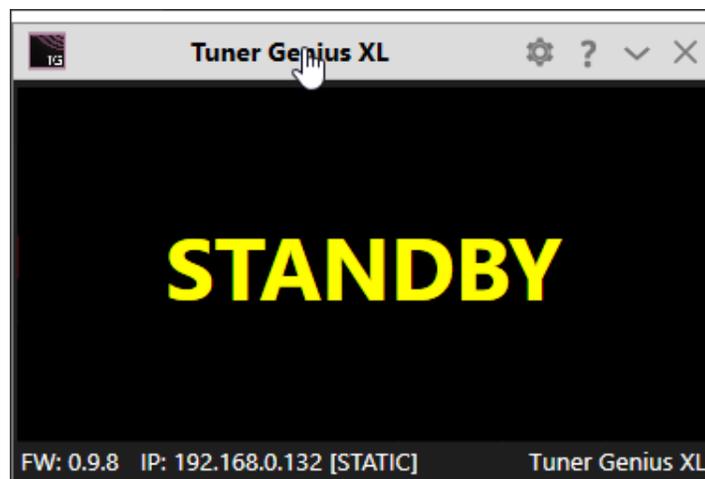
Tuner Genius XL Windows Utility Button

i – When properly configured, a convenient method for switching between Standby, Operate, and Bypass modes use software connected to the Tuner Genius XL over the LAN.

The front panel **BYPASS/OPERATE** button and the utility's **BYP** button toggle the operational state between Bypass and Operate mode. The **BYPASS** LED on the Tuner front panel is on while the tuner is in Bypass mode.

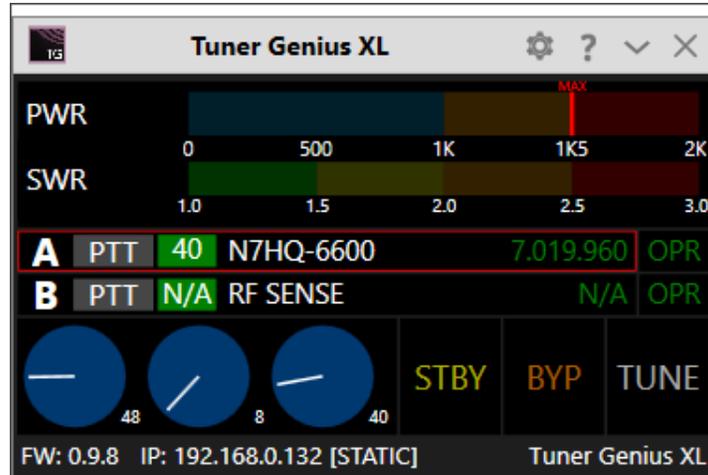
7.1.2 Standby Mode

In Standby mode, the tuner disconnects from all antennas. As a result, tuning solutions that may be applied while receiving are not applied. Standby can be entered by pressing and holding the **BYPASS/OPERATE** button or using the **STBY** button in the utility program.



7.1.3 Receiving

In Operate mode, the tuner power supply is engaged, and the tuner is prepared to receive RF Input Drive and a PTT signal. The front panel meters are active, band/frequency data is processed, and the tuning solution is applied.



7.2 Tuning

There are two modes of tuner operation: manual and automatic. In automatic mode, the user initiates a tune operation to find a successful match between the transmitter and the antenna system. When one is found, the match solution (L/C/L values and frequency) are retained in tuner non-volatile memory and automatically used when the frequency of the transmit slice is within the Match Frequency Range (with the same antenna selected).

7.2.1 What is a successful match?

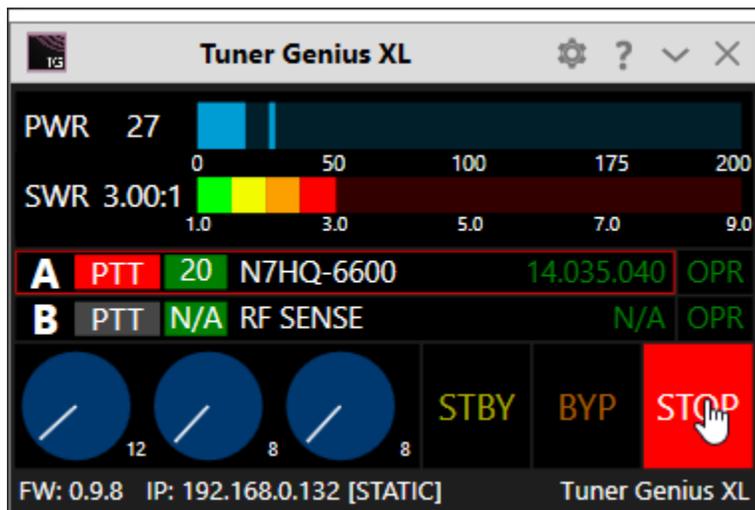
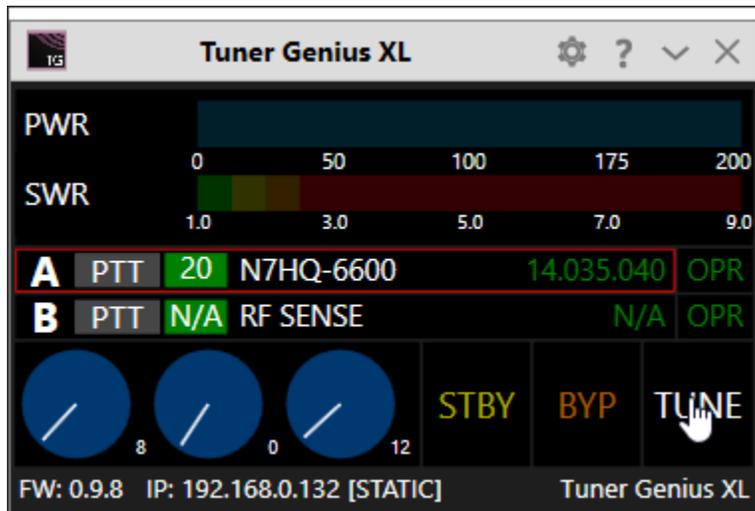
The Tuner Genius XL tries different combinations of capacitance and inductance values during automatic tuning until it finds a combination that yields an SWR less than (or closest to) the set maximum for the band. That value can be set in two ways:

- Press the center knob on the front panel, then adjust the value up and down. Finally, press the knob again to save the result.
- Adjust the minimal value in the Band Configurator screen. See section **8.3.5, Other Tab** for details.

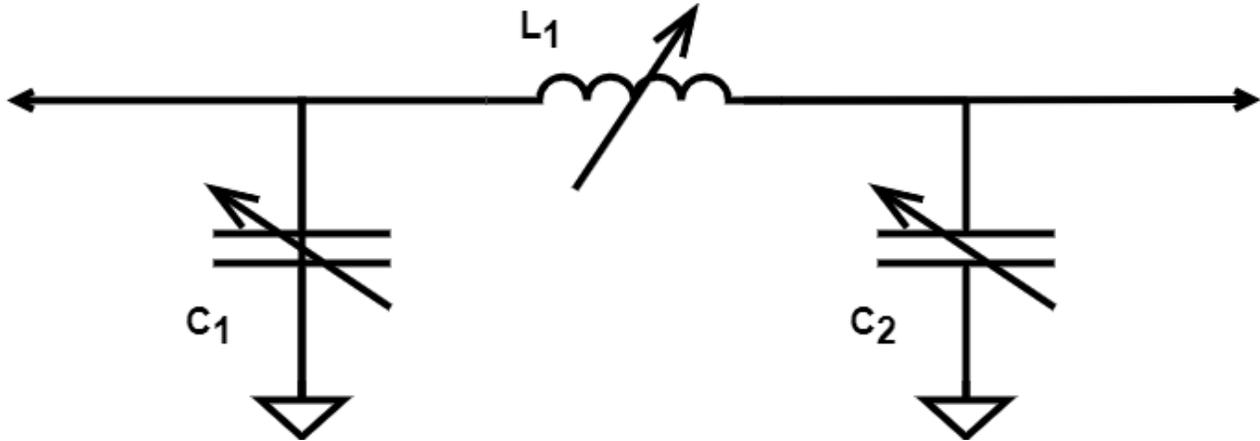
7.2.2 Tuning Errors

When the TGXL senses an antenna with a natural impedance greater than 10:1 for a given frequency, it will prevent the tune operation and display an error. When the natural impedance is less than 10:1, the TGXL will allow the tune operation; however, the exciter may be presented with impedances greater than 10:1 as the TGXL searches for a successful match.

7.2.3 Automatic Tuning



7.2.4 Manual Tuning



While the Tuner Genius XL's default mode of operation is to create tuning solutions automatically, manual tuning is possible. Three front panel controls allow manual tuning, accomplished by turning one of three knobs found along the bottom edge of the front panel. The first knob selects the first capacitor (C1) in the PI network, the second knob selects the inductor (L1), and the third knob selects the second capacitor (C2).

Procedure:

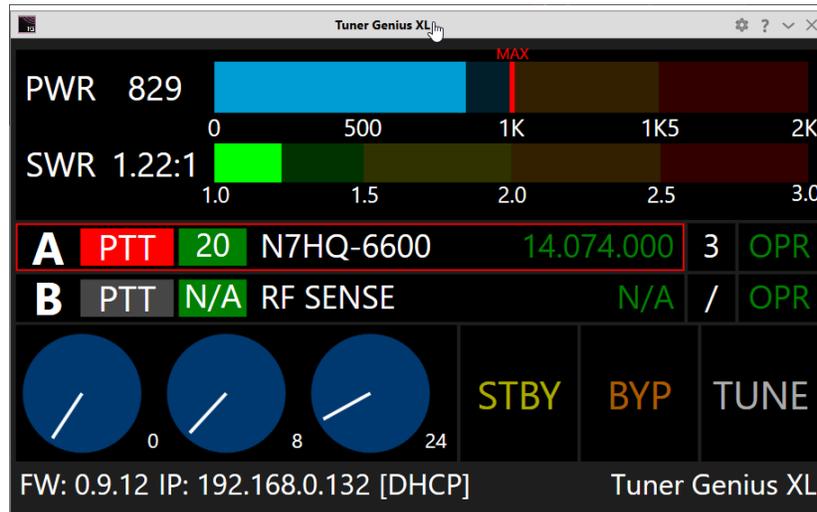
- Apply a tuning signal at the desired frequency.
- Observe the SWR value in the display.
- Press the leftmost knob to select manual tuning. The "Manual Tuning" message appears on the front panel display.
- Adjust the knob to select the first capacitance.
- Adjust the middle knob to select the inductance.
- Adjust the rightmost knob to select the final capacitance.
- Press the leftmost knob to save the result for later use.

In many cases, two or more values of the inductance may produce minimum SWR values. The general rule of thumb for this case is to select the smallest inductance (smallest "L value" on the display).

The **Tuner Genius XL Windows Utility** provides similar manual tuning controls. First, click on the leftmost "knob" in the display, and use the mouse wheel to adjust the value up and down. Continue with the second and third "knobs," then click on the first "knob" to save the tuning solution. See section **8.4.4, Manual Tuning Controls**, for more information.

7.3 Transmitting

When transmitting, the PTT indicator is illuminated, and the front panel display looks like the following:



The elements of the display are detailed in the following sections.

7.3.1 Power Meter (PWR)

The power meter indicates the transmitted peak and average power. It ranges from 0 to 2000 watts. In addition, a maximum power indicator is shown when demanded by the limits of the tuning solution.



i – Power measurements update approximately every 100ms and should be used for reference only. For a more accurate power reading, transmit a fixed amplitude and frequency signal for at least 1 second.

7.3.2 SWR meter



The SWR meter shows the Standing Wave Ratio (SWR) on the input port after the tuning solution. It represents the SWR “seen” by the transmitter or amplifier.

7.3.3 PTT, Band, and Frequency Data

A	PTT	17	N7HQ-6600	18.100.000	3	BYP
B	PTT	N/A	RF SENSE	N/A	/	OPR
1	2	3	4	5	6	

This section displays information about the current port status. A red outline around the port indicates the tuning solution that is currently applied.

1	Port
2	PTT Indicator: This label background is red when PTT is detected
3	Band Indicator: Displays the selected band
4	Frequency Source and Frequency: Displays the current frequency source and frequency. When no band data is present, this label displays RF SENSE, indicating the port will sense the RF frequency when the signal arrives.
5	Antenna Genius Antenna Port: Displays 1-8 or / of not present.
6	Bypass or Operate:

7.3.4 Additional Information

FW: 0.9.12 IP: 192.168.0.132 [DHCP] Tuner Genius XL

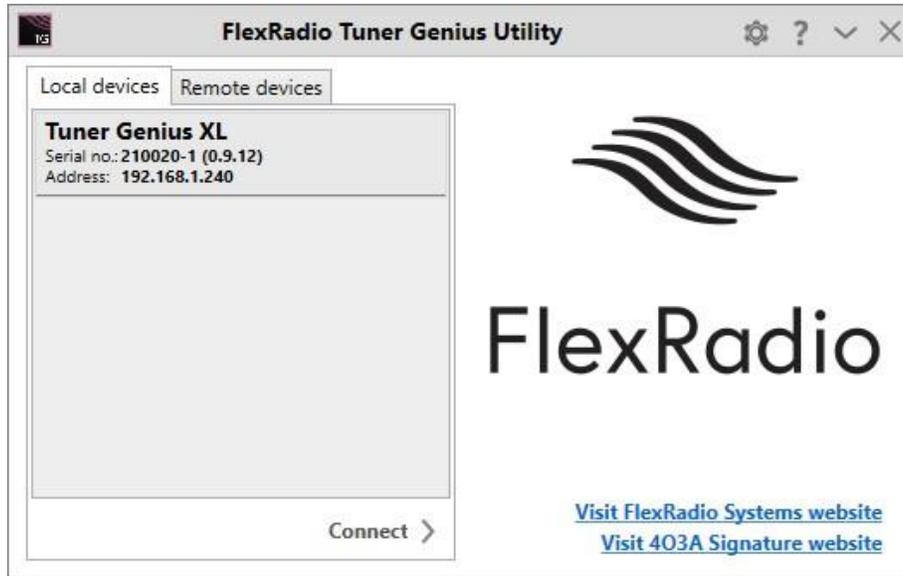
This section shows the tuner’s firmware version, IP address, [Address Mode], and device name.

8 The Tuner Genius XL Windows Utility

In addition to the tuner configuration tasks described in the previous sections, the *Tuner Genius XL Windows Utility* provides several other features.

8.1 Tuner Chooser Screen

The Chooser screen is the first screen that appears after starting the *Tuner Genius XL Windows Utility* program. The Local Devices tab shows a list of tuners available in your local area network (LAN). Click on a tuner to select it, then click the **Connect** button to display the tuner.



The **Remote Devices** tab shows a list of remote tuners that have been configured for use by the utility program. Click on a remote tuner to select it, then click the Connect button to display the tuner.

To add a remote tuner to the list, click on the + button. The screen shown below will appear. Next, fill in the name of the remote tuner, its IP address, and the authorization code assigned to the remote tuner. Finally, click Save to save the configuration for later use.

To use remote capability, you have to configure your router with a port mapping for port 9010 to your TGXL device. Additionally, you have to configure Auth. code for your TGXL required when connecting to TGXL outside your local network.

Device name:

IP Address:

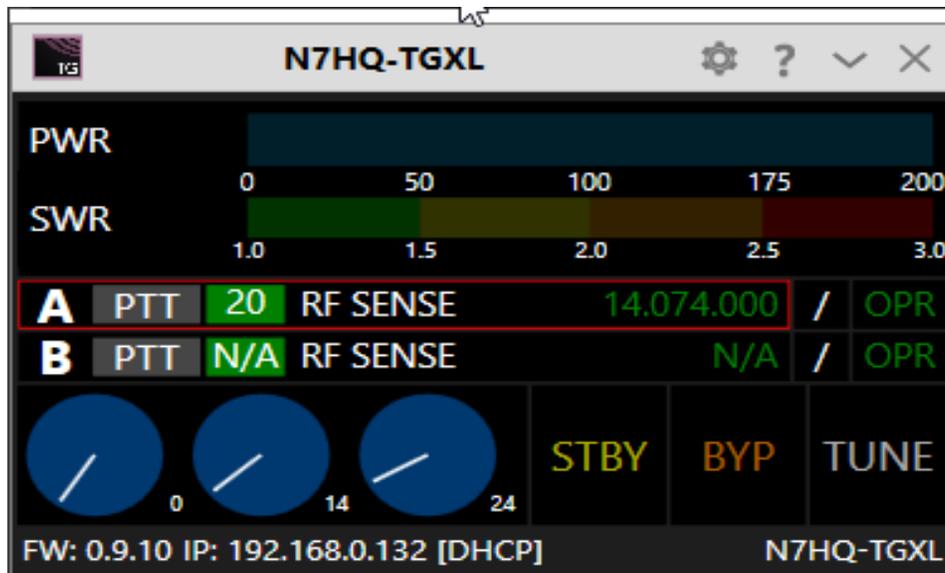
TCP Port:

Auth. code:

Save

8.2 Windows Utility Front Panel Display

The *Tuner Genius XL Windows Utility* provides an active remote version of the tuner's front panel display.



The screen's title bar includes a button that opens the configuration screens, a button that displays version information for the program, and buttons that minimize and close the display.

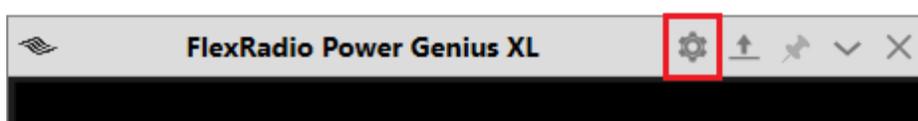
The red outline box indicates the tuning solution that is currently applied.

8.3 Tuner Configuration Dialog

Clicking the Configuration button (gear icon) at the top right of the *Tuner Genius XL Windows Utility* screen produces a menu of three selections:

1. Always on Top
2. Device settings
3. Upgrade firmware

Select Device settings to configure the tuner.



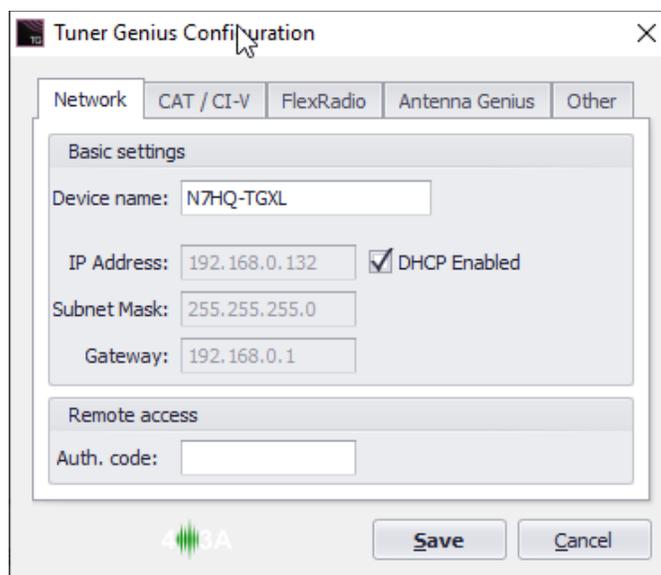
A window opens showing five configuration screens selected by tabs.

8.3.1 Network Tab

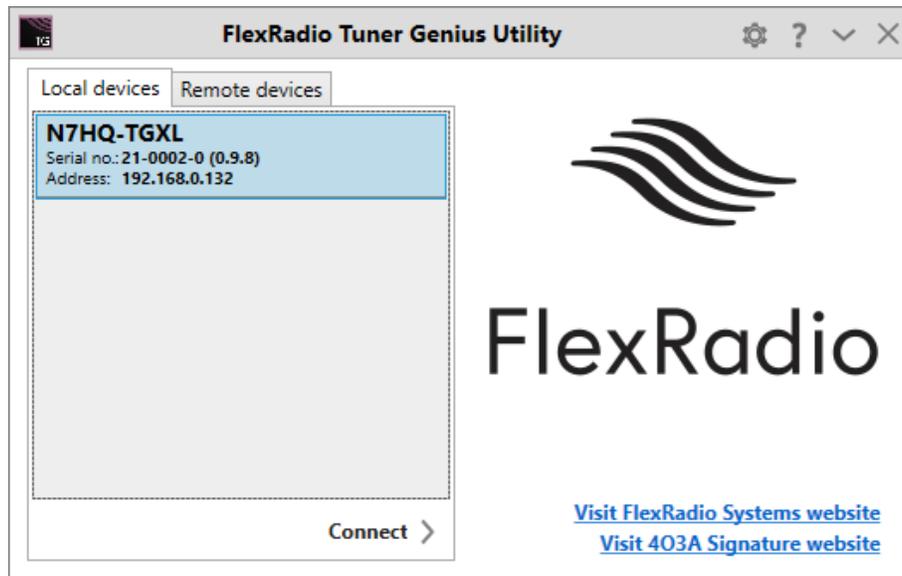
The **Network** tab is used to configure the device name and the tuner network interface.

8.3.1.1 Device Name

The **Tuner Genius XL Windows Utility** supports creating a custom “Device Name” for a tuner. This name is simply a short text string that is associated with a specific tuner. It can be set, changed, and cleared on the Network tab of the Configuration screen, as shown below:

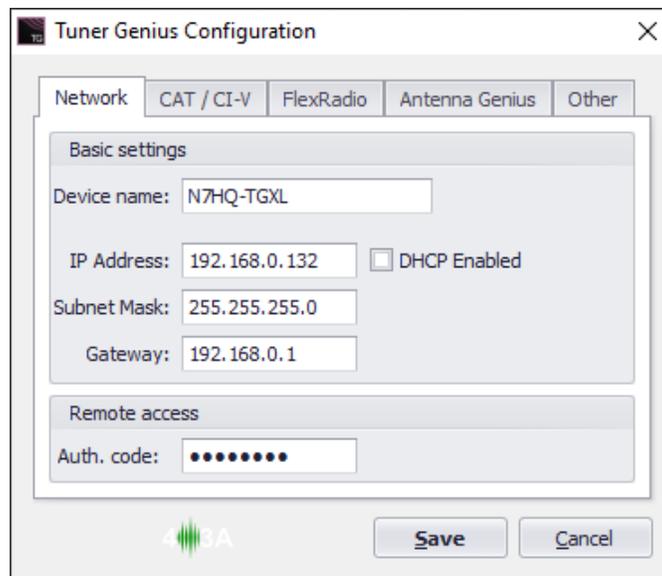


In this case, the user has set the nickname to N7HQ-TGXL. As a result, the nickname will appear in the utility program’s chooser, as shown below and in the title bar of the utility program’s main screen:



i – The default nickname is “Tuner Genius XL.”

8.3.1.2 Basic Settings



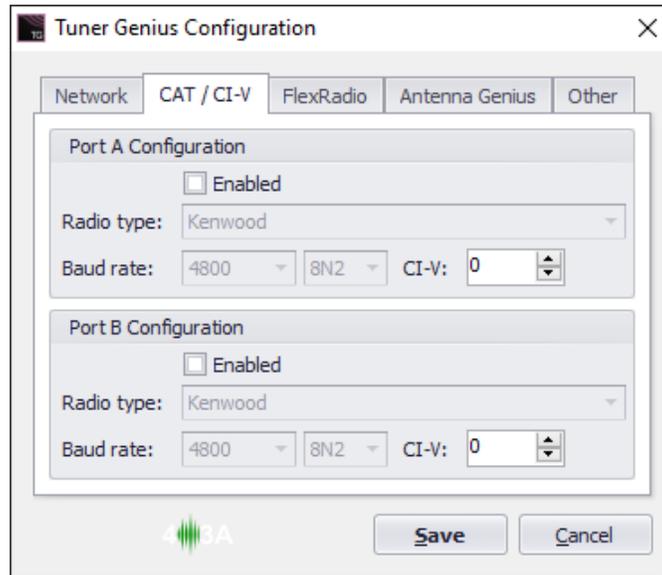
You can select between a DHCP-supplied IP Address or configure the tuner to use a static IP address. See section 6.2.3, **Network Tab: Configuring the Network** for details.

8.3.1.3 Remote access

The Tuner Genius XL can be controlled remotely with the *Tuner Genius XL Windows Utility* program by setting an authorization code in the field shown above. The value entered here is effectively a password that allows access to the program from a non-local area network such as the Internet. See section xxx for information about making a connection to a remote tuner.

8.3.2 CAT/CI-V Tab

Use the **CAT / CI-V** tab when a FLEX 6000 Series transceiver does not control the tuner. Choose the transceiver's make and model connected to each of the tuner ports and the details of the communication protocol between the radio and the tuner. A selection of radio makes and models are provided. Do not use this tab to configure FLEX-6000 Series transceivers. Click the **Save** button after the choices have been made.



8.3.3 FlexRadio Tab

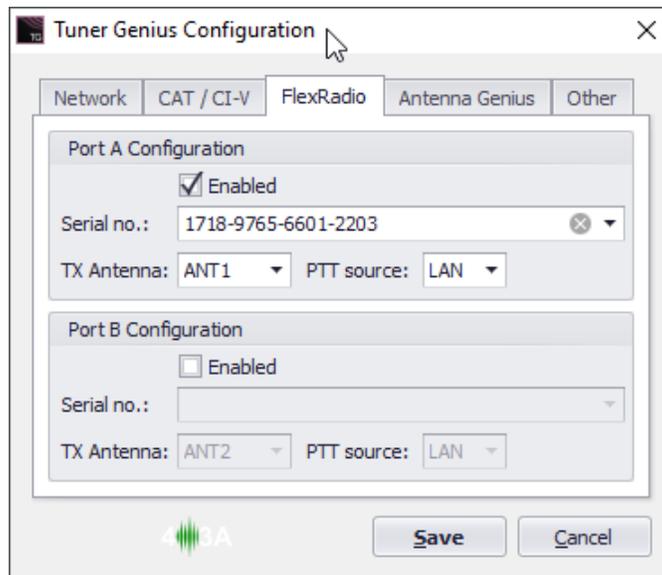


Figure 8-1 A FLEX-6600M configured for operations on Port A and ANT 1 on the Transceiver

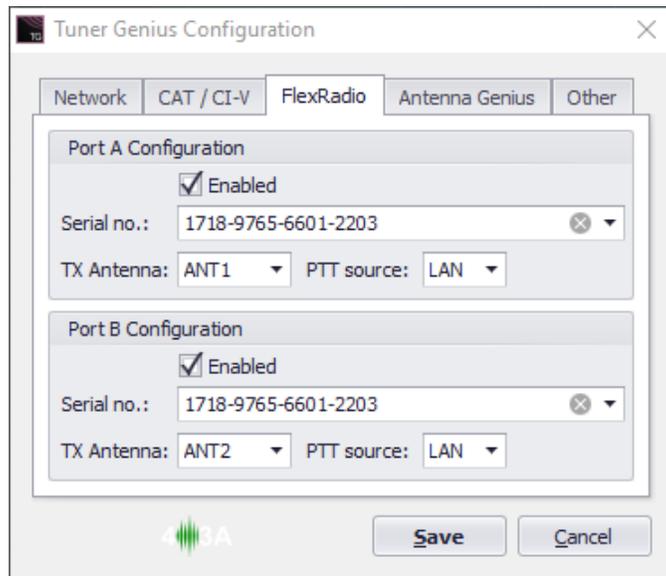


Figure 8-2 Shows a single FLEX-6600M configured for SO2R Operations.

Use the **FlexRadio** tab to configure the tuner to pair with FLEX-6000 Series transceivers.

Before beginning this configuration, make sure your FLEX-6000 Series transceivers are turned on and connected to the same Local Area Network that hosts the Tuner Genius XL. The **Tuner Genius XL Windows Utility** will discover the FLEX-6000 Series transceivers over the network.

You must select the serial number of the radio connected to each port. Leave the serial number field blank if you do not want that port paired with a FLEX-6000 Series transceiver.

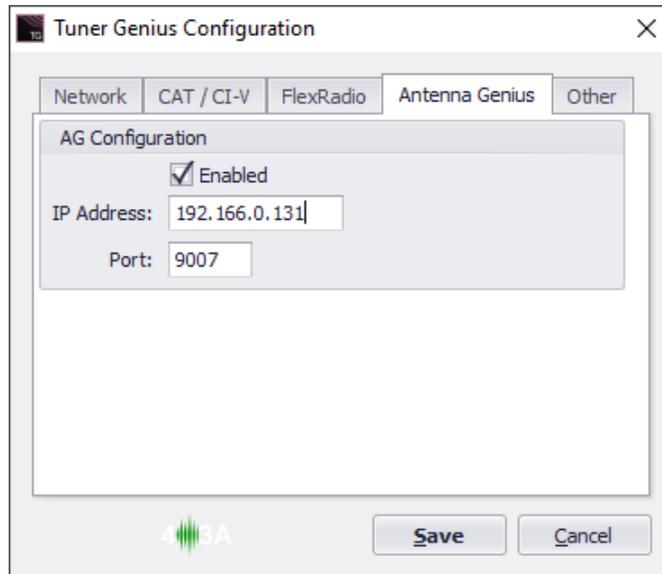
Select the antenna port from the FLEX radio (ANT1 or ANT2) connected to the tuner port (A or B).

Be sure to select LAN for the PTT source; using RCA as the PTT source for FLEX-6000 Series transceivers is not recommended.

Click the **Save** button to store the configuration after the choices have been made.

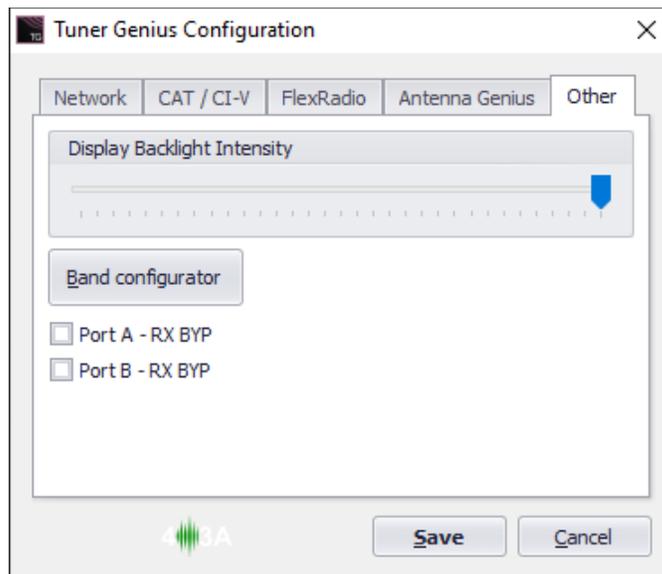
8.3.4 Antenna Genius Tab

The Antenna Genius tab allows the configuration of an Antenna Genius device downstream of the tuner. First, enter the IP address and Port that the Antenna Genius uses.



8.3.5 Other Tab

Use the **Other** tab to adjust the front panel backlight intensity, set the per-band bypass configuration, and the receive mode bypasses.



Display Backlight Intensity

This control sets the brightness of the front panel display. Click **Save** to make a change permanent.

Port A and B - RX BYP

Setting this receive-only mode will bypass the TGXL tuning solution when the exciter is in receive mode. This feature is useful when you have multi-band antennas and want to monitor other bands simultaneously using your FlexRadio.

Band Configurator (Button and Dialog)

The Band Configuration dialog allows the user to select ranges of frequencies that the tuner will selectively ignore and set the minimum SWR that will be considered a good match. For example, suppose an 80M antenna is resonant at 3750 kHz. In that case, frequencies near this value can be bypassed by selecting the Enable Bypass check box in the 80M row, then entering the range of the bypass in the Bypass Start and Bypass Stop columns. Note the use of KHz in these columns. The Port B tab is only valid for the SO2R switching model.

Band Name	Minimal SWR	Enable Bypass	Bypass Start (KHz)	Bypass Stop (KHz)
▶ 160m	1.25	<input type="checkbox"/>		
80m	1.25	<input type="checkbox"/>		
60m	1.25	<input type="checkbox"/>		
40m	1.25	<input type="checkbox"/>		
30m	1.25	<input type="checkbox"/>		
20m	1.25	<input type="checkbox"/>		
17m	1.25	<input type="checkbox"/>		
15m	1.25	<input type="checkbox"/>		
12m	1.25	<input type="checkbox"/>		
10m	1.25	<input type="checkbox"/>		
6m	1.25	<input type="checkbox"/>		

Minimal SWR

The Minimal SWR value is used as a target by the tuner solution algorithm. This feature gives the operator some control over the target SWR; however, it does not ensure the tuner will find an impedance match resulting in the desired SWR. The selected value may also give the operator some control over how long it takes for a solution to be found. For example, a lower value may take longer than a higher value for the tuner to find a match.

i – Note that setting the tuner to find the lowest possible value is enticing the performance gain of a

single decimal point less SWR may not provide much overall benefit.

RX Bypass

The **Enable Bypass** flags and Bypass Start/Stop frequencies set a “dead band” where the tuner does not engage when PTT is asserted. When these flags are not set or on frequencies outside of the segment described by Bypass Start and Bypass Sop, a tuning solution will always be applied.

8.4 User Interface Elements

8.4.1 STBY Button



The utility application provides a standby/bypass button. Clicking this button changes the tuner from Standby mode to Operate or Bypass mode and back.

8.4.2 BYP Button



The utility application provides a bypass/operate button. Clicking this button changes the tuner from Bypass mode to Operate mode and back.

8.4.3 TUNE Button



The utility application provides a **TUNE** button. A mouse click on this button starts a tuning cycle on the frequency currently shown on the display.

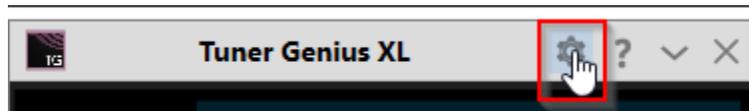
8.4.4 Manual Tuning Controls

The three circular “knobs” on the *Tuner Genius XL Windows Utility* display show the current tuning solution (C – L – C). These can be adjusted manually by clicking on the leftmost “knob” and adjusting the value with the mouse wheel. Then, click on the knob again to save the value. The middle and rightmost knobs can be adjusted in the same way. See section **7.2.4, Manual Tuning**, for more information.

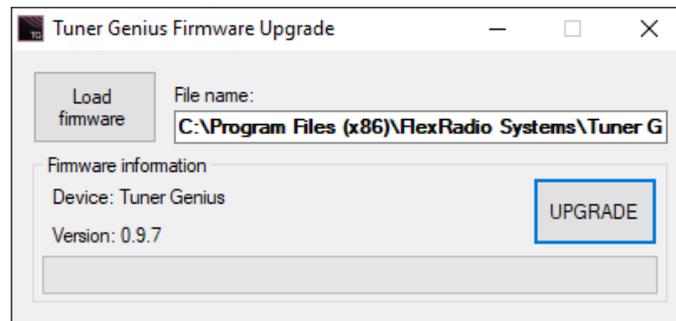
9 Remote Operation

10 Firmware Upgrade Procedure

The **Tuner Genius XL Windows Utility** can be used to upgrade the firmware in your Tuner Genius XL over the network. First, start the utility program and connect to the tuner.

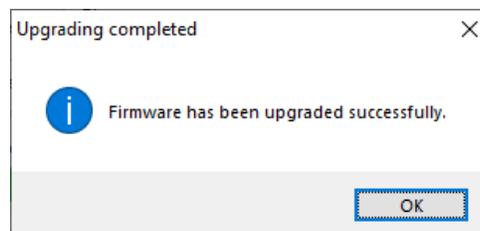


1. Click the configuration icon (gear) and select the **Firmware Upgrade** button. The Tuner Genius XL Firmware Upgrade dialog will appear:



Note that the program has filled in the path and filename to the firmware image associated with the Utility program.

2. Click the **UPGRADE** button to start the firmware upgrade process.
 - The TGXL microprocessor will enter the bootloader.
 - The firmware image will be transferred over the network to the tuner.
 - The tuner will reboot.



- When the firmware transfer is complete, a status dialog will be shown.
3. Click the **OK** button to close the notification dialog
 4. Close the Firmware Upgrade dialog by clicking the X in the top right corner.

During the reboot, the **Tuner Genius XL Windows Utility** screen may show that it is connecting. After the reboot is complete, the tuner will reconnect, enter Operate mode, and you may resume regular operation.

i – If the upgrade fails with a bootloader error on your first attempt, please press the Upgrade button again to complete the process.

11 Factory Reset the Tuner Genius XL

The configuration of the Tuner Genius XL can be reset to the “factory defaults” using the following procedure:

- Turn the tuner off using the power switch on the back panel.
- Press and hold the **BYPASS/OPERATE** front panel button.
- Turn the tuner ON
- Continue holding the **BYPASS/OPERATE** button until the “Config Reset” message appears on the front panel.
- Release the **BYPASS/OPERATE** button.
- Start the **Tuner Genius XL Windows Utility** and connect to the tuner.
- Set all configuration options as desired and then click SAVE. If you do not click SAVE, the new settings will not be retained, and you will have to rerun the reset procedure.

12 Alarms, Warnings, and Messages

If the tuner detects an operational error, a message is displayed on the main display and the Windows Utility, as shown below:

12.1 Alarms

The tuner bypasses when an alarm is raised to protect itself from damage, and the alarm is cleared when the PTT is released.

Alarm	Description
FREQUENCY OUT OF RANGE	Band data not detected. Check your band data settings/connections/sources.
WRONG BAND	
HIGH POWER	Drive power is too high to create a tuning solution
> 10:1 SWR	Antenna SWR is above the maximum that can be automatically tuned. However, you may achieve a match for SWR > 10:1 by using the manual tuning controls.

12.2 Warnings

The following are warnings.

Warning	Description
LOW DRIVE	

PTT UNKEY	Lorem ipsum
-----------	-------------

12.3 Messages

The following are messages.

Message	Description
-MANUAL TUNING	
TUNING SAVED	
MEMORY CLEARED	
CONFIG RESET	

13 Specifications

- Tuning: Fully automatic and manual tuning
- Frequency Range: 1.8 to 30 MHz continuous plus coverage of 6 meters
- Radio Interface: LAN, CAT RS-232, CI-V, BCD, Pin-to-Band (PTB), frequency sense.
- Alarms and Warnings: Low drive, Freq Out of Range, Wrong Band, High power, >10:1 SWR
- Matching Range: Up to 10:1 SWR.
- Tuning Time: Tuning solutions (2 to 12 seconds)
- Stored memory switching: < 20ms.
- Tuning Power Requirement: 10W - 200W
- RF Power 2000W maximum
- Exciter Inputs 2 – SO-239
- Antenna Outputs 2 – SO-239
- Antenna Impedance 50 ohms unbalanced
- Cooling Thermostatically Controlled Fans

Mechanical Specifications

- Dimensions 11.8" W x 13.8" D x 5.9" H (30cm W x 35cm D x 15cm H)
- Weight 15.4 pounds, 7 kg
- Operating Temperature -4°F (-20°C) to +122°F (+50°C)

Electrical Specifications

- Supply Voltage and Current 12 - 16V DC @2A

14 FCC Statement

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference, and
- this device must accept any interference received, including interference that may cause undesired operation

FCC ID: 2AK7NSKYTuner Genius XL001

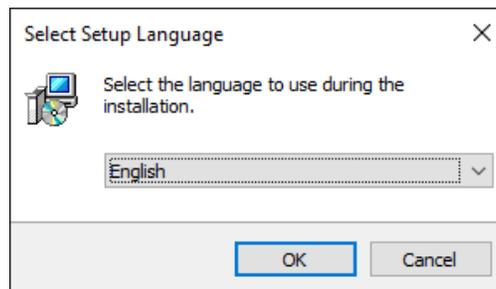
15 Appendix

15.1 Installing the Tuner Genius XL Windows Utility

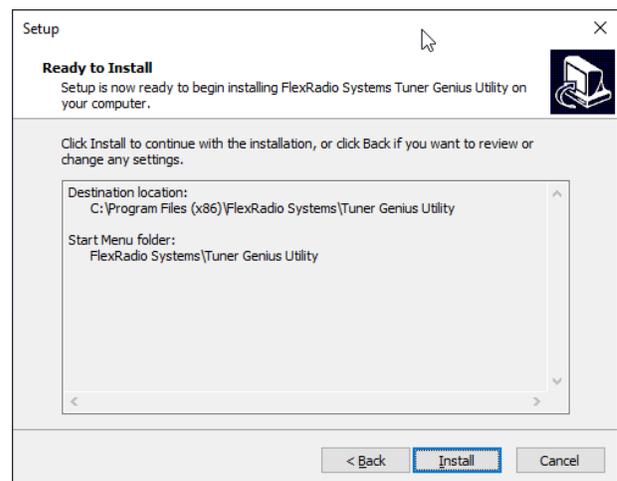
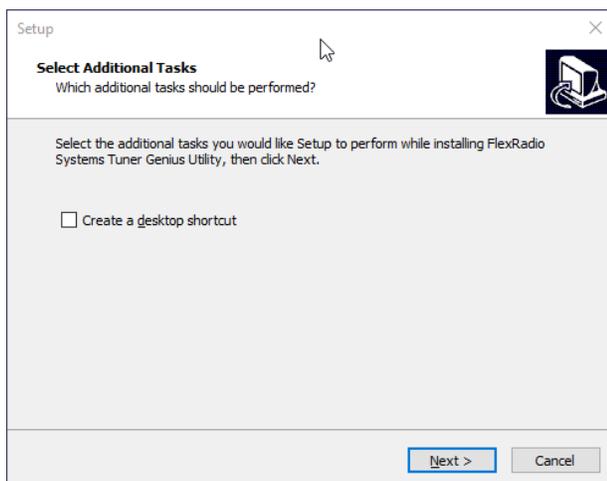
The **Tuner Genius XL Windows Utility** program is an integral part of the tuner system. The utility is used to configure the tuner, upgrade the tuner's firmware, and operate it remotely.

Download the installer from the FlexRadio website and install the program on a Windows PC located on the same local area network (LAN) as the tuner.

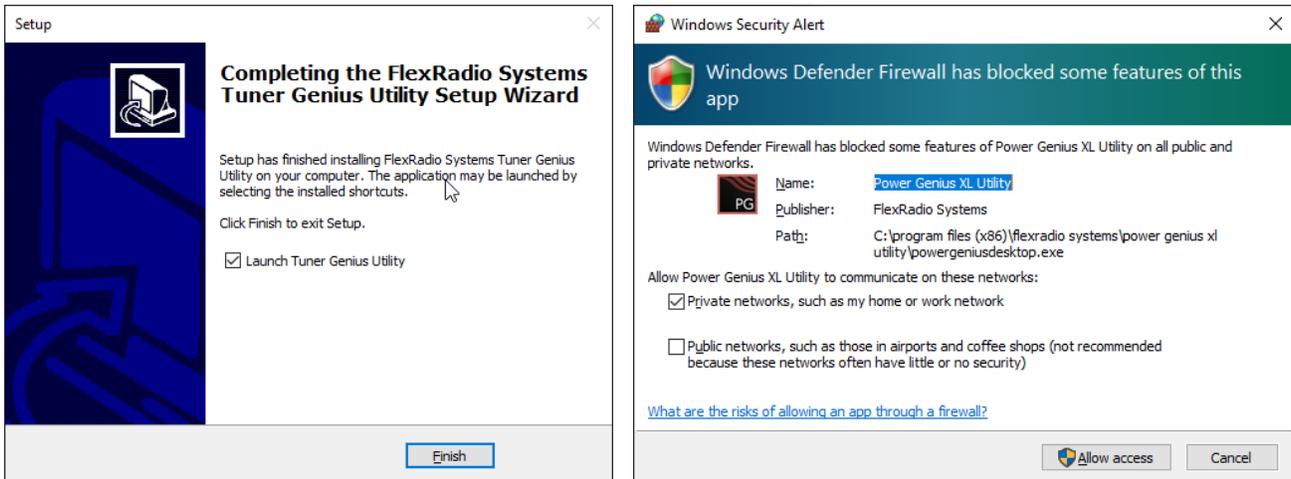
The installer can be found in the software section of the FlexRadio website:
<https://www.flexradio.com/category/tuner-genius-xl/>



You will be presented with a dialog where you select the desired language then press **OK**.



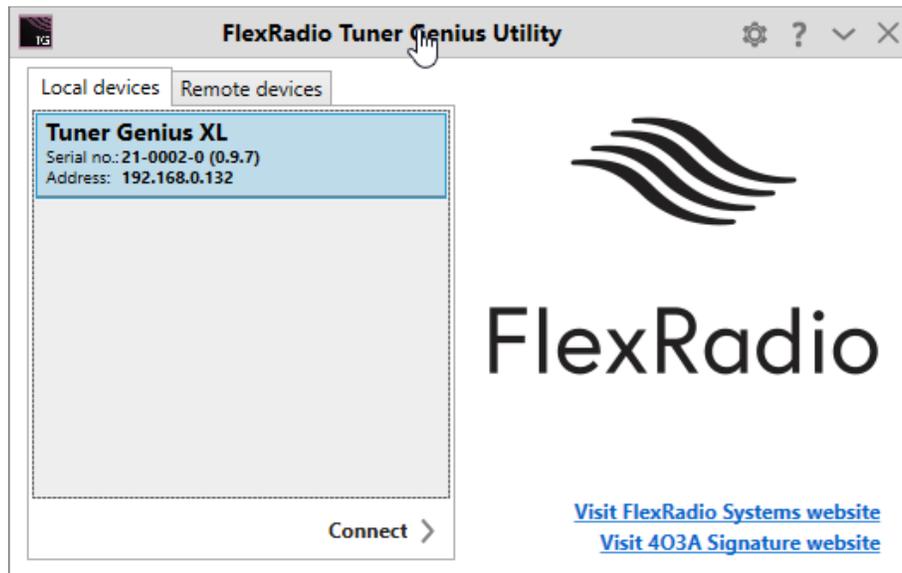
Decide if you want a desktop shortcut created, then press **Next >**. Finally, when ready, press **Install**.



When the installer completes, you will see a choice to run the Tuner Genius XL utility. Ensure that box is checked and click **Finish**.

When the utility runs the first time, Windows Firewall may query you for permission to open a port in your PC's firewall needed by the utility program to communicate with the tuner. You can choose to allow the application to function on Private Networks, Public Networks, or both network types. Click **Allow access** to complete the installation.

i – Windows Updates have, in the past, changed the network type from Private to Public without warning. Therefore, if your PC is not a laptop you travel with, a best practice is to select both network types, to prevent problems if a Windows update alters your network type.



When the utility finishes loading, it will detect any Tuner Genius XL tuners powered up and active on your LAN and display them in a list.

15.2 Power Derating Table

The tuner will scale the maximum allowed power input based on the following schedule:

Band	Natural VSWR on Antenna Port			
	1:1 - 3:1	3:1 - 5:1	5:1 - 8:1	8:1 - 10:1
160/80/60/40/30	2000W		1500W	
20/17/15/12	2000W	1750W	1500W	
10	2000W	1750W	1500W	1000W
6	1500W	1250W	1000W	High SWR

15.3 Connection Information and Pin Out Diagrams

15.3.1 Power Connector

2.1mm x 5.5mm polarized connector. DC voltage from 12 – 25vdc.

15.3.2 Ground Connection

This thumbscrew is for attaching an earth ground to the chassis of the tuner. Grounding is the most critical safety enhancement you can make to your shack. Always ground the tuner to your station RF ground using high-quality wiring, making the length as short as possible. Braided wire is considered the best for ground applications. Your station ground should be a common point where all grounds come together. You will likely be using a PC and a DC power source, so be sure to ground these devices together as well.

15.3.3 Push to Talk (PTT)

15.3.3.1 PTT IN

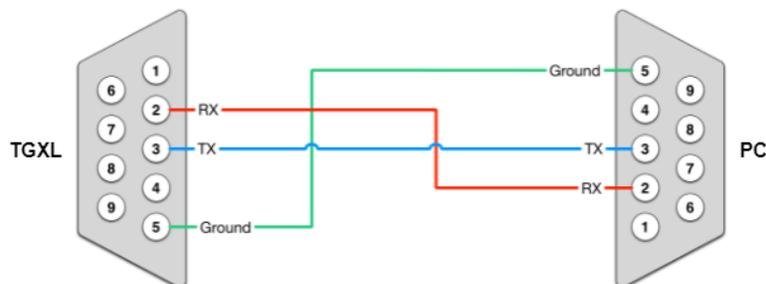
This RCA connector is provided for an external Push-To-Talk signal. Ground the center pin to engage PTT. (Note: 3.3VDC Max. Input.)

15.3.3.2 PTT OUT

This RCA connector is provided to supply a Push-To-Talk signal to other devices. The center pin is grounded when PTT is asserted. Note that the Tuner Genius XL provides this signal after making any adjustments to the tuning solution when it receives PTT. This signal can therefore be used to synchronize RF generation so that the RF signal is never generated before the tuner is ready to receive it.

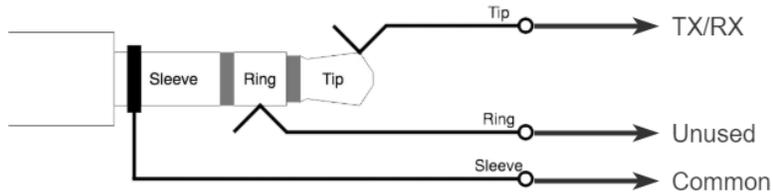
15.3.4 RS-232 Serial Connector Pinout

RS-232 stands for Recommended Standard number 232. RS-232, as an interface, has been a standard for many years and is typically employed to connect a peripheral to a computer. The standard specifies a maximum open-circuit voltage of 25 volts: signal levels of ± 5 V, ± 10 V, ± 12 V, and ± 15 V are all commonly seen depending on the voltages available to the line driver circuit. For the TGXL, the RS-232 voltage is +12 and -12vdc and uses pins 2,3, and 5. Please consult the diagram below for details.



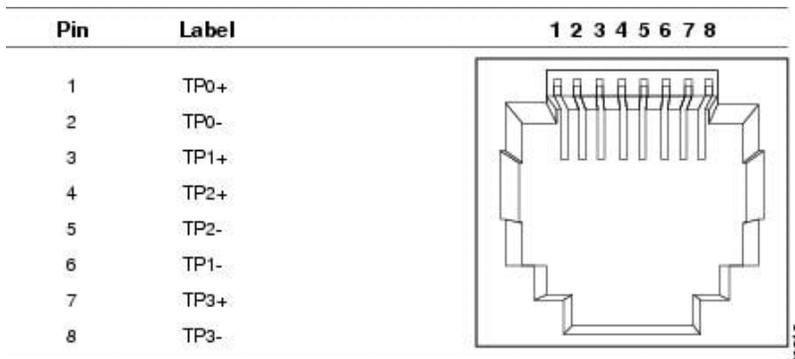
15.3.5 CI-V Connector

CI-V stands for Computer Interface 5 [Roman numeral V] and is ICOM’s designation for their digital radio control interface to a computer, peripherals, or another radio. You find it on most Icom HF and some VHF transceivers. CI-V is a simple 10-bit, negative-logic, TTL-level serial interface that allows more than one device daisy-chained or on a bus. Each device is required to have a unique CI-V address. The TGXL uses two CI-V signal lines (data [tip] and ground [sleeve]); it does not implement the PTT (RTS) line on the [ring]



15.3.6 LAN (Ethernet) Connector

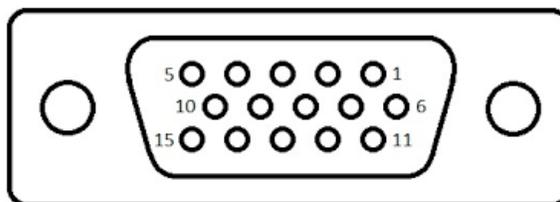
This RJ45 jack is the Ethernet network connection for the radio. It is an auto-sensing 10/100 megabit Ethernet port. It auto-senses polarity as well, so if you are using a direct connection to your PC, you do not need a crossover cable. Please refer to the network configuration options.



15.3.7 PTB/BCD Connector Pinout

PTB input – When a 5 to 15-volt DC signal is applied to one of the pins described in the following table, the tuner will select the corresponding band. The pins are optoisolated. Pin 15 is the signal ground.

Pin	Band	Frequency
1	160m	1.8 – 2.0 MHz
2	80m	3.5 – 4.0 MHz
3	40m	7.0 – 7.3 MHz
4	30m	10.10 – 10.15 MHz
5	20m	14.00 – 14.35 MHz
6	17m	18.068 – 18.168 MHz
7	15m	21.00 – 21.45 MHz
8	12m	24.89 – 24.99 MHz
9	10m	28.0 – 29.7 MHz
10	6m	50.0 – 54.0 MHz
15		Signal Ground



i – The 60-meter band cannot be selected with this method.

BCD input – A 4-bit BCD signal (5 to 15-volt DC) selects a band. The pins are optoisolated. Pin 15 is the signal ground.

The BCD inputs are designed for connection directly to a band decoder output provided by radios such as Yaesu and Elecraft.

Band	160m	80m	40m	30m	20m	17m	15m	12m	10m	6m	None
Frequency (MHz)	1.8	3.5	7	10	14	18	21	24	28	50	NA
Pin 11	H	L	H	L	H	L	H	L	H	L	L
Pin 12	L	H	H	L	L	H	H	L	L	H	L
Pin 13	L	L	L	H	H	H	H	L	L	L	L
Pin 14	L	L	L	L	L	L	L	H	H	H	L
Hex Value	1	2	3	4	5	6	7	8	9	A	0

i – The 60-meter band cannot be selected with this method.

15.4 Firmware Recovery Procedure

The following is the procedure for recovering a TGXL from a firmware load or other failure.

1. On the PC or laptop with the TGXL Windows Utility, make a note of the current setting values and change its IP address to 192.168.1.20 with a Network Mask of 255.255.255.0
2. Connect an Ethernet cable directly from the TGXL to your PC or Laptop
3. Make sure the TGXL is OFF
4. Short the PTT IN A RCA jack (*note: use a common RCA cable for this and use a clip lead to short the center conductor to the shield, do not stick a screwdriver or other tool into the RCA jack on the TGXL*)
5. Hold the OPERATE/BYPASS button on the front of the TGXL down
6. Turn ON the TGXL
7. Release the OPERATE/BYPASS button
8. The TGXL will show a bootloader version and IP address (192.168.1.250) on the front panel.
9. Start the TGXL Windows Utility, do not connect to your TGXL.
10. Click the gear Icon on the title bar of the TGXL Windows Utility
11. Select Upgrade Firmware
12. The Utility should now open another window and will allow you to upgrade the firmware
13. Once the firmware update has been completed, close the update windows.
14. Turn OFF the TGXL
15. Remove the shorting cable or plug from the PTT IN A RCA jack.
16. Reconnect your network cables to their normal configuration
17. Change your PC or laptop's IP address back to its original setting, and reboot the PC/Laptop if necessary
18. Turn ON the TGXL, it should start normally.
19. Start the TGXL Windows Utility, you should see the TGXL listed (or it may autoconnect).