FlexRadio Systems®
Software Defined Radios

# *FLEX-6000 SIGNATURE SERIES*

## MAESTRO USER GUIDE

Version *1.9.9*

*9/21/2016*

# VERSION HISTORY

| Version # | Implemented By | Revision Date | Approved By | Approval Date | Reason |
|---|---|---|---|---|---|
| 1.7 | David Fisher | 5/2/16 | | | Original Draft |
| 1.7.1 | Stephen Hicks | 5/3/16 | | | Add add'l info on batteries, front and rear panel details |
| 1.7.2 | Tim Ellison | 5/4/16 | | | Final updates before release. |
| 1.8.3 | David Fisher | 6/30/16 | | | Updated with new features and some error corrections. |
| 1.8.4 | David Fisher | 7/19/16 | | | Updated with error corrections. |
| 1.9.7 | David Fisher | 9/13/2016 | | | Updated with new features for Maestro version 1.9.7 |
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# 1 HOW TO REQUEST TECHNICAL SUPPORT AND ASSISTANCE

If you encounter any issues installing or operating your Maestro with a FlexRadio Systems Signature Series software defined radio, please use our on-line Community (https://community.flexradio.com/) to find information about Maestro and the FLEX-6000 radios. If you need assistance using the Community, please refer to the community topic "How to use the FlexRadio Systems Support Community".

If you are unable to find an existing answer to your issue on the Community, please contact FlexRadio Systems technical support by opening a HelpDesk support ticket on-line at https://helpdesk.flexradio.com/

For details on how to submit a HelpDesk support ticket, please refer to the following URL: https://helpdesk.flexradio.com/hc/en-us/articles/202118688-How-to-Submit-a-Request-for-Technical-Support.

Hours of Operation: Our Technical Support engineers are available Monday-Friday from 9:00am-5:30pm Central Time. If you contact Support after business hours, on a holiday or weekend, we will respond to your request for assistance during regular business hours in the order the tickets were received.

# 2 KEY CONTACTS

**FlexRadio Systems - U.S.A**
4616 W. Howard Lane, Suite 1-150
Austin, TX 78728
U.S.A.
Phone: 512-535-4713
Fax: 512-233-5143
Email: sales@flexradio.com
HelpDesk: https://helpdesk.flexradio.com
User Support: https://community.flexradio.com

**Outside of the USA**

Please contact your local distributor. See www.flexradio.com/distributors .

***www.flexradio.com***

# 3 GETTING TO KNOW YOUR MAESTRO

Maestro is a self-contained hardware and software system designed to operate FLEX-6000 Signature Series radios. It can operate in a fixed mode connected to external power, or in a portable mode using internal battery power. In either mode, the network connection can be wired Ethernet or a Wi-Fi connection. Please refer to the following images to identify components and controls of your Maestro:

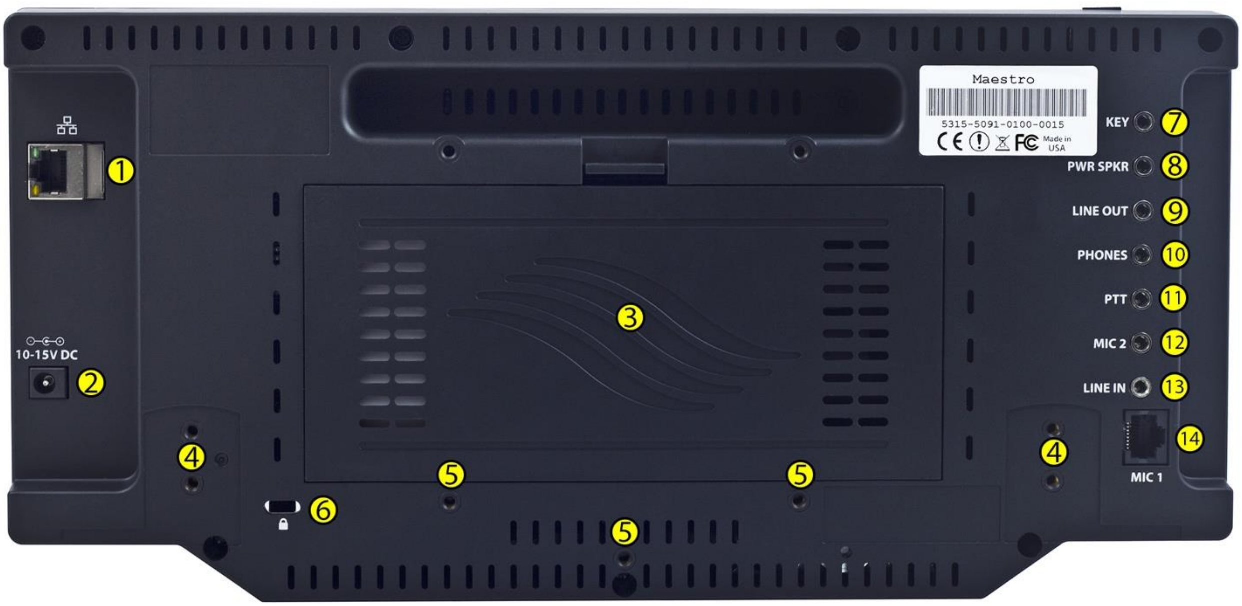

The components of the Maestro Front Panel are:

1. Eight-inch multi-touch sensitive full color high resolution display
2. Power On/Off button
3. Transceiver controls
4. Speaker


The components of the Transceiver Controls are:

1. Slice Receiver A multi-function control for audio level, AGC Threshold, Squelch and Solo audio operation
2. Slice Receiver A multi-function control for receiver filter width and position
3. Slice Receiver B multi-function control for audio level, AGC Threshold, Squelch and Solo audio operation

4. Slice Receiver B multi-function control for receiver filter width and position
5. Manual transmit (**MOX**) button
6. Manual tune (**TUNE**) button
7. Automatic Tuning Unit (**ATU**) button
8. Microphone level, key speed, transmitter power and **TX Menu** multi-function control
9. Programmable function buttons, 1 – 6
10. Slice Receiver A enable button
11. Slice Receiver A transmitter enable button
12. A > B button
13. Slice Receiver B enable button
14. Slice Receiver B transmitter enable button
15. Slice Receiver A RIT/XIT indicator
16. Slice Receiver B RIT/XIT indicator
17. Slice Receiver A tuning knob, menu / clear control
18. Slice Receiver B tuning knob, menu / clear control
19. Slice Receiver A and B step control buttons
20. Slice Receiver A and B tuning lock buttons




The components of the Maestro back panel are:

1. Wired Ethernet port
2. External power port
3. Battery compartment
4. Tilt leg mounting points
5. Fixed leg mounting points
6. Physical security point
7. Morse key socket
8. Powered speakers socket
9. Line Out socket
10. Headphones socket
11. Push-To-Talk socket
12. Microphone 2 socket

13. Line In socket
14. Microphone 1 socket

# 4 SETTING UP YOUR MAESTRO

To operate your Signature Series Flex 6000 transceiver with your Maestro, you must provide power, an Ethernet connection and an input device to the Maestro. Other equipment such as speakers, headphones, line level signals and push-to-talk switches are optional.

## 4.1 POWER

Maestro requires a supply of 10 to 15 volt DC external power such as supplied by the wall power adapter that is provided with the Maestro, or a supply such as is required to run the FLEX-6000 radio. Additionally, Maestro may be powered by a user supplied 5-volt battery placed in the battery compartment on the back of the Maestro.

## 4.2 NETWORK CONNECTION

Maestro requires a network connection to your FLEX-6000 radio. This connection can take one of two forms:

- A wired connection using the RJ-45 Ethernet port on the back of the Maestro. This connection can take two forms
  - A direct connection with a single wire, one end plugged into the Maestro, the other end plugged into the FLEX-6000 transceiver. In this configuration, the Maestro and the radio set up a two node ad hoc network and communicate across it.
  - An indirect connection through a Local Area Network switch. Many configurations are possible, but typically the Maestro is connected to a 100/1000 BaseT port on the switch, and the FLEX-6000 transceiver is connected to a similar port. A third agent, such as an ISP supplied router-modem provides IP addresses to the network components via a DHCP service.
- A Wi-Fi (wireless) connection using the built-in wireless adapter. On start-up, Maestro will attempt to make a Wi-Fi connection using information from earlier sessions, or if no recognized network is available, Maestro will present the *Choose a Wi-Fi Network* screen showing available networks. Select a network by tapping its name, then tapping the *Connect* button. You may be required to enter a password to access the network.

The next section of this document, section **5**, **Connecting to a Radio,** describes the process of selecting a radio and connecting to it.

## 4.3 INPUT DEVICE

A microphone or key is required to operate the transmitter in your FLEX-6000 transceiver. A straight key or paddles can be plugged into the Key port on the back panel of the Maestro. A microphone can be plugged into either the **MIC 1** RJ-45 port or the **MIC 2** 1/8$^{th}$ inch TRS port.

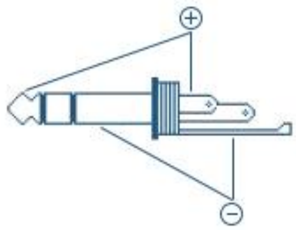
## 4.4 MAKING THE BACK PANEL CONNECTIONS

The following sections describe, in detail, the connections that can be made on the back panel of the Maestro.

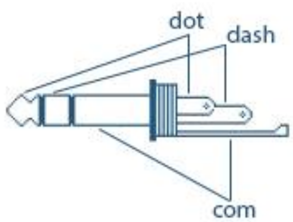
### 4.4.1 Straight Key or Paddles (KEY)

For CW operation, the ⅛ inch (3.5mm) TRS **KEY** connector accepts a TRS plug for operating a keyer with paddles or a TRS/TS plug for a straight key.

When Connecting a CW straight key.

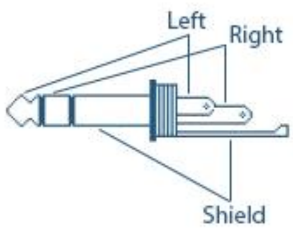


When connecting a CW paddle and using the internal electronic keyer.



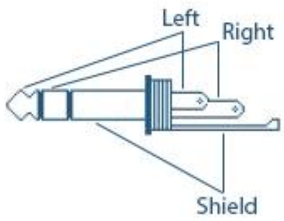

### 4.4.2 Powered Speaker (PWR SPKR) Connector

The **PWR SPKR** connector accepts a 1/8 inch (3.5mm) stereo (TRS) plug and provides stereo line level output for amplified PC speakers. **CAUTION: Do not use a mono (TS) plug as this will short-circuit the right channel signal to ground.**



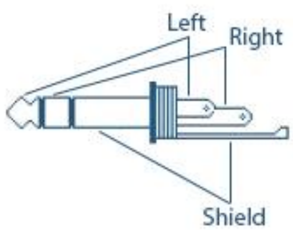
### 4.4.3 Line Out Connector

The **LINE OUT** connector accepts a 1/8 inch (3.5mm) stereo (TRS) plug and provides stereo consumer (-10 dBV) line level output. **CAUTION: Do not use a mono (TS) plug as this will short-circuit the right channel to ground.**



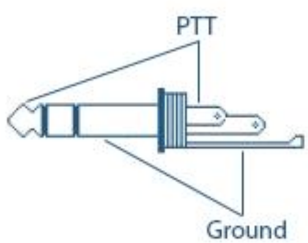

### 4.4.4 Phones Connector

The **PHONES** connector accepts headphones with a standard 1/8 inch (3.5mm) stereo (TRS) plug. Recommended ratings for headphones are 25mW into 16 ohm load or 13mW into a 32 ohm load. **CAUTION: Do not use a mono (TS) plug as this will short-circuit the right channel signal to ground.**



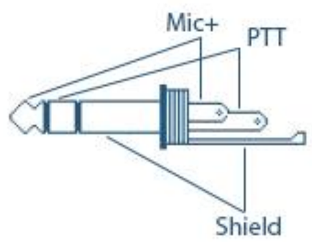

### 4.4.5 PTT Connector

The **PTT** connector accepts a 1/8 inch (3.5mm) stereo (TRS) plug or mono (TS) plug. Grounding the PTT line through an external switch keys the transmitter.



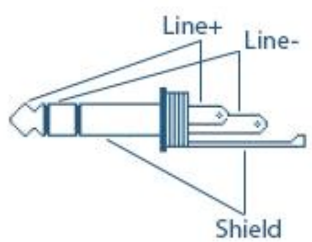
### 4.4.6 Mic 2 Connector

The **MIC 2** connector accepts a 1/8 inch (3.5mm) stereo (TRS) plug and provides an unbalanced microphone input with optional push to talk input. The connector may be used with dynamic or electret microphone elements. A software enabled 2.5V bias voltage may be applied to the Mic (+) line for electret microphones. See section **25.8**, **Phone/CW Tab** for the details. **CAUTION: Failure to enable bias on some consumer electret microphones may cause the PTT line to be asserted and key the transmitter.**



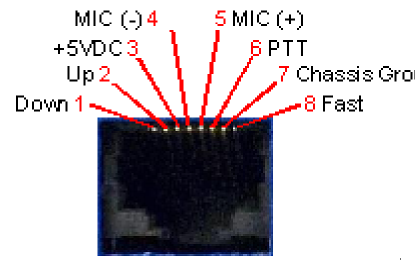

### 4.4.7 Line In Connector

The **LINE IN** connector accepts a 1/8 inch (3.5mm) stereo (TRS) plug and provides a pseudo differential line level input to the transmitter.



### 4.4.8 Mic 1 Connector

The 8-pin RJ-45 **MIC 1** connector offers the ability to connect a microphone and to key the radio via a PTT line. The RJ-45 pin-out is shown below. To engage PTT, pin 6 must be grounded to pin 7 (Shield Ground) and not to pin 4, which is the microphone ground.

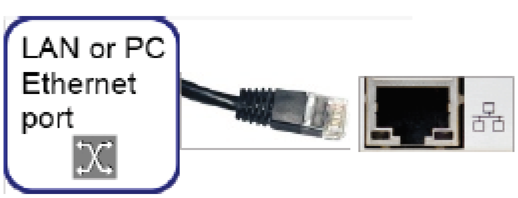
| Pin # | Signal | Diagram |
|---|---|---|
| 1 | Frequency Down (Ground) |   |
| 2 | Frequency Up (Ground) | |
| 3 | +5 VDC (470 Ohm | |
| 4 | Microphone Ground | |
| 5 | Microphone Input | |
| 6 | PTT Input | |
| 7 | Chassis Ground for | |
| 8 | Fast Step Tuning | |

To prevent ground loops and RF ingress into the microphone circuit, the MIC (-) wire should be connected to pin-4 only and NOT be connected to the pin-7 chassis ground. The microphone circuit is wired as pseudo-differential and can thus be used with balanced or unbalanced microphones so long as the MIC (-) wire connects only to pin-4. Bias for electret microphones may be derived from the +5 VDC output on pin-3.

Although Maestro will work well with many types of microphones, it is wired for the convenient use of microphones such as the FlexRadio FMH-1-RJ45. The FHM-1-8P hand microphone supplied with the FLEX-6000 Series Radios uses an 8-pin Foster connector. This microphone may be adapted to Maestro with either the ACC-ADM817 RJ45 to 8-pin Male Foster Adapter cable or the ACC-CLV-310 RJ45 to RJ45 coiled cable replacement.

### 4.4.9 Ethernet Connector

To use wired Ethernet communications, connect the included CAT5 Ethernet cable from the RJ-45 connector marked with the network symbol as shown below. The connector is located above the 10-15 VDC power connector on the left side of the Maestro back panel. Be careful not to plug the Ethernet cable into the **MIC 1** connector located on the rear right side of the back panel.

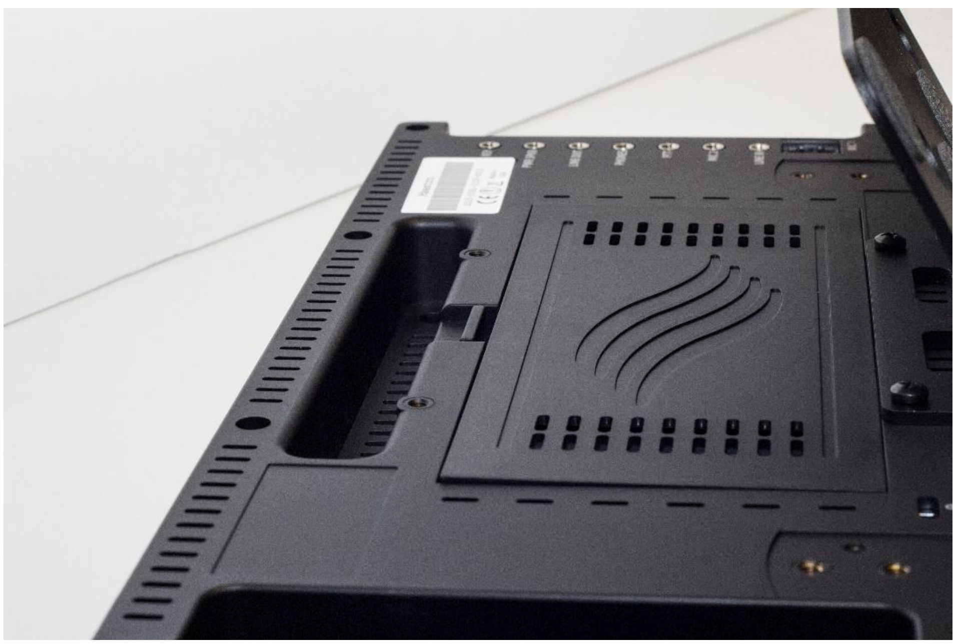


### 4.4.10 10-15 VDC Coaxial Power Connector

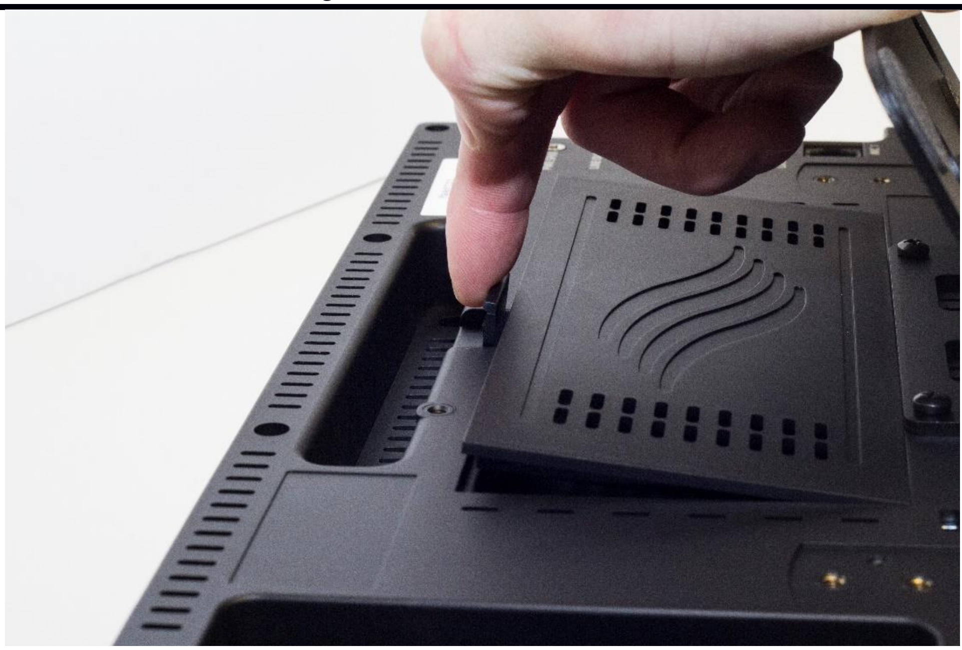
The power connector accepts a 2.1mm coaxial power plug to provide 10-15 VDC at 25W. Maestro is supplied with an AC/DC power supply with a 12V output. Also included is a DC power cable with 2.1mm plug and pigtails on respective ends. This cable may be used to connect to the station power supply bus.


### 4.4.11 USB Power Bank Connections

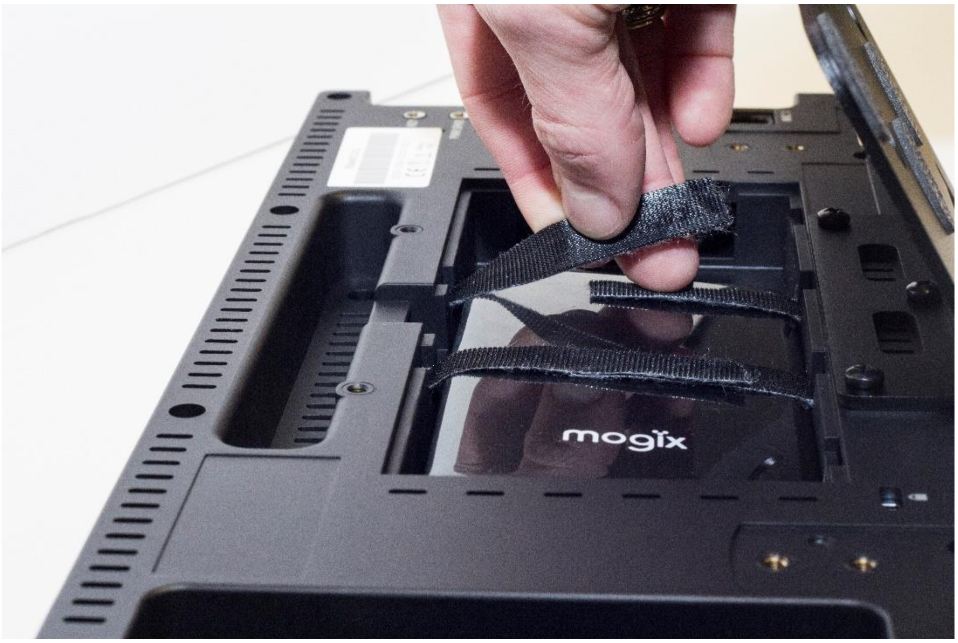
Maestro may be powered by a user supplied 5-volt battery placed in the battery compartment on the back of the Maestro. This section details the installation steps:



The door to the battery compartment is located in the middle of the back panel of the Maestro.



Depress the latch and open the battery compartment.  Remove the door.




Insert a battery of suitable size.  Secure the battery using the self-adhesive straps.  The battery must supply 5 volts DC and should be capable of supplying a minimum of 2.0 amps through a USB type A connector.

Make the battery power connection with the USB Type A plug to the battery drain connector.


Close the battery door and press the latch until it engages. Make sure the battery and the connected battery power cable fit completely inside the compartment and do not interfere with the door as it is closed.

### 4.4.12 USB Power Bank Selection

Supplemental batteries used for charging cellular phones and other electronics are plentiful and relatively inexpensive. The capacity and functionality of these batteries varies across manufacturers and models. FlexRadio has found that it is not uncommon for the advertised capacities to vary from actual measured capacities.

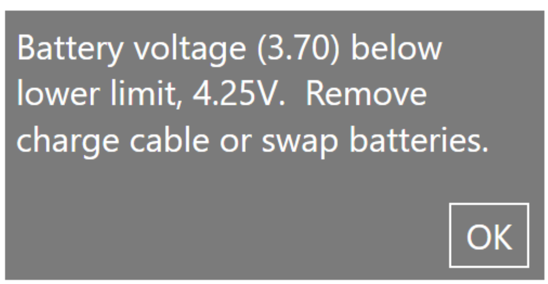
Most of these batteries contain an internal Lithium-Ion battery that has a nominal operating voltage of 3.7V. Typically, the output voltage is produced with a boost regulator that raises the voltage to 5V.

These are the specifications for batteries that are suitable for Maestro:

- Maximum size: 6" x 3" x 0.75"
- USB-A Female connector for battery drain (5V output)
- Minimum output current of 2.1A
- Auto-start preferred (will start on load without depressing a button – see below)

Maestro is designed to place a load on the battery when it loses power from the wall charger and most batteries will automatically turn on and begin supplying power in this case (auto start). If your battery does not supply power when the external supply is removed, Maestro will display a message indicating that you have two minutes to replace or turn on the battery. If your battery has an on switch and will not auto start, simply press the on switch and Maestro will detect the battery voltage, remove the message and continue normal operation.

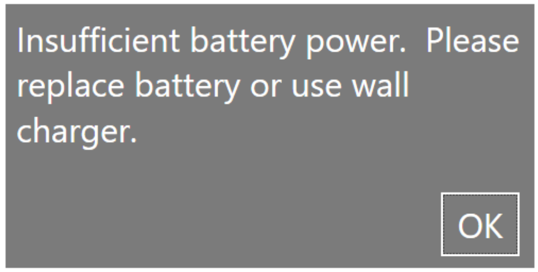
In order for the Maestro to operate properly, it requires the average voltage from the battery to be above 4.5V. If the battery voltage falls below 4.25V for an extended period, Maestro will display the following message:




This message generally indicates one of two different possibilities if the battery has been fully charged:

1. The battery has drained beyond its normal capacity and needs to be replaced. Typically, the battery voltage will be around the 4.25V range and falling. In this case, the battery should be replaced or charged.
2. There is another issue with the battery, such as a failure, a design issue or inability to provide the necessary power, that requires a replacement of the battery.

If the battery being used cannot supply the required power for Maestro, but does not fall below 4.25V, it is possible that it can cause a slow drain of Maestro's internal battery. If the internal battery is completely drained, Maestro will shut off and will require charging through the wall charger port on the back of the Maestro (up to 15 minutes may be required before Maestro will restart in this condition). Maestro can detect a loss of internal charge on the battery, and if detected will show this message:




If you receive this message, you should plug in your Maestro using the supplied wall charger or switch to a battery that can supply sufficient energy to both run Maestro and charge the internal Maestro battery.

In summary, not all batteries will function the same in Maestro and batteries may age and fail over time. For best results, check the FlexRadio Systems Community for recommendations on batteries from FlexRadio employees and other FlexRadio owners. Good batteries should provide reliable operation over many charge/discharge cycles.

## 4.5 STARTING/STOPPING THE MAESTRO

Maestro is started by pressing and holding the Power button on the top of the unit for 5 seconds. Release the button. In a few seconds, welcome screens will appear and the front panel buttons will flash, indicating that the Maestro is running.

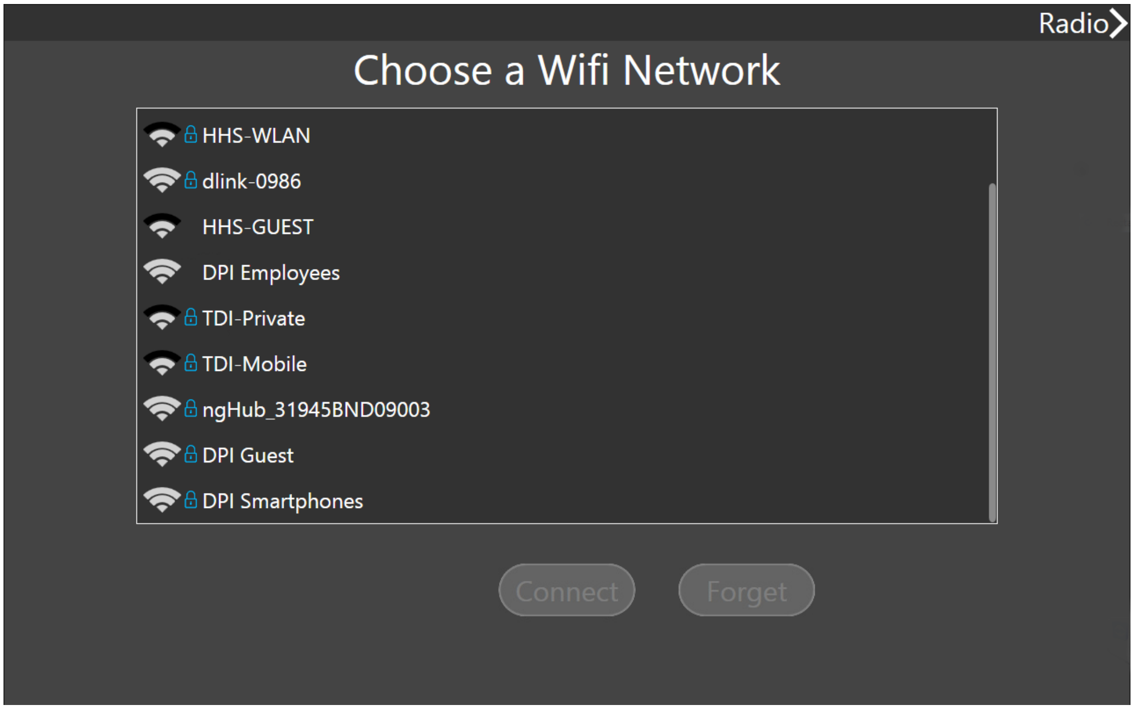
Maestro is stopped by pressing the Power button for a moment. In normal circumstances, Maestro will power down in a few seconds. Note that it can take as long as 10 seconds for the unit to completely shut down after the screen goes blank. If a momentary press of the power button does not shut down Maestro, press and hold the power button until the unit shuts off. This procedure should seldom be necessary.

## 4.6 WI-FI NETWORK SETUP

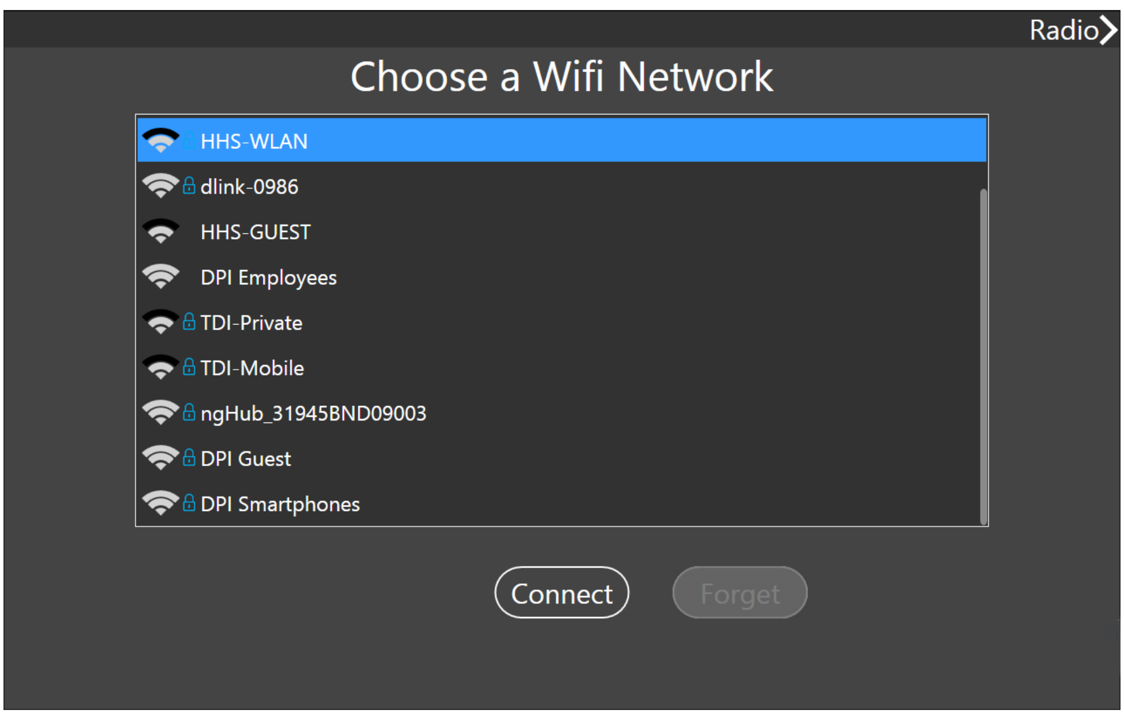
Maestro surveys the computer networks available to it at start-up. If it finds a useable network connection, either a wired Ethernet connection, or a known Wi-Fi connection, the first screen displayed to the user will be the *Select Radio* screen. But if it finds no wired Ethernet connection and no useable Wi-Fi connection, it displays the *Choose a Wi-Fi Network* screen.

Maestro supports WPA/WPA2 Wi-Fi security and can also connect to open (unsecured) Wi-Fi networks, but does not support WEP secured Wi-Fi networks. Wireless Protected Setup (WPS) is not supported.

Maestro surveys the 2.4 and 5.0 GHz Wi-Fi radio frequencies for available Wi-Fi networks. This survey may take a few minutes to complete. The survey results are displayed on the *Choose a Wi-Fi Network* screen as shown below:



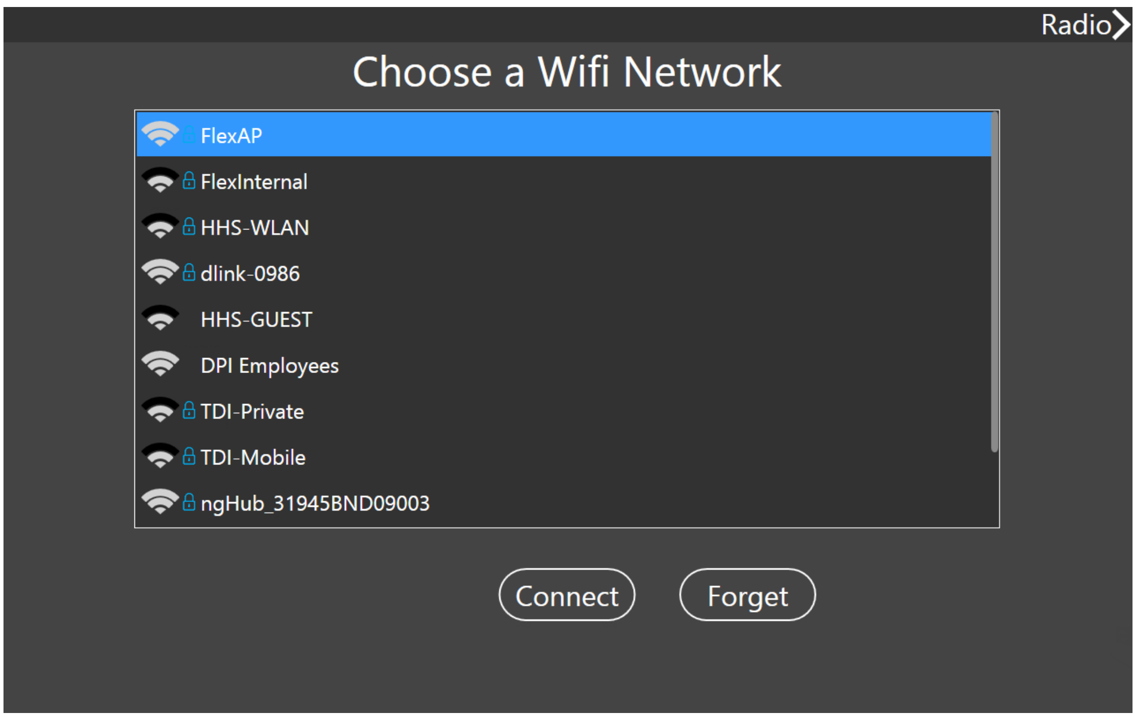

Select a network by tapping on it, then tapping the **Connect** button. If the network requires a password to complete a connection, you will be shown the *Enter Wi-Fi Password* screen. Enter the password using the software keyboard provided on the screen, then tap **Connect**.



If Maestro is able to make a connection to the network, the Wi-Fi network setup is complete and Maestro continues to the *Select Radio* screen. You can return to the *Choose a Wi-Fi Network* screen any time during the Maestro startup process by use of the navigation buttons in the upper left and right corners of the startup screens. The *Select Radio* screen offers a *"< Wi-Fi"* button to take you back to the *Choose a Wi-Fi Nework* screen.

Maestro treats Wi-Fi network connections as secondary to wired network connections. At startup it will use a wired Ethernet connection when it is available and will not connect to a Wi-Fi network, even if a known Wi-Fi network is available. If the wired connection is lost while the radio is in operation, Maestro will attempt to make a connection to the radio using a known Wi-Fi connection.

Some users may want to use a Wi-Fi connection for software updates, but avoid using it to operate the radio. A metered Wi-Fi connection might be an example of this situation. To operate Maestro in this fashion, start Maestro and use the Wi-Fi connection to update the software, then start the desired version of the software. Enter the **Main Menu** then tap the **Network** tab. Tap the **Wi-Fi Settings** button. Maestro will break its connection to the radio then return to the *Choose a Wi-Fi Network* setup screen. On this screen you can select the Wi-Fi network and use the **Forget** button to break the connection.



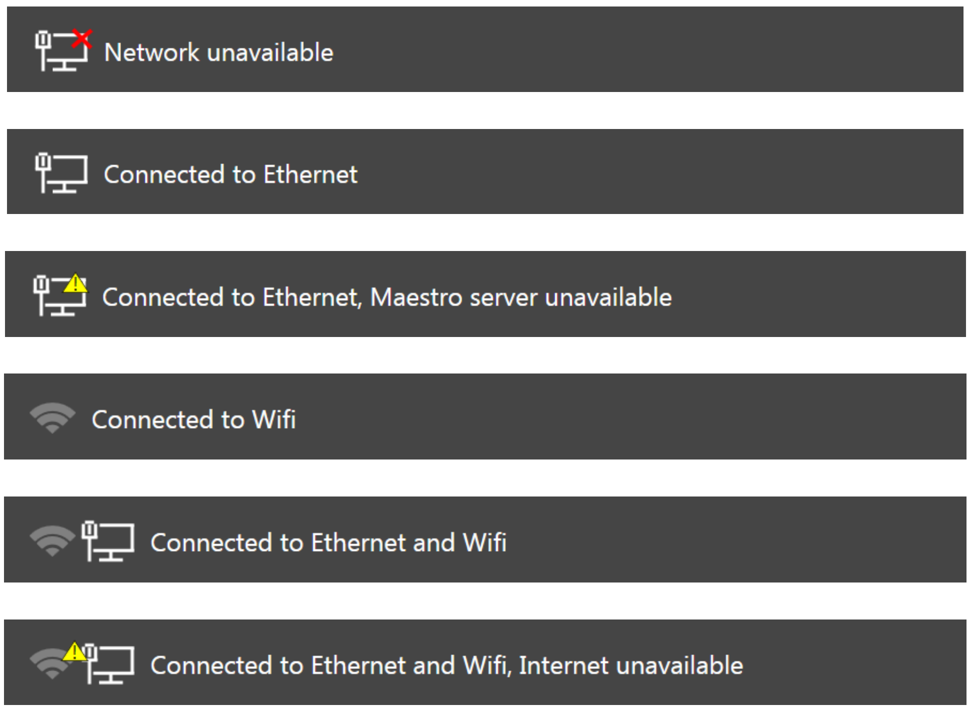

Maestro will clear any information it has stored about making a connection to that network. Subsequent Maestro startups will not connect to that Wi-Fi network until it is manually selected by the user.

See section **25.5**, **Network Tab** for more information about Maestro network connections and the **Wi-Fi Settings** button.

## 4.7 NETWORK STATUS

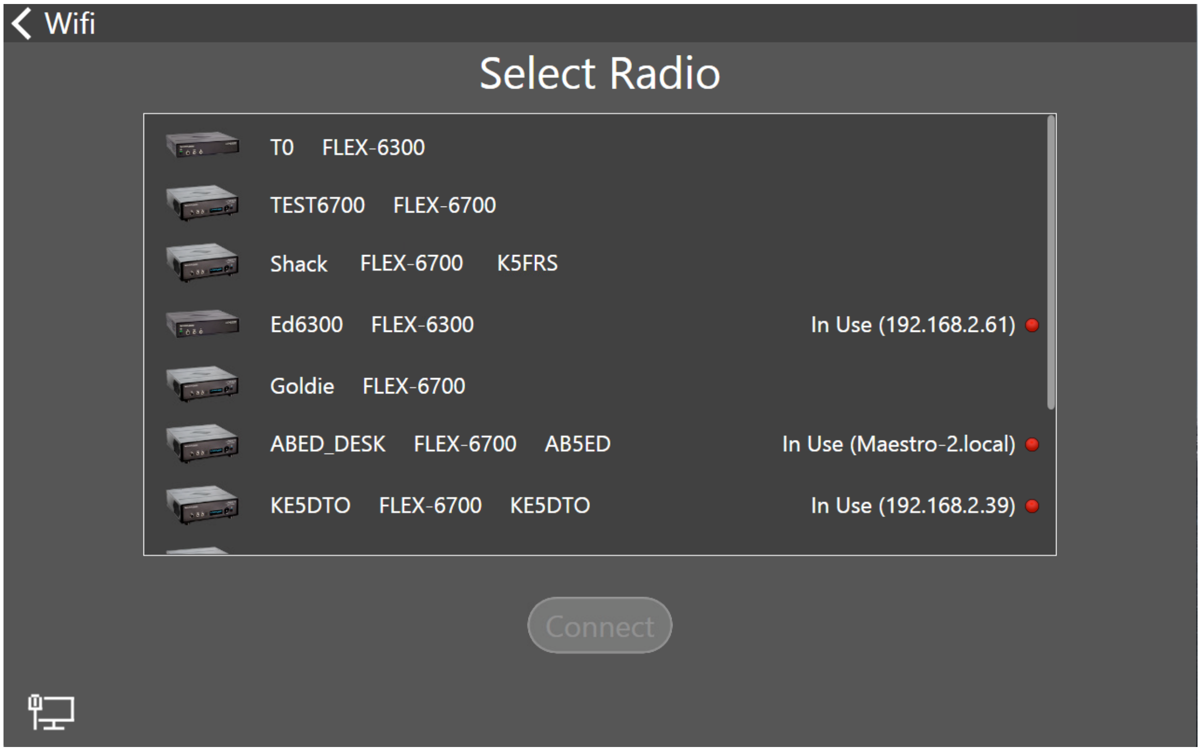
When Maestro starts, the user has a choice of the *Choose a Wi-Fi Network*, *Select Radio* and *Select a Version* startup screens. Each of these screens includes information about the network connection that Maestro has made or is attempting to make. This information is shown by an icon in the lower left corner of each of these screens.

The icon provides status information about a wired Ethernet connection, a wireless Wi-Fi connection and the Maestro server (which provides Maestro software for installation). Tap the icon to display text that provides more information. Some examples of the network status icon follow:



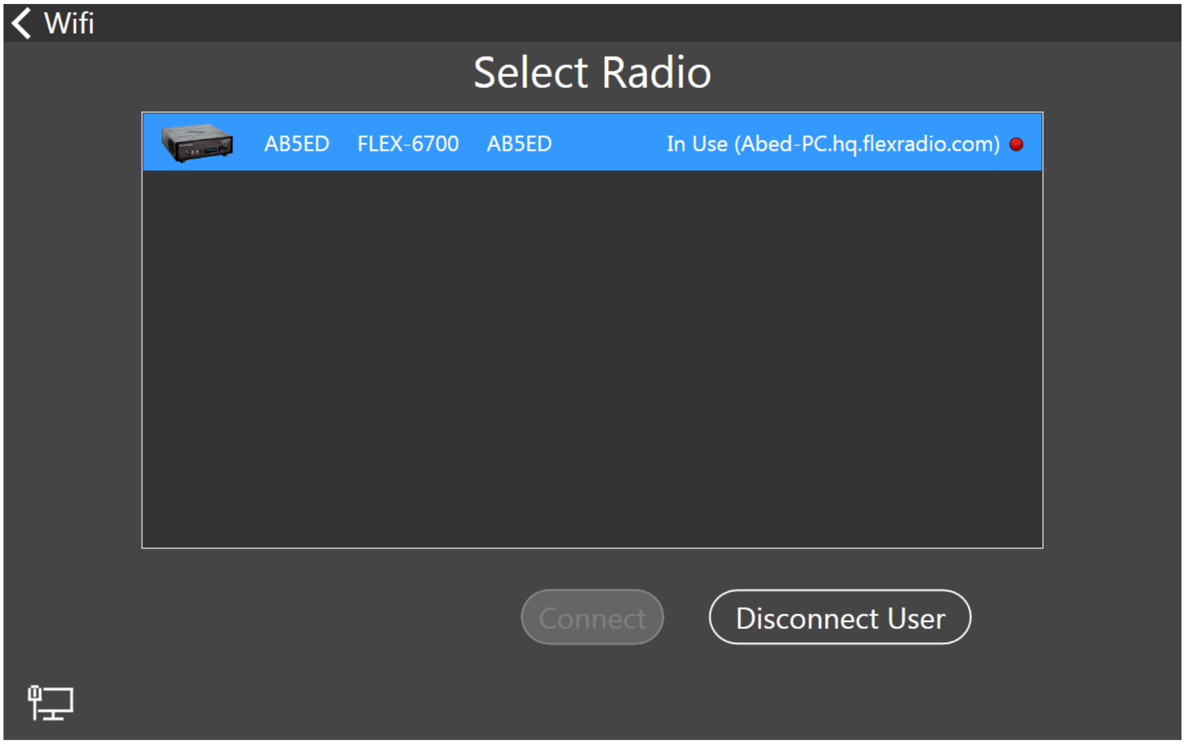
# 5 CONNECTING TO A RADIO

After Maestro starts, a screen is displayed showing radios found on your local network. Maestro locates these radios using a network broadcast protocol that is limited to the local subnet that Maestro is connected to. If your radio is running and is connected to your local network, it should appear in the *Select Radio* screen as shown below:




Select a radio in the *Select Radio* screen by tapping it. If the radio is already in use on another computer or is connected to a third-party application that provides radio GUI functions, you will see **In Use** next to the radio's name.

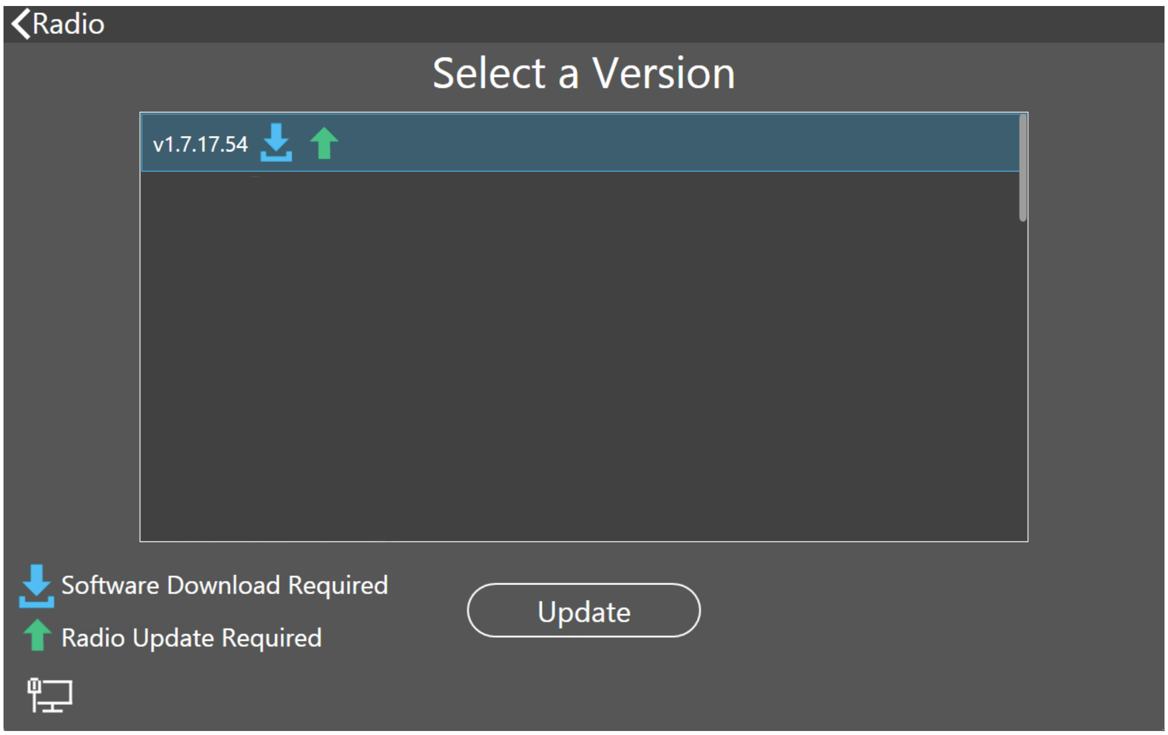
To connect to a radio that is in use by another client, select the radio by tapping it. A **Disconnect User** button will appear to the right of the **Connect** button. Tap this button to disconnect the other client. The radio will then be available for use.



# 6 HOW TO SELECT MAESTRO AND RADIO SOFTWARE

After a radio is selected, Maestro will display the *Select a Version* screen, and a list of available versions of Maestro software and radio firmware.

Maestro manages software versions automatically. Each time Maestro is started It checks for new versions of the software and displays them on the *Select a Version* screen. When a new version is available, you will have the option to download and install it. If a new version requires a change to the radio firmware, this is also downloaded and made ready to install in the radio. A number of versions of the software will usually be available for installation, giving you the option to move forward or backward through the versions. The newest software is listed at the top of the screen, the oldest at the bottom.




Select a software version to run by tapping the version, then tap **Update** to proceed.

Maestro will download and install the software for itself and the radio as needed. If the version you select has been downloaded before, it is not downloaded again. A single version of SmartSDR for Maestro is installed on Maestro at a time, but up to five are kept on Maestro for later installation. Any time a different version is selected, a short installation process will commence to reinstall the selected software on Maestro. The *Select a Version* screen displays an  if a change is required in the radio firmware. In most cases, the radio will stop and restart once or twice as the radio firmware is installed.

Once the installation process has started you will see a progress bar showing the approximate completion status. Firmware updates usually complete in a few minutes. If a progress bar goes all of the way to the right and stops, and the update does not complete within a few minutes, restart the radio and Maestro and try again.

# 7 MAESTRO OVERVIEW

## 7.1 THEORY OF OPERATION

Maestro is a hardware and software system designed to operate FLEX-6000 Signature Series radios. FLEX-6000 radios perform wide-band sampling of the RF spectrum. How is wide-band sampling different from other radios?

In superheterodyne (also called “superhet” or “multiconversion”) radio systems, a series of down-conversions using local oscillators is performed on the RF input ultimately resulting in a baseband signal. This signal is generally only a few kilohertz wide and is ready to be demodulated and presented to the operator in the form of audio. In a superheterodyne architecture, generally only a single receiver is available at a time and the receiver has limited bandwidth.

In a wide-band sampling radio, a large portion of the spectrum is sampled (turned into digital information) all at once. This sampling provides the basis for the use of a number of analysis tools and receivers in the spectrum simultaneously, all from the one hardware sampler.

## 7.2 KEY SYSTEM COMPONENTS

### 7.2.1 Spectral Capture Unit (SCU)

Because the notion of a receiver is firmly established in both the amateur community and possibly the rest of the world, it seemed inappropriate to describe the functionality of a wide-band sampling system simply as a “receiver”. Instead, in the FLEX-6000 world there are one or more “Spectral Capture Units”, or SCUs, that are responsible for the collection of wide-band data from the RF spectrum. The SCU components are: an antenna input, an optional set of receive preselectors, and an analog-to-digital converter (ADC). Each SCU in the radio system can be connected to only a single antenna at a time, but due to the sampling architecture it may support any number of receivers and spectrum displays. The SCU enables listening to multiple bands at the same time on the same antenna. A hardware platform with multiple SCUs such as the FLEX-6700 allows for monitoring multiple bands on different antennas or the ability to perform more complex noise mitigation techniques that are available in multi-antenna systems.

### 7.2.2 Slice Receiver

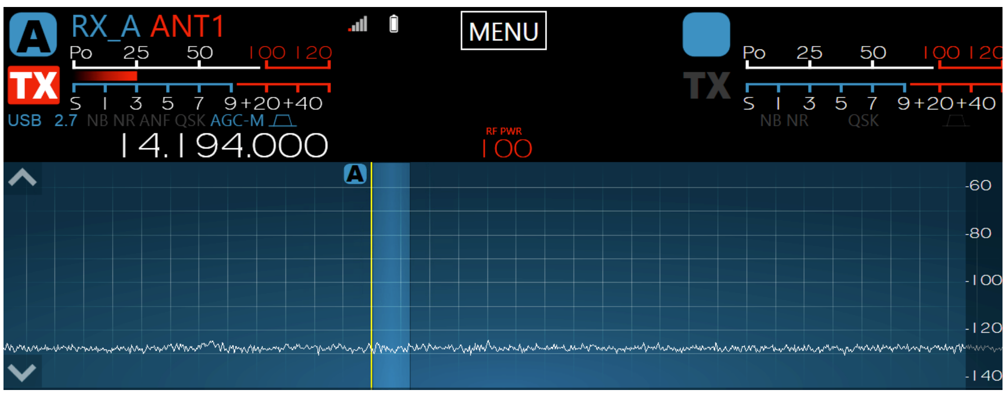
Maestro can create two receivers out of the data collected from the SCU. How does this work? The characteristics of the SCU sampled data stream vary by radio model, but is typically 1-4Gbps of data that contains all activity across a large section of the RF spectrum. In the FLEX-6700, for example, an SCU tuned to the HF band collects every signal present in the spectrum from 0-73MHZ! This data is not directly observable or understandable by an operator, so a number of tools exist for understanding and using the SCU data, the first of which is the Slice Receiver. Each Slice Receiver is tuned to a specific frequency just as a Variable Frequency Oscillator (VFO) would be in a traditional radio. The Slice Receiver then takes this more manageable amount of data (typically describing 10-20kHz of the band) and performs operations to output the signals required by the operator.

For example, in the case of a single sideband receiver, the Slice Receiver will demodulate the upper (or lower) sideband of the data collected, will filter it according to the receiver filter settings, may perform noise mitigation techniques on the data and then ultimately passes it to an audio system to become sound for the operator. Because the source of the Slice Receiver data is always the SCU data and each Slice Receiver uses the same techniques to demodulate, filter and convert the signal into audio, each Slice Receiver shares the same base performance as the other Slice Receivers. For the operator, this means that access to two receivers with the same top performance may be used interchangeably without concern for differing performance characteristics of each receiver often found in superheterodyne receivers.

### 7.2.3 Panadapter

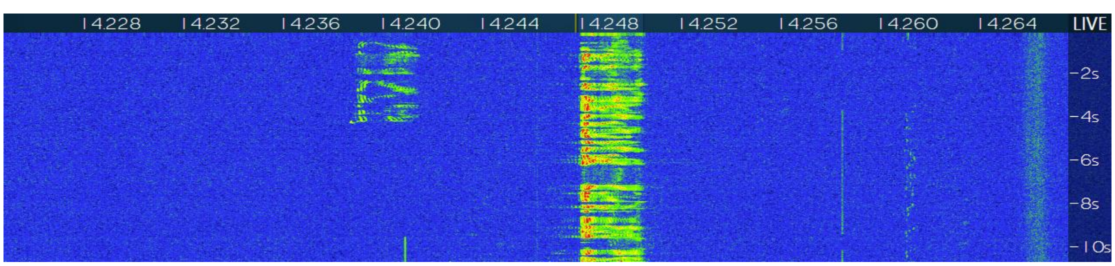
The Panadapter uses the data available from the SCU and turns it into a visual representation of the radio frequency spectrum. The Panadapter display, pictured below, shows the level of signals present across a specific region of the spectrum just as a spectrum analyzer would. The higher the white line appears in the display, the stronger the signal is in that part of the band. A scale for the absolute signal level in dBm (decibels above or below one milliwatt) is provided on the right hand side of the display. This allows the operator to quickly identify signals of interest where the operator can focus his/her efforts.

Each Panadapter is derived from the data from a single SCU so it is possible in multiple-SCU radios to show two different Panadapters tuned to the same region of the spectrum, each with data from a different SCU and ultimately a different antenna. The Panadapter shows the current state of the spectrum and can be adjusted to show various widths of spectrum. A Panadapter can be seen below:



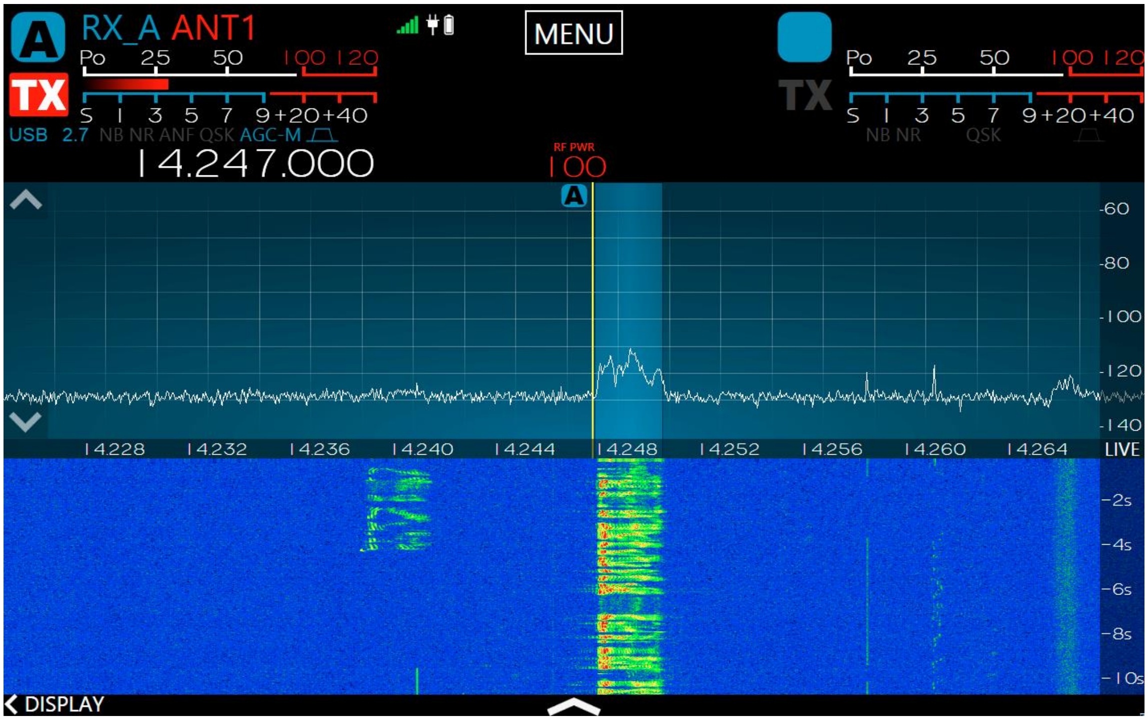

### 7.2.4 Waterfall

The Waterfall uses the same data from the SCU as the Panadapter and turns it into a time-based visual representation of the spectrum. In the Waterfall, intensity of signal is represented by a change in color in a similar way as water density is shown in weather radar. The vertical position in the Waterfall represents the time that the information on the spectrum was obtained. The Waterfall owes its name to the way that it continually moves downward like a Waterfall as time passes. The Waterfall can be useful for understanding how signals are distributed in the spectrum over time, locating where stations have recently transmitted and even locating "holes" where operation will not interfere with other stations. A Waterfall can be seen below:



### 7.2.5 Panafall

The Panafall display is simply a Panadapter and a Waterfall that are joined such that the horizontal axis has the same frequency location. In this way, the Panadapter portion of the display will show the current state of the spectrum and the Waterfall portion will show a historical perspective.



# 8 HOW TO OPERATE A SLICE RECEIVER

## 8.1 HOW TO CREATE AND DESTROY A SLICE RECEIVER

Maestro can control two Slice Receivers labeled A and B. The first two columns of knobs and buttons on the Maestro front panel control the A Slice, the second two columns control the B Slice. When the A Slice Receiver is operating, the A **RX** button will be illuminated green. When the B Slice Receiver is operating the B **RX** button will be illuminated green. Press the buttons to turn the A and B Slice Receivers on and off.

Pressing the A or B **RX** button will place a Slice Receiver resource inside the corresponding Panadapter. A Slice Receiver will be created in the center of the Panadapter if none exists. If a Slice Receiver is already present in the Panadapter, the new Slice Receiver will be created with the same basic characteristics (mode, DSP settings, etc.) as the active or closest Slice Receiver to the center of the Panadapter with a mode specific frequency offset.

The various models of the Signature Series transceivers support different numbers of Slice Receivers, varying from two to eight. Maestro supports a fixed number, two Slice Receivers.

When a Slice Receiver is active, pressing its **RX** button will deactivate it and remove it from the Panadapter display. It is possible to disable both Slice Receivers so that only the panafall display remains. With no Slice Receivers, no signals will be audible from Maestro or the radio.

***Note: If the removed Slice Receiver was enabled for transmission, the radio will be unable to transmit until another Slice Receiver is selected for transmission.***

If a Slice has moved off-screen outside the bounds of a Panadapter, the Slice Receiver display will change to indicate where the Slice is tuned relative to the Panadapter. 

Double tapping on the indicator will center the Slice in the Panadapter display. The 

indicator also will show if the transmitter is enabled in the off-screen Slice.

An off-screen Slice can be closed by pressing its **RX** button to disable it.

If a Slice Receiver moves too far beyond the bounds of the Panadapter, it will be put into a detached state and will no longer produce audio. Moving the Slice back into the bounds of the Panadapter will put the Slice Receiver back into a normal state which produces audio. The bounds of the Panadapter are determined by the radio hardware, and vary by radio model.

## 8.2 HOW TO TUNE A SLICE RECEIVER

**Knob Tuning:** Use the two front panel tuning knobs to adjust the frequency of the A Slice Receiver (larger knob) or the B Slice Receiver (smaller knob). The knobs are weighted and spin freely to provide rapid tuning. Each full revolution of a knob creates 64 pulses each of which maps to one step change in frequency, up or down. Turning the knob quickly enables acceleration to traverse more of the band faster. The size of the steps, in Hertz, is controlled by the A and B Step buttons. See section **28.2, Slice Receiver Tuning Knobs and Buttons** for full details.

**Drag Tuning:** Drag Tuning is one of the more common tuning methods. By touching the Receive Filter (lighter blue area of the Slice Receiver) or the carrier (the vertical yellow or red line of the Slice Receiver), and moving your finger left or right, the Slice will move up or down in frequency while the Panadapter remains stationary. This tuning occurs in increments of the currently selected step size. Once the Slice reaches the edge of the Panadapter the Slice will stop and the Panadapter will begin to move behind the Slice. This is called Pan Edge Tuning and allows rapid tuning above or below the Panadapter's current frequency range.

**Tap Tuning:** Double tapping anywhere in the Panadapter grid will initiate a Tap Tune. Tap Tune will move the active Slice to the frequency where the tap occurred. The active slice is designated by a yellow carrier line and yellow triangle at the top of the carrier line (see section **8.3**, **Making a Slice Receiver Active**).

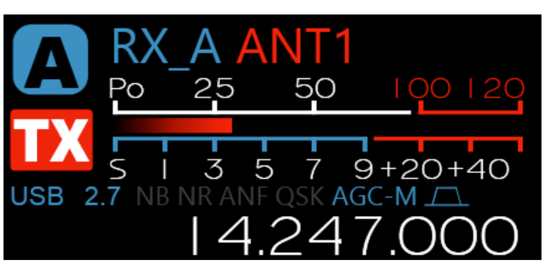
**Direct Frequency Entry:** Direct Frequency entry for any Slice Receiver is a tuning option. Simply tap on the Slice Receiver's frequency display to open the Slice Receiver's Control Panel and use the ten-digit touch pad to enter the frequency in megahertz using a single separator specific to your country (for the US it is a period, for other countries it may be a comma). For example, entering "14.0705" will tune to 14.070.500. You can also enter some frequency ranges using kilohertz, but the data entered is limited to 4 or 5 digits and you cannot use a country specific separator. For example, entering "7250" will tune the Slice Receiver to 7.250.000 megahertz.

**Tune Step Size:** The tuning knobs generate 64 pulses per revolution. The amount of frequency change caused by one pulse from a tuning knob or by dragging the Slice Receiver is determined by the active Slice Tune Step Size. Tune Step Size is mode specific and can be set with the A or B Slice Step Button. A single press of the button increases the step size by an amount appropriate to the Slice's mode. The new value is shown in a pop-up display. A longer press of the button decreases the step in a similar manner.

## 8.3 MAKING A SLICE RECEIVER ACTIVE

A Slice Receiver consists of a center Carrier Frequency displayed by a solid yellow  or red  vertical bar. A yellow bar indicates the Slice is "Active," indicating that this is the Slice that you are currently manipulating. Moving the A or B Tuning knob makes the corresponding Slice Receiver active. Tapping a Slice's receive filter display makes that Slice active. When a new Slice Receiver is selected as the active Slice, the old active Slice will become inactive and its carrier line will change to red. There can only be one Slice active at a time.

## 8.4 HOW TO CHANGE THE DEMODULATION MODE




When a Slice Receiver is active, the Slice Receiver Flag shows the mode and receive filter width in use. To change the mode, tap the frequency display or depress the slice receiver's tuning knob for two seconds or more. The Slice Receiver's Control Panel will be displayed. Tap on the desired mode in the mode sub-menu. The Slice Receiver will change to that mode and values in the Slice Flag will change accordingly. To close the pop-up menu, tap on the Slice Receiver's frequency display or anywhere outside of the pop-up menu or depress the slice receiver's tuning knob for two or more seconds.

The position of the Receive Filter relative to the Carrier Frequency will correspond to the conventions of the current mode. A Receive Filter to the right of the Carrier indicates Upper Sideband mode. A Receive Filter to the left indicates Lower Sideband mode. A Receive Filter that spans both the left and right of the Carrier will indicate a double sideband mode.

## 8.5 HOW TO ADJUST THE SPEAKER AND HEADPHONE VOLUME OF A SLICE RECEIVER

Speaker and headphone audio levels are controlled by the AF/AGCT/SQL multi-function controls on the Maestro front panel. Speaker and headphone audio level is controlled with the inner knob. The Automatic Gain Control Threshold is adjusted with the outer knob. When the Slice is operating in an FM mode, the outer knob controls the audio squelch level. A short press of the inner knob mutes the other Slice, placing the audio in Solo mode. A long press of the inner knob mutes or unmutes the corresponding Slice. When a Slice is muted, a mute indicator appears superimposed on the Slice Flag.

Controls for left to right audio balance and AGC decay rate can be found in the Slice Receiver's Control Panel. Tap the Slice's frequency display to bring up this menu. See section **11.1,AGC Threshold** for detailed information about the use of the AGC.

## 8.6 HOW TO CHANGE THE RX FILTER OF A SLICE RECEIVER

Surrounding the Carrier Frequency bar in a Slice Receiver is a blue Receive Filter bar which represents the filtered receive audio. The portion of the RF spectrum that is highlighted by the Receive Filter bar will be output as audio.

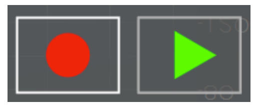
The Receive Filter width can be adjusted manually with the RX filter multi-function control. The control has two modes. In the High/Low mode, the inner knob controls the position of the lower frequency edge of the RX filter and the outer knob controls the position of the higher frequency edge. In the Center/Width mode, the inner knob controls the frequency of the center of the RX filter and the outer knob controls the width of the filter. A pop-up display shows the frequency of the filter parameter, relative to the Slice Receiver's tuned frequency as the filter is adjusted. Information about the Receive Filter's width and the knob mode is shown in the Slice Flag's Annunciator area.

A short press of the inner knob cycles the RX filter through a series of preset filter configurations that are determined by the selected mode. A long press of the knob toggles the knob's function between High/Low and Center/Width modes. See section **28.4**, **Slice Receiver Bandwidth Knobs** for more details.

Mode specific RX filter presets are also available in the Slice Receiver's Control Panel, which can be reached by tapping the Slice Receiver's frequency display.

## 8.7 RECORDING AND PLAYBACK OF SLICE RECEIVER AUDIO

Slice Receivers may be recorded and the recording played back over the air using the Quick Record/Playback feature of the Maestro. The controls for these functions are located in the Slice Receiver Control Panel. Tap the Slice Receiver's frequency display to raise this menu. The controls are in the upper right corner of the menu and consist of a record button (red circle) and a play button (green triangle):



On startup, there is no recorded audio in the playback buffer and so the play button will be disabled (greyed out). To record audio from the Slice Receiver, press the record button (red circle) once. While recording, the record button will pulsate.

Recording will continue until the record button is pressed again or until two minutes have passed. Recording will include any received audio while in receive mode and also any transmit audio when the radio switches to transmit mode. Once the recording is stopped, the record button will return to a solid red circle and the play button (green triangle) will be active.

To playback the audio, press the play button. If the play button is pressed while the radio is in receive mode, the playback audio will be routed to the speakers and headphones. If play is pressed while the radio is in transmit mode, the audio recording will also play through the transmitter.

To stop playing audio, press the play button a second time or wait for the recorded audio to finish playing.

To record or play again, press the appropriate button. Only one audio recording per Slice Receiver is saved. The audio played during transmit can originate in any Slice Receiver regardless of whether the Slice Receiver that recorded the audio is the Slice Receiver now transmitting. For example, you may record audio using Slice Receiver A and then playback that audio over the air using Slice Receiver B. To do this, make Slice Receiver B the transmitter by selecting it using the red TX selection below the letter B, or by pressing the Slice's TX button. Press the **MOX** button, PTT on the microphone, footswitch or other PTT source and then press the play button on Slice Receiver A.

# 9 HOW TO OPERATE THE PANADAPTER / WATERFALL

## 9.1 HOW TO CREATE / DESTROY A PANADAPTER / WATERFALL

Maestro runs with a minimum of one and a maximum of two Panadapters. To add the second Panadapter, tap the upward pointing arrow at the bottom center of the display. To remove the second Panadapter, tap the downward pointing arrow in the middle of the display.

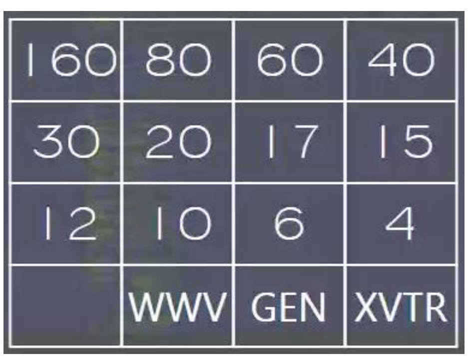
## 9.2 HOW TO CREATE / DESTROY A SLICE RECIEVER IN THE SECOND PANADAPTER

When a second Panadapter is added to the radio a Slice Receiver may also be added by Maestro if either the A or B Slice is not in use at the time the Panadapter is added. If both Slices are active in the first Panadapter, no Slice Receiver will be added when the second Panadapter is created. The user can move either the A or B Slice Receiver to either the first or second Panadapter by repeated presses of the A or B **RX** button.

## 9.3 HOW TO CHANGE THE PANADAPTER FREQUENCY (TUNE)

Each Panadapter has the ability to perform a pan function to adjust the frequency range that is displayed. Touching and dragging within the Panadapter grid will reorient the frequencies being viewed on the Panadapter in the direction that your finger moves. By moving your finger to the right you will display lower frequencies and vice-versa.

Opening a Slice Receiver's Control Panel opens a band selection menu. Selecting a band from this list will adjust the Panadapter to display all or part of the corresponding amateur radio band. Selecting band buttons allows for rapid switching between views of the amateur radio bands. Tapping on the **XVTR** button in the lower right swaps the buttons to a list of XVTR bands. Tap the **HF** button to swap back.

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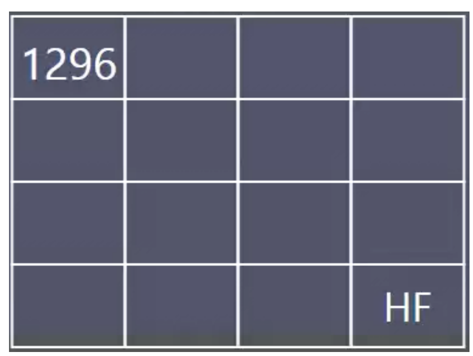



When switching between bands, if any Slice Receivers are defined in the Panadapter, these are removed. If Slice Receivers were present in the new band the last time the band was active in the radio, they will be recreated. If no Slice Receivers were present, none are created.

## 9.4 HOW TO ZOOM A PANADAPTER

Each Panadapter has a zoom range up to a maximum of 14 MHz for the FLEX-6500 and FLEX-6700 or 7 MHz for the FLEX-6300 and down to a minimum of 1.5 kHz in bandwidth for the FLEX-6700 and

6kHz in bandwidth for the FLEX-6500 and FLEX-6300. There are multiple methods for adjusting the zoom of the Panadapter.

Tapping the Panadapter reveals plus and minus magnifying glass buttons located in the upper left corner of the Panadapter. Tap these buttons to zoom the Panadapter in or out. Zooming out (-) will double the bandwidth presented in the Panadapter while zooming in (+) will halve the bandwidth. The frequency at the center of the Panadapter will remain the same after each change in bandwidth, except in the case where the active Slice Receiver is not in the center of the panadapter. In this case, the panadapter will be re-centered on the slice before the zoom operation.

For more precise control of the zoom, touch and drag anywhere on the frequency labels located at the bottom of the Panadapter.


Dragging the frequency labels to the right zooms in, dragging to the left zooms out. With this method the frequency at the point where your finger was located will remain stationary in the Panadapter.

When zooming out of a Panadapter there are certain points where the amount of data needed to create the display must be doubled. As this occurs more noise will be included in the FFT bins comprising the display which will cause a noticeable increase in the noise floor. The reverse occurs when zooming in on a Panadapter. Each time one of these thresholds is crossed, either zooming in or out, the noise floor will increase or decrease by about 3 dB. If the displayed spectrum after the zoom operation exceeds the width of band preselectors in the FLEX-6500 or FLEX-6700 the radio will switch to wideband mode, which causes the radio to open the Bandpass Filters to their maximum bandwidth. When this occurs, any Panadapters using that antenna will display   in the top right corner to indicate that they are in wideband mode.

*Note: The FLEX-6300 is always in WIDE mode and will not show this indicator.*

Just to the left of the WIDE indicator is an indicator for whether the preamplifier is active and if so, at what level. A complete description of the preamplifier control can be found starting in section **20.9**, **Using the Receive RF Gain/Preamplifiers**.

To the left of the preamplifier indicator is an indicator for whether the Panadapter is on a Transverter (XVTR) band. A complete description of how to setup for XVTR operation can be found in section **21**, **How to Configure Transverters**.

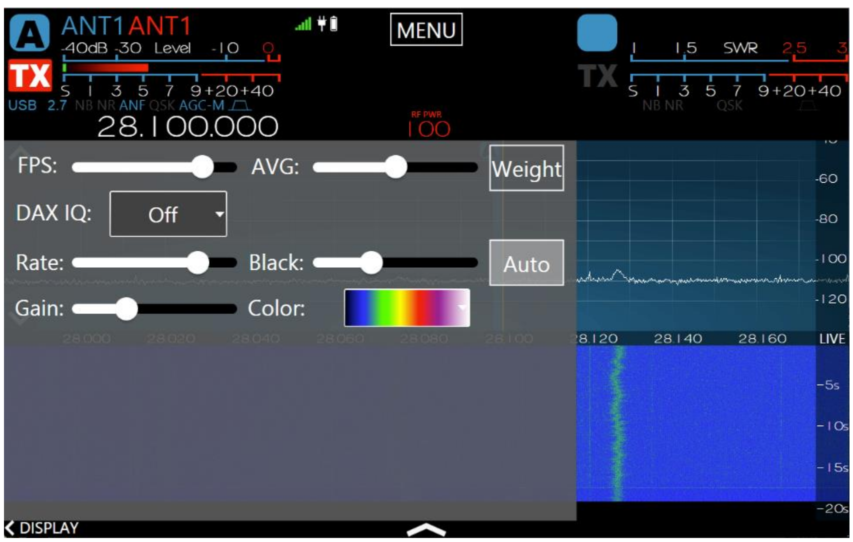
## 9.5 HOW TO CHANGE THE SIGNAL MAGNITUDE SCALE OF A PANADAPTER

The maximum and minimum amplitude displayed in each Panadapter may be adjusted. Tapping the up  or down  arrows displayed along the left edge of the Panadapter increases or decreases, respectively, in 10 dB increments, the maximum amplitude displayed. You may also adjust the minimum amplitude by touching and dragging the vertical axis on the right side of the panadapter. This will effectively adjust where the noise floor is positioned within the Panadapter. The radio remembers these settings by band so that future switches to the band will restore these settings.

The vertical scale is calibrated in dBm, showing the signal strength as measured at the antenna terminal.


## 9.6 ADJUSTING THE PANADAPTER AND WATERFALL CONTROLS

Touching the Display control at the bottom of the first Panadapter opens the display controls. When one Panadapter is active, the upper half of the control panel is populated and the lower half is blank. When both Panadapters are active the upper and lower halves of the control panel are populated.




The **FPS** slider controls the rate that the Frequency Spectrum is drawn on the Panadapter, in frames per second. Lowering the **FPS** control has several effects:

- It lowers the rate at which the Panadapter is updated
- It lowers the network bandwidth of data sent from the radio to the Maestro, which may be important in situations of limited network bandwidth
- As the rate of update is lowered, the extra data not displayed is averaged and so the variance of the data is lowered, making both the Panadapter and the Waterfall smoother

If you prefer a faster updating display, but a more averaged or smoother one, adjust the **FPS** setting for the update speed you prefer and then raise the **AVG** (averaging) control. The **AVG** control increases the number of frames that are averaged, lowering the variance and smoothing the display.

The **Weighted Average** control emphasizes signals that are increasing in amplitude over ones that are declining. This emphasizes locations where signals have recently been and shows a more precise view of their full amplitude when they first appear.

The **Gain**, **Black** and **Auto** controls work together to adjust how different signal levels are displayed in the Waterfall. The **Black** control sets the level below which all pixels will render as black. In other words, it sets the level at which signals are no longer of interest. The **Auto** control automatically sets the black level to just below the noise as band conditions, preamplifier changes or antenna changes alter the noise floor. To enable auto-black, tap the **Auto** button so that it is highlighted.

The **Gain** control adjusts how rapidly the Waterfall will advance through the color spectrum for minimal changes in signal level. Lowering the gain gives the Waterfall a broader dynamic range, but lessens its ability to show small variations in signals. Raising the gain lowers the dynamic range, but provides more detail in the variations in smaller signals' magnitudes.

The **Rate** control adjusts how quickly the Waterfall advances on the screen. At the lowest setting, many minutes of data can be displayed. At its highest setting, the Waterfall displays a rapidly changing spectrum in the most detail.

In most cases **Auto Black** properly adjusts the background color or black level for the display's zoom factor and the relative noise floor of the band you are viewing. However, you can manually adjust the Waterfall's settings to display weak signals at or near the noise floor. If the **Black Level** is set too low, many of the "in the noise" FFT bins will always be zero, regardless of the **Gain** setting. To achieve an ideal setting for the **Black Level**, do the following:

- Adjust the **Gain** to maximum
- Adjust the **Black Level** to a point where the Waterfall is primarily white, but there are approximately 2-5% black areas displayed.
- Decrease the **Gain** until the background is deep blue.

This ensures that small signals in the noise will be easily seen.

A significant portion of the network bandwidth used by Maestro is consumed by the panadapter and waterfall displays. For local area networks, inside of your home for example, bandwidth used is generally not a consideration. When Maestro is used in a wide area network, on the Internet for example, bandwidth is often a consideration. Referring to the **Network** tab on the **Main Menu** after adjusting the display rates will show the amount of network bandwidth consumed by Maestro. See section **25.5**, **Network Tab** for more details.

# 10 NOISE MITIGATION IN MAESTRO

In order to properly utilize the DSP noise reduction features Maestro, it is important to understand the type of noise causing interference. There is no single solution for noise mitigation since different types of noise require different algorithms. There are two primary types of noise that can be minimized using DSP techniques: white noise and impulse noise.

White noise is defined as random or uncorrelated noise with a uniform frequency spectrum over a wide range of frequencies. The sound of rain is an example of white noise. Three techniques are best used to improve signal to noise ratio in the presence of white noise:

- Reduced filter bandwidth
- Optimized AGC threshold (**AGC-T**) setting
- DSP Noise Reduction (**NR**)

Reducing filter bandwidth and optimizing the AGC threshold can significantly improve the SNR without adding distortion or "coloring" the signal so long as the desired signal is not at the antenna noise floor. However, DSP noise reduction (**NR**) can provide significant intelligibility improvement on weak signals which may be near or below the atmospheric noise floor.

Impulse noise is a category of noise that includes almost instantaneous impulse-like sharp sounds generated by voltage spikes from arcing power lines, automotive ignition systems, electric fences, etc. Impulse noise can raise the wide band noise floor received at the antenna by tens of dB and thus completely mask signals that would otherwise be readable.

Traditionally, "noise blankers" have been utilized to mitigate this type of impulse noise. These techniques detect the noise pulses and literally turn off the receiver during the time of the impulse. The problem with traditional noise blanking techniques is that they have no way to tell strong signals on the band from impulse noise and can thus "mix" impulses with the strong signals to cause unwanted interference. Maestro incorporates a Wideband Noise Blanking (WNB) algorithm that can differentiate between modulated signals and impulse noise, virtually eliminating the "mixing" problem found in traditional blankers. This WNB algorithm operates in real time over the entire Spectral Capture Unit (SCU) bandwidth to detect and replace impulses with an estimate of the desired signal.

# 11 HOW TO CONFIGURE NOISE MITIGATION

The FLEX-6000 has a number of digital-signal-processing functions that enhance reception in noisy environments.

## 11.1 AGC THRESHOLD

Automatic Gain Control (AGC) is a feature which automatically adjusts the Slice Receiver's audio gain (volume) based on the strength of signals in the receiver's passband filter. The goal of AGC is to amplify weak signals and attenuate strong signals so that they all lie within a comfortable listening range.

The receiver Automatic Gain Control Threshold (**AGC-T**) can be adjusted for optimum performance in noisy or quiet environments. The **AGC-T** sets the maximum gain applied under any circumstances. Since the noise floor is relatively constant on a given band at a given time, the AGC can be adjusted using the threshold control so that the AGC never applies gain to noise, but it will apply gain to signals just out of the noise. In doing so, the AGC can *reduce* the level of noise you hear and help signals pop out of the noise.

The AGC system in Maestro is a dual track system, meaning that it can track both slow and fast increases in signal strength, making appropriate gain correction decisions in the presence of each. The speed of the AGC (FAST, MED, SLOW) determines how quickly or slowly the AGC recovers after attenuating a strong signal. You can easily hear this by tuning to a CW signal and going through the three settings. On FAST with a strong signal you can hear the gain pump up and down while on SLOW it recovers after a longer pause once the signal stops. When the signal stops you will hear the noise floor increase as the gain returns.

**How to Set AGC for Different Operating Conditions**

If you are listening to a loud voice signal, AGC SLOW will resist increasing the gain between syllables and therefore reject most of the noise which is at a level far below the signal. FAST and MED provide faster levels of recovery for situations when you want the system to more closely follow the dominant signal in the passband. Any time you have a very strong signal that causes the gain in the AGC to be reduced, you could experience a loss of gain to a weak signal you are listening to. The filter passband edges, which are continuously adjustable, and TNFs can be used to eliminate signals that might interfere with AGC operation.

The operator might prefer to use SLOW settings when rag chewing in a high signal to noise environment where there isn't much QRN and the noise floor is stable. This keeps the gain at more of a constant level that is less distracting. If the operator is trying to pull a weak CW signal out of the noise, they may prefer to use FAST mode to quickly ensure that the long term average of the noise floor doesn't overcome the signal and prevent it from being heard. MEDium is a reasonable compromise.

When AGC is set to OFF, a *fixed* amount of gain determined by the **AGC-T** setting will be applied to both fast and slow signals regardless of their level. The more you increase the **AGC-T**, the more gain is applied and the louder the signal *and noise* will be. The benefits of increasing SNR with AGC are lost in this mode. Another disadvantage of turning AGC off is that the operator must adjust the 'RF Gain' manually to avoid distortion due to overload by strong signals.

Operating with AGC turned OFF may desired by operators who want to avoid having a strong signal drive a weak nearby signal into the noise floor resulting from AGC audio attenuation, such as when operating digital modes.

To adjust the AGC Threshold, tune to a quiet spot between stations. Starting with the **AGC-T** at a high value decrease the **AGC-T** until the background noise just begins to decrease. This is the **AGC-T** "sweet spot" or the "knee" of the AGC algorithm. Depending on band conditions, if the **AGC-T** is set below 50, you may have to compensate for the loss in audio gain (volume) by increasing the Slice volume to a higher value. When you get the knee and AF volume adjustment correct for the band conditions, it will keep the volume of strong signals constant which will allow weaker signals to be heard even with AGC in FAST mode. Thus **AGC-T** is one of the most important adjustments, and often overlooked, to achieve the maximum weak signal receive performance out of the FLEX- 6000 series SDRs.

The Automatic Gain Control Threshold (**AGC-T**) adjustment is located on the AF/AGCT/SQL multi-function control. Each Slice Receiver has its own settings for the AGC timing and threshold.

The AGC attack/release time is controlled by the AGC button on the Slice Receiver Control Panel. You can choose FAST, MEDium, SLOW or OFF.

## 11.2 DSP NOISE MITIGATION FEATURES

The Slice Receiver Control Panel contains the enable buttons and threshold adjustments for the Wideband Noise Blanker, Slice Specific Noise Blanker, Noise Reduction, and Automatic Notch Filter. The midrange settings of the threshold controls are good starting points for adjustments.


## 11.3 WIDEBAND NOISE BLANKER (WNB)

The Wideband Noise Blanker (WNB) is used to combat fast rise time pulse-type noise such as power line hash and car ignitions. To enable the Wideband Noise Blanker, tap the WNB button, then adjust the threshold control for the best noise suppression. In general, the default setting is adequate, but depending on the noise characteristics, some adjustment can help. The WNB Threshold control adjusts the level at which a sample is considered to be impulse noise. The general rule of thumb for this adjustment is to use the lowest level that is effective. For large impulse noise (meaning the noise floor jumps are large) a lower level should be used. If the impulse noise is causing only small jumps in the noise floor, a higher level can be used.

Large signals, both in the passband and around it, can result in distorted audio if the WNB threshold control is set too high.

Since the Wideband Noise Blanker operates at the Panadapter level rather than at the Slice level easy detection of wideband correlated noise pulses is possible. The algorithm employs an automatic slider normalization function to make the WNB work consistently on different bandwidths and signal levels.

This unique architecture allows pulse removal with far less distortion than many traditional noise blankers.

Given the wideband nature of this feature, the threshold slider controls an entire Panadapter, which may have several Slice Receivers attached to it. This means that the WNB can positively impact not only the audio of Slice Receivers, but also the panafall visual display. For convenience, the slider is available in each Slice and each Panadapter. Adjusting any one of them adjusts an entire Panadapter, and all related slider controls are updated. Enabling and disabling the WNB function is available separately for each Panadapter.

When the WNB detects a significant change in signal level or bandwidth, it attempts to normalize the slider value. During this time, blanking will be momentarily bypassed, and the WNB indicator in the Panadapter will start to flash (blink). Once a suitable normalized slider range has been re-established, the noise blanking action will resume, and the WNB indicator will return to a solid color.

It is possible for certain WNB level settings to cause distortion with certain types of signals. For example, in the proximity of very large signals, noise may become worse with aggressive settings of WNB. If this is the case, either lower the WNB level setting, or disable WNB on that Panadapter.

## 11.4 SLICE SPECIFIC NOISE BLANKER (NB)

The Slice Specific Noise Blanker (NB) is used to combat fast rise time pulse-type noise such as power line hash and car ignitions, on an individual Slice Receiver basis. To enable the Noise Blanker, tap the NB button in the Slice drop-down menu, then adjust the threshold control for the best noise suppression. In general, the default setting is adequate, but depending on the noise characteristics, some adjustment can help. The NB Threshold control adjusts the level at which a sample is considered to be impulse noise. The general rule of thumb for this adjustment is to use the lowest level that is effective. For large impulse noise (meaning the noise floor jumps are large) a lower level should be used. If the impulse noise is causing only small jumps in the noise floor, a higher level can be used.

Unlike the Wideband Noise Blanker, the Slice Specific Noise Blanker algorithm considers only 24kHz of the RF spectrum, centered on the Slice Receiver’s tuned frequency, not the entire SCU RF spectrum, as is the case with WNB. The NB algorithm complements the WNB algorithm and may be used with or without WNB. It may more effective than WNB, less effective or have no effect on specific examples of impulse noise.

The Slice Specific Noise Blanker may be turned on or off and adjusted for each Slice Receiver.

## 11.5 NOISE REDUCTION (NR)

The Noise Reduction processor (NR) will reduce random (“white”) noise making signals more readable which are buried in the noise. It is best to adjust the AGC threshold first, and then enable the Noise Reduction.

The Noise Reduction algorithm uses a correlation based adaptive filter. Noise Reduction increases correlation between input and output with the assumption that noise is uncorrelated and should be canceled out. The threshold adjustment controls the adaptation rate of the filter, so in the case of Noise Reduction, there will be very little audible change while adjusting the threshold unless the noise is changing rapidly or dramatically. The most aggressive settings of Noise Reduction increase the signal to noise ratio but will tend to “color” the signal. The slider should be set for the optimal tradeoff between signal to noise ratio and minimal distortion of the desired signal.

## 11.6 AUTOMATIC NOTCH FILTER (ANF)

The Automatic Notch Filter algorithm uses a correlation based adaptive filter. The Automatic Notch Filter decreases correlation of the input and output since a constant tone is highly correlated and should be canceled out. The threshold adjustment controls the adaptation rate of the filter. If a loud tone is present and you move the receive filter around it, you should hear the tone get canceled at different rates depending on the threshold control setting.

# 12 HOW TO USE PROFILES

Profiles allow the user to name and save the state of the radio and recall it later. Profiles can even be exported and restored on another FLEX-6000 Series radio. This facilitates convenient backup of radio configurations and also helps IT managers of DXpeditions or contest super-stations test configurations and then install or restore them at a site. Individual operators can also save their favorite settings and then, after others have operated, restore the state of the radio.

There are three types of profiles: GLOBAL, TRANSMIT and MIC. Global profiles store the state of the radio including the Panadapters and Slices that are open, the mode associated with each Slice and all of the settings for noise blankers, AGC, filters, etc. Transmit profiles save the transmitter power level, tune power level, transverter power level and the various transmitter delay parameters. MIC profiles save a configuration for a specific microphone or audio source, including the TX filter settings, the MIC selection and level and the DEXP, PROC, DAX, VOX and EQ settings.

Profiles are far superior to traditional "band stacking" in that you can save as many different configurations as desired and give them a meaningful name for recall.

## 12.1 MIC PROFILES

MIC profiles manage a set of radio parameters associated with microphones and other audio sources. These include TX filter settings, MIC selection and level, and DEXP, PROC, DAX and VOX settings. A complete list of the parameters is provided in section **12.7**, **Comparing Profiles and Persistence**.

The MIC profile can be selected from the **Profiles** control panel in the Maestro **Main Menu**. Tap the name of the desired profile, then tap the **Load** button.

MIC profiles can be associated with the mode of a Slice Receiver. The MIC profile in effect at any point in time is determined by the mode of the transmit Slice, or by a Global profile. Two Slice Receivers may exist, set to different modes, but only one controls the transmitter and that Slice determines the MIC profile that is invoked in the radio.

A MIC profile is associated or “linked” with a demodulation mode by selecting a profile from the **Profiles** control panel at the same time that the desired mode is selected in the *transmit* Slice. When a new MIC profile is created, it is associated with a mode in the same way. Note that the modes that can be associated with a MIC profile are SSB, Digital, FM, AM, RTTY and Waveforms.

For the purpose of associating a MIC profile with a mode, modes groups are used. LSB and USB are considered to be a single mode group (SSB), as are DIGU and DIGL (Digital), FM, NFM and DFM (FM) and AM and SAM (AM). RTTY and each Waveform installed in the radio are treated as a separate mode.

To associate or link a Mic profile to a particular mode group, set the transmit Slice to the mode you wish to link, then load or save a Mic profile while the transmit Slice is in that mode. From then on, whenever the transmit Slice is set to that mode the linked Mic profile will be loaded. For example:

- Slice A – Mode is USB
- Load Default FHM-1 Mic profile. (This Mic profile is now linked to the USB/LSB mode group)
- Change Slice A to SAM (This loads the default linked MIC profile Default)

- Load Default PR781 Mic profile. (This Mic profile is now linked to the AM/SAM mode group)
- Change Slice A to LSB or USB. (This loads the Default FHM-1 Mic profile)
- Change Slice A to AM or SAM. (This loads the Default PF781 Mic profile)

When any value associated with a selected MIC profile is changed but not saved, an asterisk (*) will appear before the profile's name in the **Profiles** control panel. If a different profile is selected, either by use of the control panel or by selecting a different transmit mode, the changes will be lost if not saved before changing the MIC profile. Use the Save button in the **Profiles** control panel to save changes to modified profiles.

MIC profiles are band-independent. A MIC profile that is associated with a mode will invoke the same values in any band in which it is used.

***NOTE: If a MIC profile is modified, the change will affect all MODES and Global profiles with which the MIC profile is associated.***

## 12.2 TRANSMIT PROFILES

Transmit profiles manage the transmitter power and interlock settings. The power settings are saved by band, while the interlock settings apply to all bands. The power settings include the transmitter power level, tune power level, ALC, and transverter tune and power levels. The interlock settings include the TX Delay, PTT Timeout, and the controls for the various transmitter engaged signals. A complete list of the settings is provided in section **12.7**, **Comparing Profiles and Persistence**.

***NOTE: Power settings are saved for every band in a Transmit profile. To save the appropriate power settings set a Slice as the TX Slice. Tune to every band in which you want to save a power setting and change the setting. When this is done save the Transmit profile.***

The Transmit profile can be selected from the **Profiles** control panel in the Maestro **Main Menu**. Tap the name of the desired profile, then tap the Load button.

Transmit profiles are linked to the TX Antenna setting in the transmit Slice. When the antenna used by the transmit Slice is changed, the Transmit profile associated with the new antenna selection is invoked. For example:

- Slice A is the transmit Slice. TX ANT is ANT1
- Slice B is NOT the transmit Slice. TX ANT is ANT2
- Load SO2R_TX1 Transmit profile. (This Transmit profile is now automatically linked to ANT1)
- Set Slice B as the transmit Slice.
- Load SO2R_TX2 Transmit profile. (This Transmit profile is now automatically linked to ANT2)
- Set Slice A as the transmit Slice. (This loads the SO2R_TX1 Transmit profile)
- Change Slice A TX ANT to ANT2. (This loads the SO2R_TX2 Transmit profile)

To associate a Transmit profile with a TX antenna, select the TX Antenna you wish to associate in the transmit Slice, then load or save a Transmit profile using the **Profiles** control panel in the **Main Menu**, or select an existing Transmit profile using the drop-down menu.

Each Transmit profile saves a set of power settings, one setting for each band. To save power settings for each band, select the Transmit profile from the drop-down menu, then tune to each band and adjust the power settings. As the adjustments are made, an asterisk should appear before the Transmit profile name in the drop-down menu, indicating that the Transmit profile has been modified. When all bands of interest have been set, save the modified Transmit profile using the **Profiles** control panel in the **Main Menu**.

***NOTE: If a Transmit profile is modified, the change will affect all Global profiles with which the Transmit profile is associated.***

## 12.3 GLOBAL PROFILES

Global profiles manage the state of Panadapters and Slice Receivers and the layout of these components on the Maestro display. Panadapter settings saved in Global profiles include the number of Panadapters on the Maestro display, frequency ranges, bandwidth and scaling and display parameters. Slice Receiver parameters include the frequency, mode, MIC profile, RX and TX filter settings, DAX channel, audio gain and many others. See section **12.7**, **Comparing Profiles and Persistence** for details.

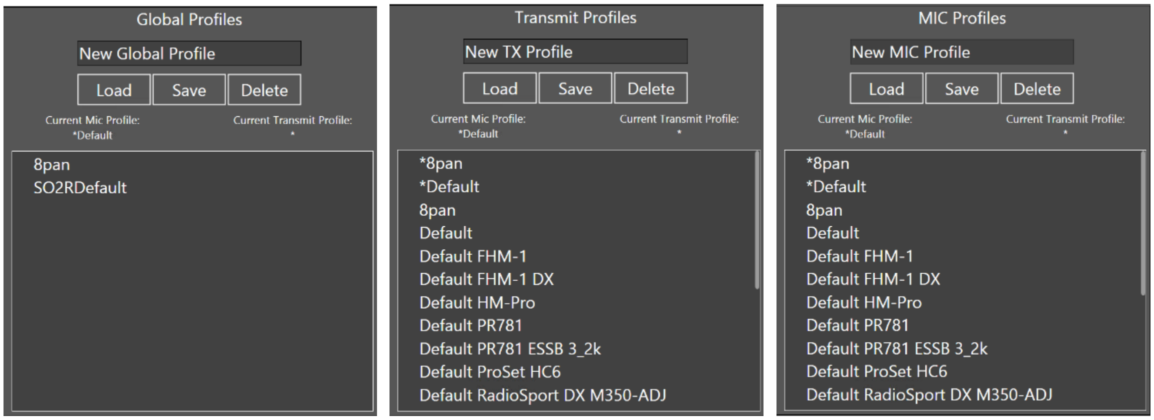
In addition, Global profiles also record the linking of each TX Antenna in each Slice to a Transmit profile, and each Slice Receiver's mode. Invoking a Global profile therefore creates a set of Panadapters and Slices, selects a Slice to control the transmitter, then invokes the Transmit profile indicated by the selected TX antenna and the MIC profile. Selection of a different Slice to control the transmitter may change the selected Transmit and MIC profiles. Similarly, changes to the selected TX antenna or mode within the transmit Slice may change the selected Transmit or MIC profiles.

To create or save a Global profile, configure all Panadapters and Slice Receivers to the desired settings. TX Antennas and modes should be set to the desired values. Each TX Antenna that will be used in the Global profile should be selected and then linked to a Transmit profile by selecting the profile in the **Profiles** control panel. Select the mode and MIC profile in each Slice Receiver. When these adjustments are complete, save the Global profile using the **Profiles** control panel.

Note that changes made to Panadapters and Slices are not automatically saved to a loaded Global profile. Changes to existing Global profiles can only be made by manually re-saving the profile using the **Profile** control panel.

## 12.4 SAVING AND DELETING PROFILES

On the **Profiles** control panel tap the Global, TX or MIC option appropriate for the profile you wish to save or delete. This will bring up one of the following Profile control panels:




To save a new profile, type the desired name into the text box at the top of the control panel and tap Save. Saving a Global profile saves the Panadapter settings, the CWX settings, and the Slice Receiver configuration. Saving a Transmit or MIC profile will save only the settings related to the transmitter or microphone. See section **12.7**, **Comparing Profiles and Persistence**. for details.

***Note: When creating a new global profile, it must have a TX and MIC profile associated with it. At the time the new global profile is saved, if there isn't a TX or MIC profile associated with the global profile, new TX and MIC profiles are created having the same profile name as the global profile.***

Take care when creating a new MIC profile to ensure that the Slice Receiver that is selected to control the transmitter also selects the mode to be associated with the new MIC profile. If this is not the case, the new MIC profile may become associated with the wrong mode.

For the purpose of creating a MIC profile, LSB and USB are considered to be a single mode (SSB), as are DIGU and DIGL (Digital), FM, NFM and DFM (FM) and AM and SAM (AM). Each Waveform installed in the radio is treated as a separate mode.

To delete a profile, select the appropriate profile name and tap the delete button.

***Note: Performing a database reset from the front panel of the radio will delete all non-default profiles. It is recommended that you export your profiles with all options selected before performing a database reset.***

## 12.5 LOADING PROFILES

To load a profile from the **Profiles** control panel, select the desired profile and tap Load.

***Note: You can load profiles created by different FLEX-6000 models without any adverse interactions.***

## 12.6 DEFAULT PROFILES

A number of default profiles are included in the radio software. These profiles provide a basic level operation for the radio and are listed in the illustrations in section **12.4, Saving and Deleting Profiles** above.

A default global profile, *SO2RDefault*, provides an example setup of the radio for SO2R operation. See section **24.3.1**, **FLEX-6700 SO2R Operation** for more information. The default Transmit profiles provide common transmitter settings for “barefoot” operation. The default MIC profiles provide example values for microphone level, transmit filters, DEXP settings, voice processor settings, equalization settings and other settings for a number of popular microphones and headsets.

Default profiles can be modified or deleted from the radio using the **Profiles** control panel, but will be restored if the radio is reset to the factory defaults (see section **29**, **Restoring to Factory Defaults**).

***Note: Default profiles can be modified, but the modifications cannot be saved using the default profile name. A new profile name has to be entered.***

## 12.7 COMPARING PROFILES AND PERSISTENCE

Profiles are different from persistence. As described above, profiles are a way to manually save and restore a complete radio configuration and then return to that configuration later. Profiles require action on your part to both save and restore, but are a very quick way to put the radio in exactly the state you want.

Persistence, always enabled on your Signature Series radio, remembers settings from band to band without your direct action so that when you return to a band your settings are restored. For example, if you are operating on 20m and set the output power to 60W, then go to 10m and set the output power to 100W and then go back to 20m, persistence will return your 20m power to 60W. Resetting the radio to the factory settings (see section **29**, **Restoring to Factory Defaults**) will clear the persistence settings.

Persistence remembers a large number of settings as shown in the following table:

| **Radio** | | |
|---|---|---|
| | PTT Timeout | Show mic meter in receive |
| | TX1/2/3/Acc enabled and delay | Show transmit signals in Waterfall |
| | TXREQ enabled and polarity (RCA & ACC) | DAX transmit enabled |
| | Speaker volume and mute | Hardware ALC enabled |
| | Headphone volume and mute | Transmit inhibit setting |
| | Remote audio enabled | VOX Level and hang time |
| | Processor enabled and setting | Raw I/Q mode enabled |
| | Selected microphone | Transmit filter passband (low, high) |
| | CW/CWX Keyer speed | AM Carrier Level |
| | CW/CWX breakin delay | CW Sideband (CWL or CWU) |
| | CW Pitch | CW Iambic mode / straight key |
| | CW Monitor enabled / level / pan | CW/CWX synchronize settings enable |
| | SSB monitor enabled / level / pan | Reference calibration offset |
| **Mode** | | |
| | Selected microphone | |
| **Microphone** | | |
| | Bias enabled | Level |
| | Boost enabled | Compander settings |
| | Accessory Mix enabled | |
| **Slice** | | |
| | Frequency | AGC Mode |
| | Filter limits | **AGC-T**hreshold / AGC Off Level |
| | Mode (USB, CW, etc) | Mute state |
| | RX Antenna | Audio level, pan |
| | TX Antenna | WNB, NR, ANF, APF states and levels |
| | TX state (is this the transmit Slice?) | Diversity state / Slice |
| | DAX channel | FM tone mode |
| | Squelch settings (for FM) | FM repeater offset |
| **Panadapter** | | |
| | Center Frequency and Bandwidth | DAX I/Q Channel |
| | RX Antenna and Loop settings | Display frames per second |
| | Preamplifier setting | Display averaging settings |
| | Display min/max dBm | |
| **Waterfall** | | |
| | Auto-black enable and level | Gradient selection |
| | Scroll speed (line duration) | Color gain |

| Global Profile Fields | | | |
|---|---|---|---|
| **PANADAPTER** | **CWX** | **SLICE** | **Global** |
| Center Frequency | CWX Macro 1 | Frequency | RX EQ Enable |
| XVTR Frequency | CWX Macro 2 | XVTR Frequency | RX EQ Levels (all frequencies) |
| XVTR Key | CWX Macro 3 | XVTR Key | Full Duplex ON/OFF |
| Bandwidth | CWX Macro 4 | Diversity | |
| RX Antenna | CWX Macro 5 | Mode | |
| Loop A Enabled | CWX Macro 6 | RX Filter Low | |
| Loop B Enabled | CWX Macro 7 | RX Filter High | |
| RF Gain | CWX Macro 8 | RX Ant | |
| Min dBm | CWX Macro 9 | TX Ant | |
| max dBm | CWX Macro 10 | Parent Panadapter | |
| FPS | CWX Macro 11 | Is this Slice the TX Slice | |
| Averaging ON/OFF | CWX Macro 12 | DAX Channel | |
| Weighted average ON/OFF | | Is muted? | |
| DAX IQ Channel | | Audio Gain | |
| Waterfall black level | | Audio Pan | |
| Waterfall color gain | | Is locked? | |
| Waterfall line duration level | | AGC Mode | |
| Waterfall autoblack ON/OFF | | AGC Threshold | |
| Waterfall gradient | | AGC Off Level | |
| Waterfall Type | | NR Enabled | |
| Show TX in Waterfall | | NR Level | |
| | | NB Enabled | |
| | | NB Level | |
| | | ANF Enabled | |
| | | ANF Level | |
| | | APF Enabled | |
| | | APF Level | |
| | | Squelch Enabled | |
| | | Squelch Level | |
| | | FM Tone Mode | |
| | | FM Tone Value | |
| | | FM Repeater Offset | |
| | | TX Offset Frequency | |
| | | FM Repeater Offset Direction | |
| | | Diversity Child AGC Mode | |
| | | Diversity Child AGC Level | |
| | | Diversity Child Audio Gain | |
| | | Diversity Child RX Ant | |

| TX Profile Fields | |
|---|---|
| **Interlock** | **Power** |
| TX Delay | Hardware ALC Enabled |
| PTT Timeout | Tune Level |
| PTT Inhibit | Power Level |
| ACC TX Request Enable | XVTR Tune Level |
| RCA TX Request Enable | XVTR Power Level |
| ACC Polarity | |
| RCA Polarity | |
| ACC TX Relay Enable | |
| ACC TX Relay Delay | |
| TX Relay 1 Enable | |
| TX Relay 1 Delay | |
| TX Relay 2 Enable | |
| TX Relay 2 Delay | |
| TX Relay 3 Enable | |
| TX Relay 3 Delay | |

| MIC Profile Fields |
|---|
| TX Filter Low |
| TX Filter High |
| Mic Selection |
| Mic Level |
| Mic Boost |
| Mic Bias On/Off |
| DEXP Enable |
| DEXP Level |
| PROC Enable |
| PROC Level |
| Monitor Enable |
| Monitor Level |
| Monitor Pan (L/R) |
| DAX Input Enable |
| VOX Enable |
| VOX Level |
| VOX Delay |
| Show MIC Meter in RX Enable |
| AM Carrier Level |
| TX EQ Enable |
| TX EQ Levels (all frequencies) |

# 13 HOW TO OPERATE MAESTRO AUDIO

Maestro can be operationally “decoupled” from the radio hardware by playing Slice Receiver audio through the Maestro speaker (or other attached playback device) and using a connected microphone or other audio input device to make phone QSOs. This feature streams compressed audio over the Ethernet connection between the radio and the Maestro, eliminating the need for the speakers and microphone to be directly connected to the radio hardware. Although from the perspective of the radio the audio is remote, from the perspective of Maestro, this is the conventional way audio is handled.

In order to provide diagnostic capabilities for the Maestro audio feature, monitors are included in the Maestro software. The Network Quality Monitor and Audio Streaming Monitor provide a visual indication of a network’s capability to adequately stream audio to Maestro, which is essential when using a wireless link between Maestro and the radio hardware.

Maestro audio uses a compressed audio format suitable for transmission over the local area network. Compression is accomplished with the Opus codec. Opus is an audio coding format developed by the Internet Engineering Task Force (IETF) and has been standardized in RFC 6716. Although technically lossy, Opus provides excellent fidelity with minimal bandwidth usage.

## 13.1 PLAYING SLICE AUDIO USING THE DEFAULT PLAYBACK DEVICE

As noted above, Maestro audio uses the playback and recording devices available to Maestro. Tapping the **Main Audio Out** button located in the **Audio** tab of the Maestro **Main Menu** enables streaming of Slice audio from the radio to the Maestro playback device (speakers or headphone). When Maestro audio streaming is enabled the **Main Audio Out** button will be highlighted.

## 13.2 TRANSMITTING USING A CONNECTED RECORDING DEVICE

In order to transmit using a microphone connected to the Maestro you will need to select from the M-MIC1, M-MIC2 or M-LINE inputs in the TX control panel. Press the inner knob of the transmitter multi-function control to open this control panel, and tap the desired input device.


Transmit can be triggered using the MOX button on the transmit panel or using VOX, or any PTT input.

***Note: Maestro has an override feature which allows microphones other than the selected microphone to be used during a transmission. This is discussed in section 13.4, PTT Override when Operating LAN Remote below.***

## 13.3 CONFIGURING THE AUDIO OUTPUT DEVICES

The Maestro provides several audio output options. A speaker is built into the front panel of the Maestro. The **Front Speaker** button in the **Audio** control panel of the **Main Menu** enables and disables the speaker. Plugging a headphone or similar device into the back panel **Phones** connector disables the front panel speaker regardless of the **Front Speaker** button state.

The back panel of the Maestro provides a connector for the connection of powered speakers and a similar connector that provides a line level output. Plugging devices into these connectors does not affect the front panel speaker.

## 13.4 PTT OVERRIDE WHEN OPERATING LAN REMOTE

When operating in a non DIGx mode, using a hardware PTT such as the RCA PTT input on the transceiver back panel or the transceiver front panel microphone PTT will override the Maestro PTT. This feature is provided to allow an operator at the transceiver to override the Maestro input with a PTT switch connected directly to the radio.

## 13.5 OPERATING CW WHEN USING LAN REMOTE

A key or paddles can be connected to the Maestro back panel **Key** connector. CW signals generated by the internal Winkeyer 3 module are transmitted from Maestro to the transceiver across the network connection. Sidetone from the keyer is generated inside Maestro and played out of the speaker, headphones or powered speaker output. CW operation, especially in contest and DX environments, tends to be fast paced and relatively intolerant of delays which can add confusion.

Many issues can affect the LAN performance of Maestro including, but not limited to, the wireless router used, the congestion on local wireless channels, settings inside the router such as packet coalescing and duplex modes, cabling issues such as interference from florescent light ballasts on the wired connection to the router, etc. The network diagnostics in Maestro can help diagnose these, but in the event that network issues are suspected, a thorough investigation of the network may be in order.

Generally, wired networks will perform better than wireless networks. In many cases, the Internet will have better packet latency and jitter performance than a wireless network with some degree of congestion. For this reason, FlexRadio recommends using wired networks for CW as there tend to be less issues that require troubleshooting on wired networks. Maestro will always attempt to compensate for any jitter or latency caused by any kind of network, but the mechanism for compensation is to add latency to ensure a steady stream of CW at the radio transmitter.

## 13.6 MONITORING REMOTE AUDIO AND NETWORK PERFORMANCE

There are two ways to monitor the performance of the network while using Maestro. The first is with a convenient Network Health Indicator display in the top middle of the Maestro display. The second is a detailed Network Diagnostics display.

### 13.6.1 Network Health Indicator

The network health indicator provides a quick way to determine if your network connection is performing well enough to properly operate your radio for both remote and local modes of operation. As shown below, the indicator is a series of “bars”, usually green, indicating error free streaming at a sufficient rate.


If network errors do occur, the number of illuminated bars in the indicator will decrease. As long as the indicator is green, the radio should perform properly. If the indicator changes to yellow, occasional audio dropouts and screen freezes may occur, but the radio will continue to operate. Once the health indicator drops to red bars or no bars, the link is not reliable enough to maintain communications.

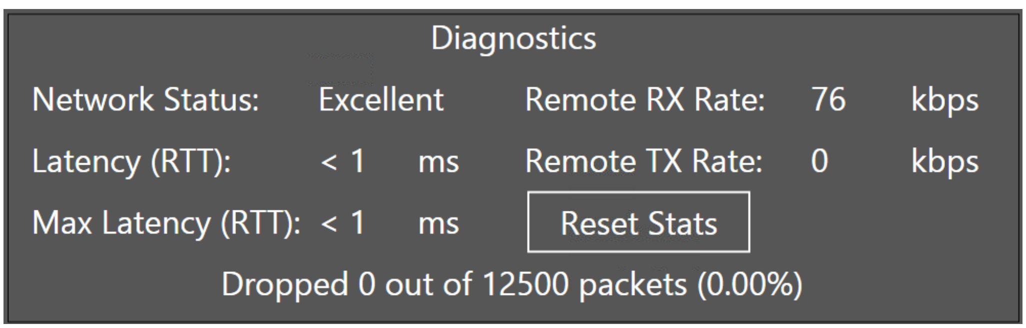
### 13.6.2 Network Diagnostics

When LAN issues occur with Maestro, it is useful to have additional details to aid in diagnosing the problem. A Network Diagnostics feature provides this information. To access this information, open the **Network** tab in the **Main Menu**.

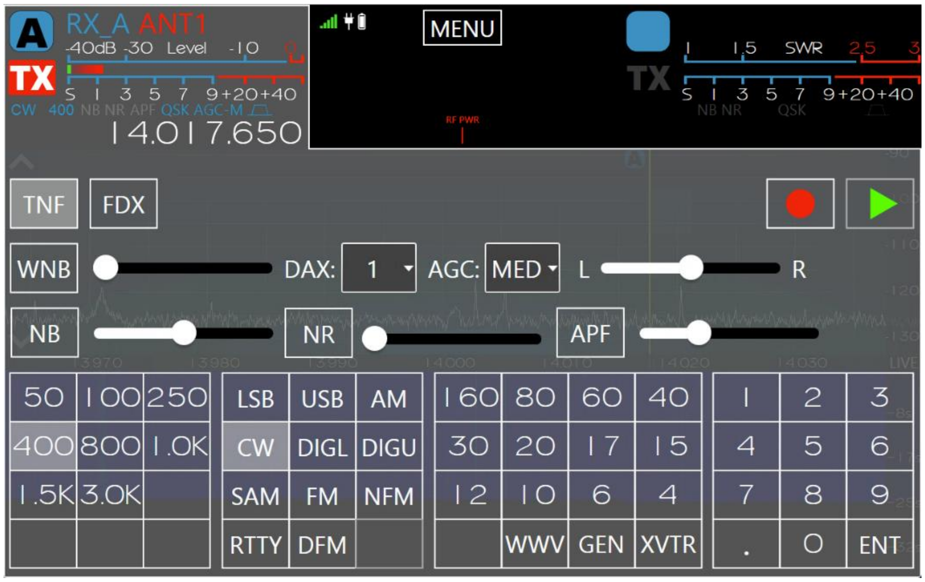
The Network Diagnostics show several types of diagnostic data. There is a **Network Status** indicator that describes a summary of the quality of your network connection. **Latency (RTT)** is the round trip time in milliseconds for a keep-alive packet to be sent between the Maestro and the radio hardware. A lower number indicates better network quality. On a LAN, **Latency (RTT)** should be no more than a few milliseconds and should not vary greatly. For a wireless network link, this number may be much higher and can vary depending on factors inherent to wireless network links such as signal attenuation and multipath reflections. **Max Latency (RTT)** is the greatest observed value of **Latency (RTT)**. If this number is much higher than the real-time **Latency (RTT)** values, this indicates a network link that has a lot of quality variability, which in general is not desirable.

The **Remote RX** and **TX Rates** are the rates, in kilobits per second, of all data sent over the LAN including audio, control commands, and display information for panadapters and waterfalls.

Additionally, there is a listing of the number of dropped packets and the total number of data packets sent between the radio and the Maestro since the Network Diagnostic data was reset or since the Maestro started. On a healthy LAN connection with sufficient bandwidth, you should not experience any dropped packets. When using a wireless network connection, dropped packets cannot be avoided and you may observe the occasional dropped packet. However, if you observe a rising number of dropped packets, greater than 0.10% after the radio has been running for several minutes, this is an indication that your network lacks sufficient capacity or throughput to provide error free operation. You can reset this count tapping on the Reset Stats button.



# 14 HOW TO OPERATE CW MODE

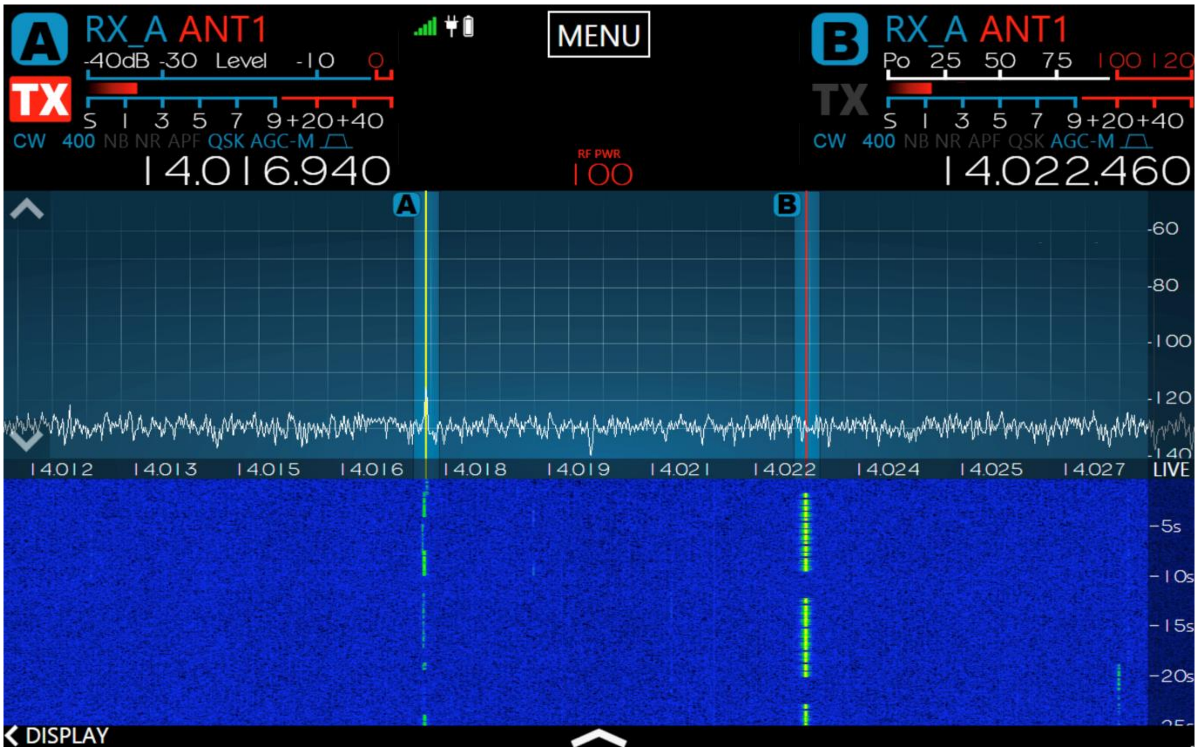



To use Maestro in CW mode, select CW in the Slice control panel. This shows the narrower CW receive filter presets in the Slice control panel and brings up the CW specific controls in the **TX Menu**.

The CW display is slightly different from the SSB display. In CW mode, the Slice carrier indicator line is in the center of the receiver passband. This coincides with the CW carrier frequency. It shows exactly the location of your transmitted carrier. The pitch of received CW signals depends on the value of the Pitch control in the CW Transmit Control Panel (see section **28.6.2**, **CW Mode Transmitter Control Panel**) and the distance of the CW carrier from the tuned frequency.

## 14.1 HOW TO OPERATE CW IN SPLIT MODE

Many DXpeditions prefer to operate in split mode, in which they transmit on one frequency, but listen on another, up or down a few kilohertz. In order to do this with Maestro, the A Slice must be set to the DX station's transmitting frequency, and the B Slice must be inactive. Press the B slice TX button or the Split button if you have defined this as a function key (see section **25.4**, **Function F1-F6 Tab**). The B Slice will become active, its frequency will be set to a value 1 KHz higher than the A Slice's frequency and the transmitter control will move to the B Slice. Your Panadapter display should look similar to this:

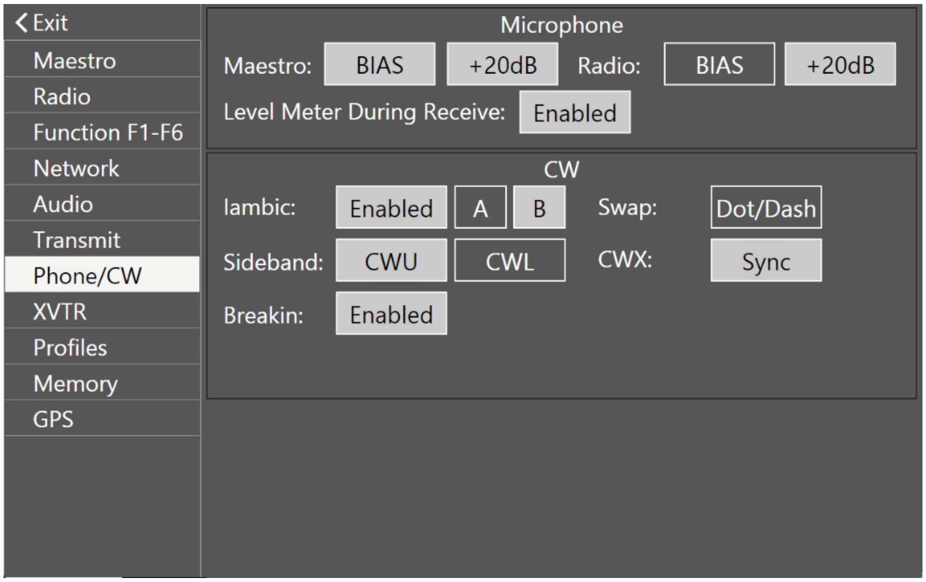



If you prefer, you can use the Slice audio controls to pan the Slice audio so one receiver is in your left ear and the other is in your right ear. Touch and drag the L/R control in the Slice control panel to move that Slice's audio to the left or right ear.

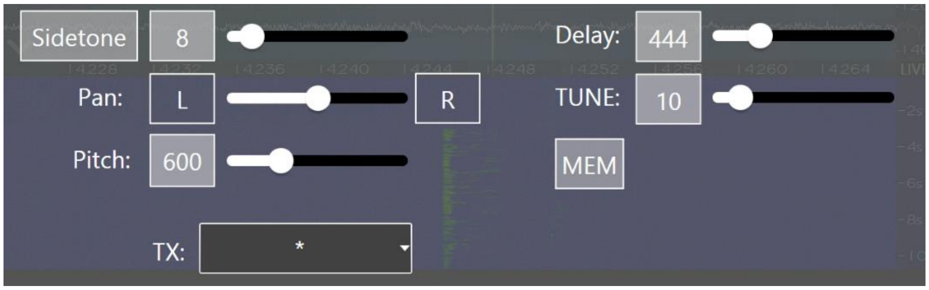
To leave split mode and restore the transmitter to the A slice, you must use the Split function button which should be illuminated from when split was entered. To leave split mode and disable the transmitter, press the B-RX button to remove the B slice.

## 14.2 CW TRANSMITTING

In order to transmit in CW mode using the keyer built-into the FLEX-6000 radio, you will need either a straight key or an iambic paddle. Refer to the FLEX-6000 Hardware Reference Manual for wiring instructions.




*Main Menu, Phone/CW tab*

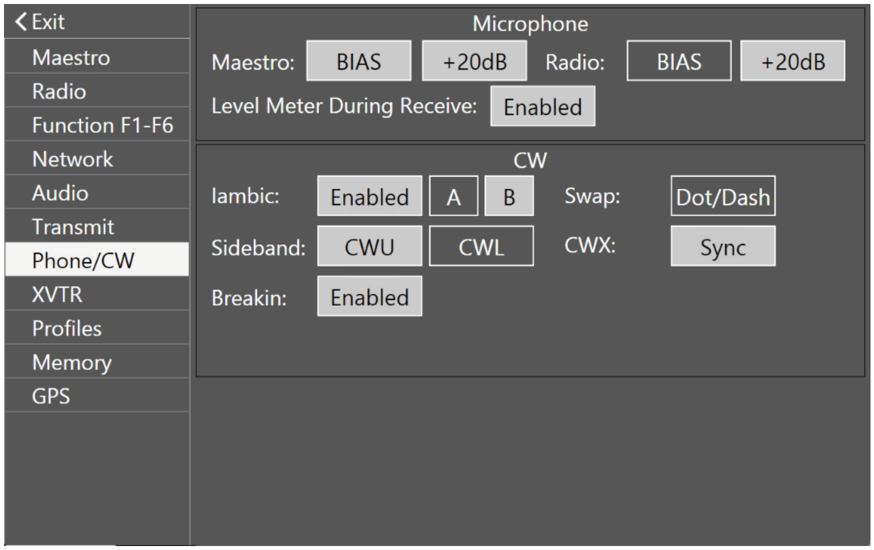



*TX Menu, CW Mode*

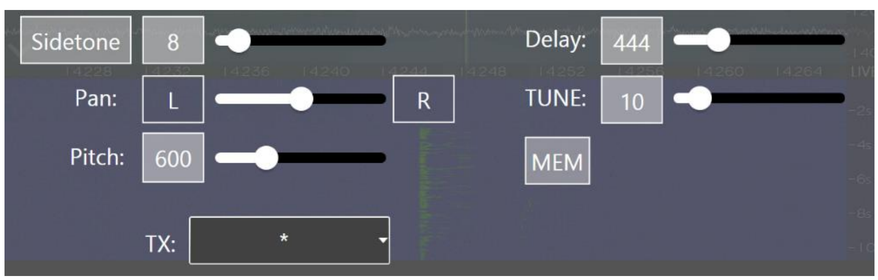
To use a straight key, disable the **Iambic** control and enable **Dot/Dash Swap** in the Phone/CW control panel in the Maestro **Main Menu**. Connect the straight key to the tip and sleeve of a 1/8$^{th}$ inch TRS plug, and connect it to the **Key** input on the back panel of the Maestro. The **Breakin** control allows automatic PTT when the key is pressed. The **Delay** slider in the **TX Menu** sets the PTT hold time for break-in in milliseconds. It can be set anywhere from zero (full QSK), to 2000 milliseconds (2 seconds). See section **28.6.2**, **CW Mode Transmitter Control Panel** for details about these controls.

## 14.3 USING THE BUILT-IN KEYER

Maestro has a built-in iambic keyer that can be used either as iambic "A" or iambic "B". Controls for the keyer are found on the **Phone/CW** tab of the Maestro **Main Menu**. See section **25.8, Phone/CW** Tab for details about these controls.




The keyer speed can be set between 5 and 100 WPM using the **Speed** control (inner knob) on the Transmitter multi-function control. The **IAMBIC** selector must be enabled to use the built-in keyer. The **Sidetone** control will increase or decrease the sidetone volume in the speakers and headphones. Note that the sidetone button to the left of the slider should be illuminated to enable sidetone output.



## 14.4 HOW TO OPERATE QRQ (HIGH SPEED) CW WITH QSK

All FLEX-6000s are capable of full QSK operation. In order to achieve the full benefit of QSK, the **Delay** control on the CW TX Menu must be set to zero. This will allow the transmit/receive switching to occur immediately upon release of the key. In QSK mode the FLEX-6000s use a very fast reed relay for CW T/R switching, but at higher CW speeds, above 30 WPM, better inter-element receiving results are obtained by using one antenna for transmit and a different antenna for receive. Refer to section **20**, **How to Configure Antennas** for information on how to configure separate transmit and receive antennas. Full break QRQ is only available in the FLEX-6700 model.

## 14.5 HOW TO CONNECT AN EXTERNAL KEYER USING THE FSK/KEY INPUT ON THE ACCESSORY CONNECTOR

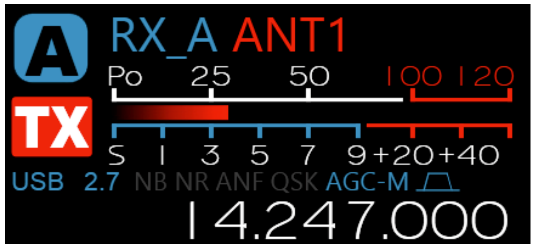
In CW mode, the FSK/Key input on the FLEX-6000 rear panel accessory connector (pin 4) can be used as a straight key input. This is useful if you wish to attach an external keyer, such as a K1EL WinKeyer, microHAM microKEYER, or other contest-oriented interface. This input is always active, and is not affected by the FLEX-6000 internal keyer settings. It's therefore possible to use both the external keyer, and the internal keyer at the same time.

## 14.6 USING CW WITH A CONTEST LOGGER

At the time of this writing, SmartSDR for Maestro v1.7 has certain limitations with respect to CW contesting that should be considered if you will be using a logger in conjunction with the Maestro and a FLEX-6000. A typical contesting setup would include a logger, such as Logger+ from N1MM, that is connected to the FLEX-6000 via a CAT interface. An additional Winkeyer emulation interface is provide in CAT (see the *SmartSDR for Windows* Software Manual) which will allow Logger+ to send CW through the radio using Winkeyer commands. Using this method will only produce CW sidetone in the radio speaker and headphone outputs. This limitation, which is likely to be lifted in the future, may conflict with using the Winkeyer inside of Maestro because the sidetone for the Winkeyer is only output through the Maestro speaker and headphone connections, to avoid unnecessary network delay in the sidetone which can affect keying comfort in the CW operator.

Because of this limitation, it is recommended that headphones and CW paddles be connected to the radio when Maestro is used for CW operation in conjunction with a logger. Again, this limitation will likely be removed in a future release of SmartSDR for Maestro.

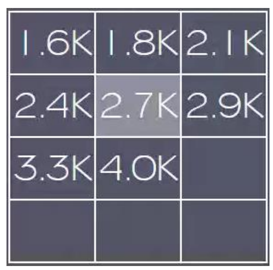
# 15 HOW TO OPERATE SINGLE SIDEBAND MODE (SSB)




To use the Maestro in SSB mode, select either USB or LSB in the Slice Receiver Control Panel. This brings up the SSB receive filter presets and shows the SSB specific controls in the transmit panel. Conventional USB or LSB settings are automatically selected for each band when the band selection panel is used.

In SSB modes, the Slice carrier indicator line will be located to the left of the receiver passband for USB and to the right for LSB. It shows exactly the location of your transmitted SSB suppressed carrier frequency. If the Slice is the active Slice, the carrier indicator line will be displayed in yellow. If the other Slice is active, it will be displayed with a red carrier indicator.

## 15.1 HOW TO SELECT THE SSB RX FILTER BANDWIDTH




Standard SSB receive filter bandwidths from 1.6K to 4.0K can be selected from the Slice Receiver Control Panel. Custom bandwidths can be adjusted by use of the High/Low Shift/Width multi-function control. When the control is in High/Low mode, adjusting the inner knob moves the location of the lower frequency margin of the filter, while adjusting the outer knob moves the location of the higher frequency margin. Pop-up displays provide detailed information as the adjustments are made.

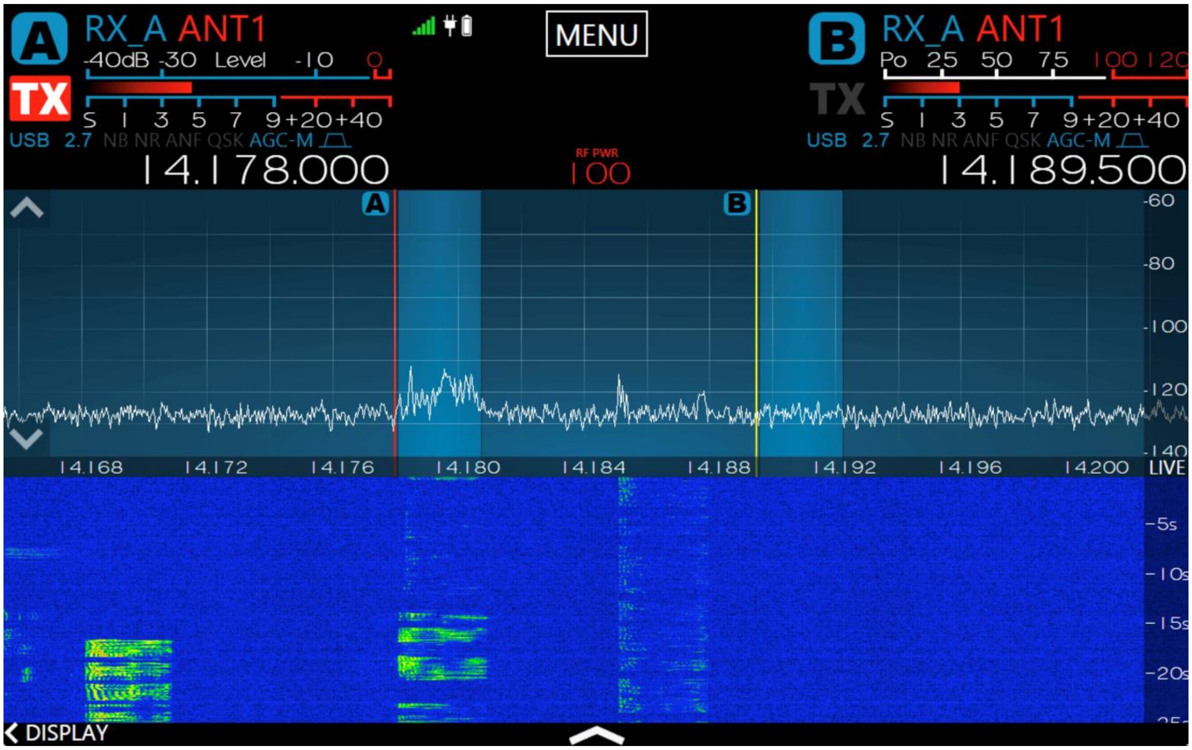
## 15.2 SELECTING RX FILTER FAVORITES

A favorites function allows the selection of the most commonly used filter bandwidths and provides a convenient way to toggle between these filters. To select a favorite, press and hold your finger on the square containing the favorite filter. A small triangle will be added to the filter square. Do this for as many favorites as desired.

A short press of the BW Select knob will cycle through the filters chosen as favorites.

## 15.3 HOW TO OPERATE SSB IN SPLIT MODE

Many DXpeditions prefer to operate in split mode, in which they transmit on one frequency, but listen on another, up or down a few kilohertz. In order to do this with Maestro, the A Slice must be set to the DX station's transmitting frequency, and the B Slice must be inactive. Press the B Slice TX button or the Split button if defined. The B Slice will become active, its frequency will be set to a value 5 KHz higher than the A Slice's frequency and the transmitter control will move to the B Slice. Your Panadapter display should look similar to this:



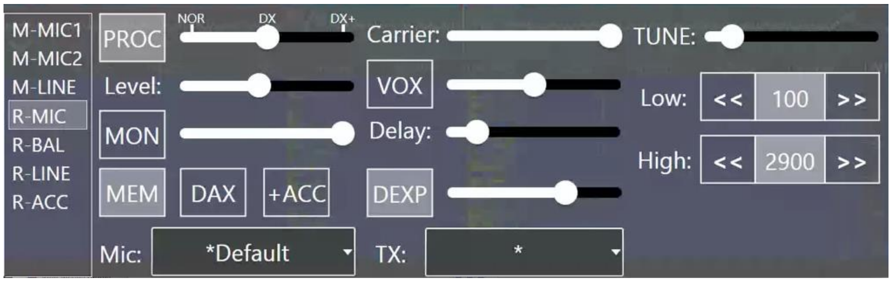

If you prefer, you can use the Slice audio controls to pan the Slice audio so one receiver is in your left ear and the other is in your right ear. Touch and drag the L/R control in the Slice control panel to move that Slice's audio to the left or right ear.

To leave split mode and restore the transmitter to the A slice, you must use the Split function button which should be illuminated from when split was entered. To leave split mode and disable the transmitter, press the B-RX button to remove the B slice.

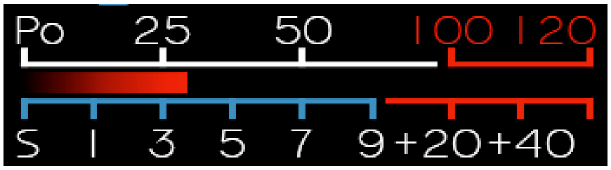
## 15.4 HOW TO CONFIGURE THE AUDIO CONTROLS FOR PHONE MODES

Connect a suitable microphone to the 8-pin front panel connector or to the balanced microphone input of the FLEX-6000 transceiver, following the instructions provided in the FLEX-6000 Hardware Reference Manual. Or, connect a microphone to the RJ45 MIC1 connector or the 1/8th inch TRS MIC2 connector on the back panel of the Maestro. Press the Maestro **TX Menu** button to bring up the transmitter control panel, then select the appropriate microphone from the microphone list at the left side of the control panel. See section **28.6.1**, **Audio Modes Transmitter Menu** for a description of the inputs. See section **15.4.7**, **DAX TX Channel and Microphone Interaction** for information about coordinating DAX TX channel usage with microphones.

### 15.4.1 Setting the Transmit Filter Bandwidth




The bandwidth of a single sideband transmission is determined by the **Low** and **High** bandwidth controls found on the **TX Menu**. The bandwidth is adjustable up to 10 KHz in 50 Hz steps. The transmit bandwidth is double for symmetric sideband modes such as AM.



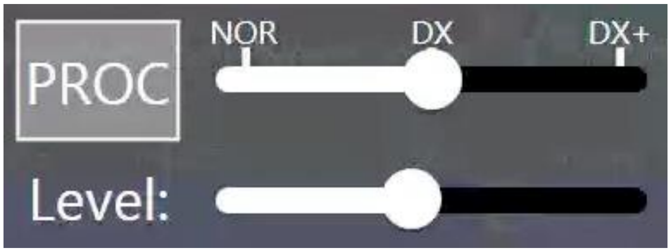

Each Slice Receiver can display an input level meter. Tap the Slice Receiver meter display to cycle through the available meters. There are two indicator components of the microphone or input Level meter that show the actual audio input level. The leftmost component is a solid bar indicating the average input level and the smaller box-like component farther to the right of the average input level bar is the peak level indicator. The Level meter indicator bars also utilize three colors to visually indicate the input level range. Signals up to -10 dB are shown in green. Signals levels between -10 and 0 dB are shown in yellow. Any signal level greater than 0 dB is shown in red.

When setting up your microphone audio for optimal modulation, adjust the input gain so that the peak level indicator is peaking just BELOW the 0 dB on voice peaks. It is very important that your peak level indicator never exceed 0 dB and turn red at any time. A red peak level indicator indicates over-driven or “clipped” input audio levels resulting in audio distortion. The input ALC is active, but excessive input signal levels may result in input signals that can exceed 0 dB. If you see the peak level indicator turn red at any time, turn down the audio input level until you no longer see the peak level indicator turn red.

The compression meter indicates the amount of compression provided by the speech processor based on the PROC setting and the input gain level. This meter is informational only and is not used in setting microphone levels.

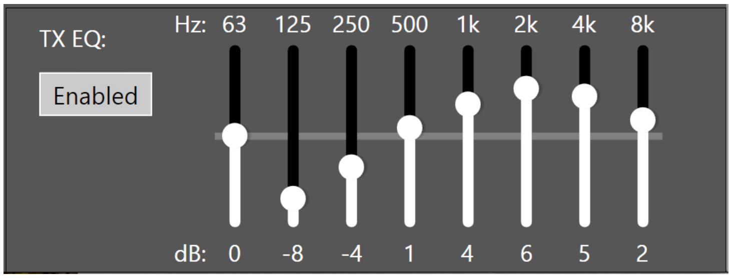
### 15.4.2 Operating the Speech Processor

The speech processor implements the W9GR Controlled Envelope Single Sideband (CESSB) peak limiting algorithm in SSB, AM and FM modes. The processor may be on or off and has three different settings when enabled. In the NOR or normal setting, the processor provides minimal additional gain and simply prevents audio peaks from clipping or producing power in excess of the set level. In the DX setting, some compression is provided to the audio to increase the overall sideband envelope which results in a stronger signal that may be more readily heard at a distance. The DX+ setting adds even more compression increasing your talk power or "punch" without incurring significant audio distortion. DX+ is most effective if you increase the low cut TX filter to between 200-400 Hz in order to concentrate your talk power in the audio frequency range that has the greatest intelligibility.

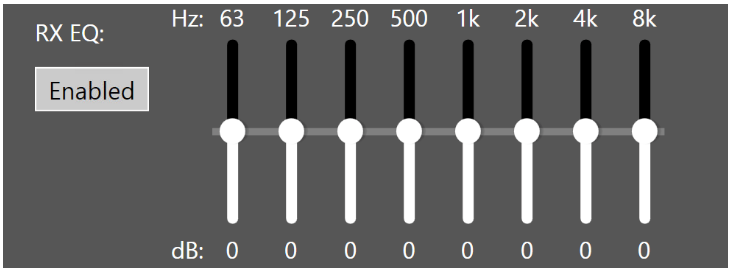



The recommended setting is to leave the speech processor enabled and in the NORmal or DX position.

### 15.4.3 How to Configure the Equalizer (EQ)

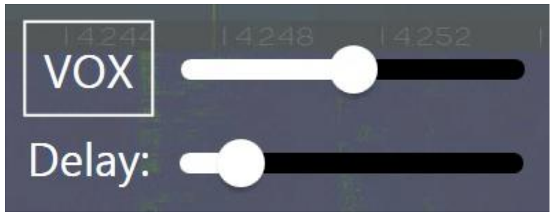



The Transmit Equalizer control panel is found on the **Transmit** tab of the **Main Menu** as shown above. When enabled, the graphic equalizer can be optimized for different microphones and operating styles such as DX, contesting and ESSB. The sliders provide a +/- 10 dB adjustment range over eight octaves. The settings shown above provide very good audio quality for many dynamic microphones.



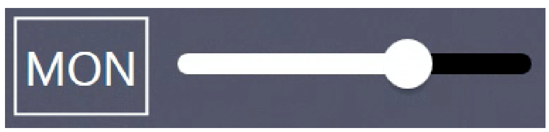
In a similar fashion, the Receive Equalizer is found on the **Audio** tab of the **Main Menu** as shown above. When enabled, the graphic equalizer can be optimized for different listening conditions and operating styles. The sliders provide a +/- 10 dB adjustment range over eight octaves.

### 15.4.4 How to Configure VOX




The VOX controls are found in the **TX Menu**. Tap the VOX button to enable voice operated transmit operation and adjust the VOX gain slider to adjust the VOX sensitivity. Sensitivity should be adjusted to the minimum that allows reliable keying by the voice without keying from other room noises. **VOX Delay** sets the hang time before the transmitter unkeys after you stop speaking. The delay should be set to be comfortable for the style of operation desired. See section **15.4.7**, **DAX TX Channel and Microphone Interaction** for details concerning the interaction of VOX and the DAX TX channel.

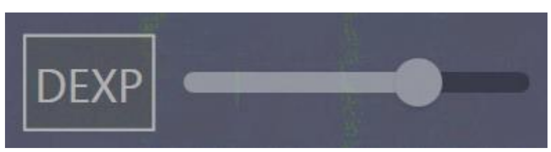
### 15.4.5 Monitor Mode Operation




The Monitor controls are found in the **TX Menu**. Monitor mode is enabled by tapping the MON button. The monitor level may be controlled by the adjacent slider.

***Note: The MON feature allows for monitoring of the processed audio prior to the final brick wall filtering and ALC limiting, compression and equalization, allowing the operator to listen to the transmitted audio in "real time" with minimal latency or delay. However, since the monitor audio bypasses the signal processing stages, the audio heard in the monitor is not the same as what is being transmitted and therefore is not suitable for determining the over the air quality of your transmitted signal.***

### 15.4.6 How to Configure the Downward Expander (DEXP)




The Downward Expander controls are found in the **TX Menu**. The Downward Expander reduces the microphone input gain during the quiet periods between spoken words, eliminating extraneous background noise. This improves the apparent signal to noise ratio of your transmitted audio by "soft gating" ambient room noise between words.

To adjust the Downward Expander, enable **DEXP** and move the DEXP Threshold slider to 0. While transmitting and listening with MON without speaking, adjust the DEXP Threshold until you can no longer hear the background or ambient noise at your operating position. In most cases a DEXP threshold level of 60-70 should be sufficient.

### 15.4.7 DAX TX Channel and Microphone Interaction

When the DAX TX channel has been selected to provide audio for the transmitter (DAX button in the **TX Menu**), the radio will still accept audio from the selected microphone as long as the DAX TX stream contains no data. As soon as data appears, the DAX TX channel become the transmitted audio.

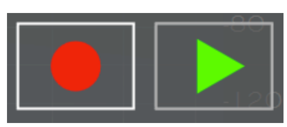
This feature is provided to support voice keyer configurations. The user can enable both the DAX TX channel and a microphone and use the microphone normally as long as the voice keyer program is not sending a message. When a voice keyer message is desired, the associated program simply plays the audio into the DAX TX channel and transmitter automatically switches to it, overriding the microphone.

In a similar fashion, VOX can be triggered from either the DAX TX channel or the selected microphone audio. If the DAX TX channel information is above the VOX triggering level, DAX will key the radio.

## 15.5 MONITORING YOUR TRANSMITTED AUDIO

The Quick Record and Playback feature in Maestro can be used to monitor your transmitted audio. The audio recorded in this manner represents transmitted audio using all of the enabled signal processing features so that adjustments can be made to optimize your transmitted audio.

- Connect your radio to a dummy load and switch the transmit antenna to the appropriate antenna connector or turn down the power output to 1W (a setting of 0W will not transmit any audio).
- Open the control panel for the Slice Receiver that controls the transmitter.
- Press **MOX** or press a PTT to enabled the transmitter.
- Tap the RECORD icon (red dot) on the control panel. It will flash when recording.



- Talk normally into the microphone.
- When done, tap the RECORD icon to stop recording.
- Tap the PLAY icon to play back the transmitted audio.

See section **8.7**, **Recording and Playback of Slice Receiver Audio** for complete details on the usage of this feature.

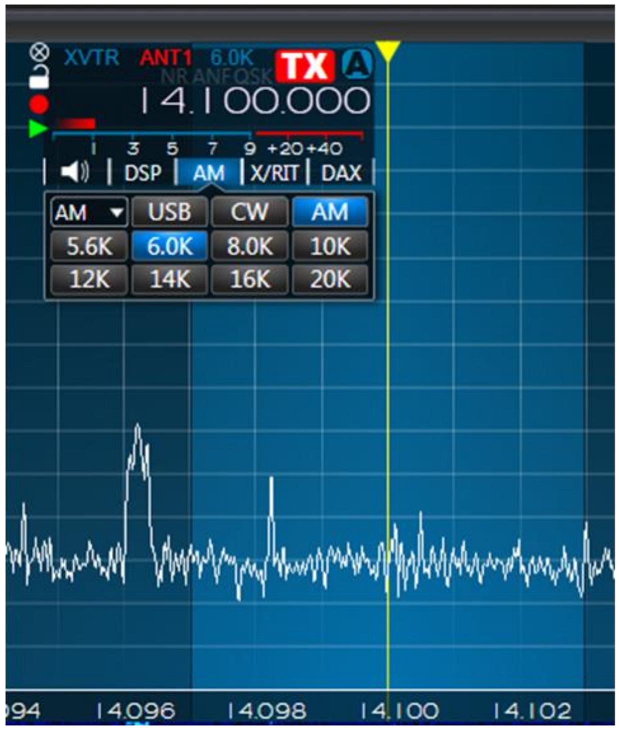
## 15.6 RECOMMENDED AUDIO ADJUSTMENT STEPS FOR PHONE MODES

Use of a second receiver to monitor your transmitted audio in real time is the preferred method for making the adjustments listed below. Otherwise, use the Quick Record and Playback procedure described above for monitoring your transmitted audio and making the following adjustments.

- Select the desired microphone input from the list in the **TX Menu**.
- Select the desired transmit filter width on the **TX Menu**.
- Turn the speech processor off by pressing the PROC button in the **TX Menu** so that it is not highlighted.
- Adjust the TX Equalizer to compensate for the microphone and operating conditions. The default setting is a good starting point for most microphones. The TX EQ is located after the processor in the signal chain so it should typically be adjusted prior to engaging the processor. Minor adjustments can be done after engaging the processor but care is needed to avoid excessive peaks.
- Speak into the microphone at the loudest voice level you would normally use.
- Adjust the microphone gain control so that the peak indicator hovers near 0 VU on the Level meter. **Most microphones will require the +20 dB gain preamp to be enabled** on the Phone/CW tab of the **Main Menu**.
- Turn on the speech processor with the PROC button. The adjacent slider sets the Compression setting. In most cases use the NORM (normal) setting. Selecting DX and DX+ adds additional compression without distorting the audio.
- Readjust the transmit equalizer to optimize the audio for your voice characteristics, the desired operating style and microphone response once PROC is enabled.
- Enable the DEXP, setting it for your operating position's ambient background noise. Ideally any device that generates background noise should be on so that the DEXP is optimally configured.
- If VOX operation is desired, enable the VOX button and adjust VOX gain/delay for proper operation.

The settings described above are included in MIC profiles. After the controls are adjusted, their settings can be saved for future use by storing a MIC profile. See section **12.1**, **MIC Profiles**.

# 16 HOW TO OPERATE AM AND SAM MODES




To use the Maestro in Amplitude Modulation (AM) or Synchronous AM (SAM) mode, select either AM or SAM in the Slice Receiver Control Panel. In selective fading conditions SAM mode may provide better detection of AM signals. The carrier frequency indicator is shown at the center of the filter passband.

Standard AM receive filter bandwidths from 5.6K to 20K can be selected from the Slice Receiver Control Panel. Custom bandwidths can be adjusted by use of the High/Low Shift/Width multi-function control. When the control is in High/Low mode, adjusting the inner knob moves the location of the lower frequency margin of the filter, while adjusting the outer knob moves the location of the higher frequency margin. Pop-up displays provide detailed information as the adjustments are made.


The AM Carrier control is found on the **TX Menu**. It allows the carrier level to be set while maintaining a constant overall PEP output of the transmitter. With the AM Carrier control set to maximum, standard 25% carrier operation is provided. When both the RF Power and AM Carrier controls are set to maximum, the carrier level will be approximately 25W and PEP output will be approximately 100W. Reducing the RF Power control will reduce the carrier level and PEP in proportion. By reducing the AM Carrier level, the percentage of carrier relative to total PEP can be reduced to increase talk power in the AM sidebands. This is called Reduced Carrier AM.

# 17 HOW TO OPERATE FM MODE

To use the Maestro in Frequency Modulation (FM), Narrow FM (NFM) mode or Digital FM (DFM) mode, select either FM, NFM or DFM in the Slice Receiver Control Panel.

Wide FM is the standard FM mode used by commercial radio stations and provides 5kHz deviation FM modulation and demodulation with pre-emphasis and de-emphasis, CTCSS tone encoding and memories.

NFM is the same basic mode, but with a 2.5kHz deviation for narrower channel spacing.

DFM is a digital FM mode providing 5kHz of deviation, but no pre-emphasis and de-emphasis. This mode can be used for modulation of digital data that prefers a flat bandpass such as 9600 baud packet data.

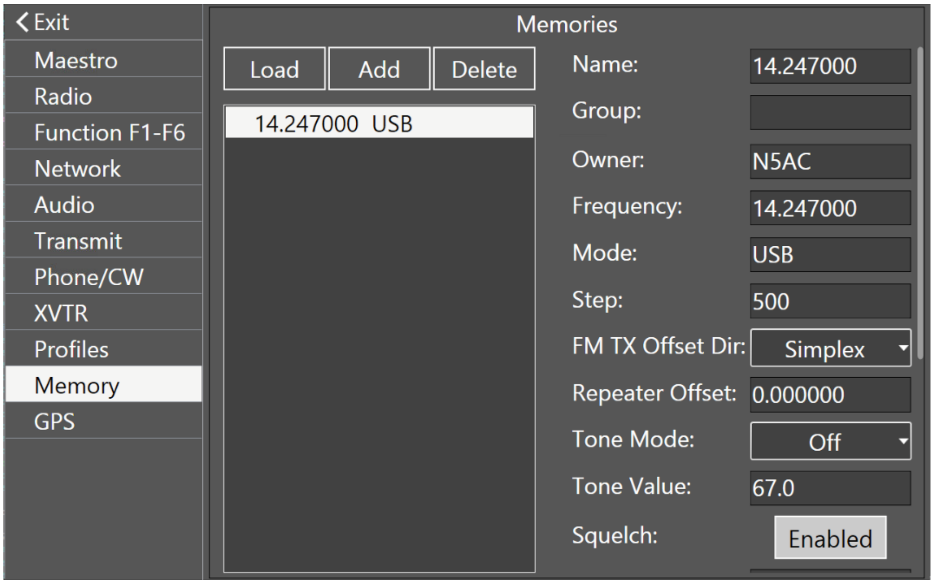
When an FM mode is selected, controls specific to FM modes are displayed in the Slice Receiver Control Panel, as shown below.


## 17.1 OPERATING FM REPEATERS

From left to right, the first of the FM specific controls enables and disables CTCSS tones in transmissions. The second control selects the CTCSS tone value. The repeater controls, “-“, “SIMP”, and “+” set the repeater offset direction or enables simplex mode (no offset). The REV button enables a quick frequency change to the repeater split or transmit frequency. The Offset control selects the frequency offset or “split” in MHz for repeater operation.

## 17.2 MEMORY CHANNELS

Memories for FM as well as any other mode can be stored in the Memory form accessible on the **Memory** tab of the **Main Menu**. The memory form, as shown below, stores the frequency along with other settings such as the mode, CTCSS tone, etc.




The fields in a memory entry are defined as follows:

- **Name** - A unique name for this memory - Initially blank.
- **Group** - The combination of Group/Owner identifies a set for import when using *SmartSDR for Windows*. When importing, the existing Group/Owner memories will be removed prior to importing the new fields. This makes it easy for a user to keep a master list of memories and distribute them and not have to worry about merging existing old data - initially blank.
- **Owner** - This is important for importing files and is typically the callsign of the person creating the memory. This will be populated automatically when creating a new memory if a callsign has been entered in Maestro.
- **Freq** - The frequency to tune the Slice when selecting the memory. This will initially be set to the Active Slice frequency when adding a memory.
- **Mode** - The Modulation/Demodulation mode for the Slice (e.g. USB, CW, FM, etc.). Initially set to the Active Slice mode.
- **Step** – The frequency step size in Hertz, associated with this setting.
- **OffsetDirection** - If in FM mode, this sets the direction for the repeater transmitter offset. Options are Down, Simplex and Up. Initially this will be set to the matching setting in the Active Slice.
- **RepeatersOffset** - The offset in MHz. Initially this will be set to the matching setting in the Active Slice.
- **ToneMode** - In FM transmit, this can be set to Off or CTCSS TX for PL tones. Initially this will be set to the matching setting in the Active Slice.
- **ToneValue** - The tone value in Hz to use for CTCSS TX
- **Squelch** – Turns FM Squelch on or off.
- **Squelch Level** – The Squelch threshold value.
- **RF Power** - The power setting from 0-100 to use for this memory.

- **RX Filter Low** - The Receive Filter Low Cut in Hz
- **RX Filter High** - the Receive Filter High Cut in Hz
- **RTTY Mark** - The mark frequency when using RTTY mode
- **RTTY Shift -** The shift frequency when using RTTY mode
- **DIGL Offset -** The offset when using DIGL mode
- **DIGU Offset -** The offset when using DIGU mode

# 18 HOW TO OPERATE DIVERSITY RECEPTION (FLEX-6700 ONLY)

Diversity Reception is a powerful method for improving the readability of a signal by using two or more communication channels with different characteristics. Diversity is very useful for aiding reception in weak and fading (QSB) signal conditions. With optimally configured antennas, weak signal QSB copy can be improved by as much as 75%.

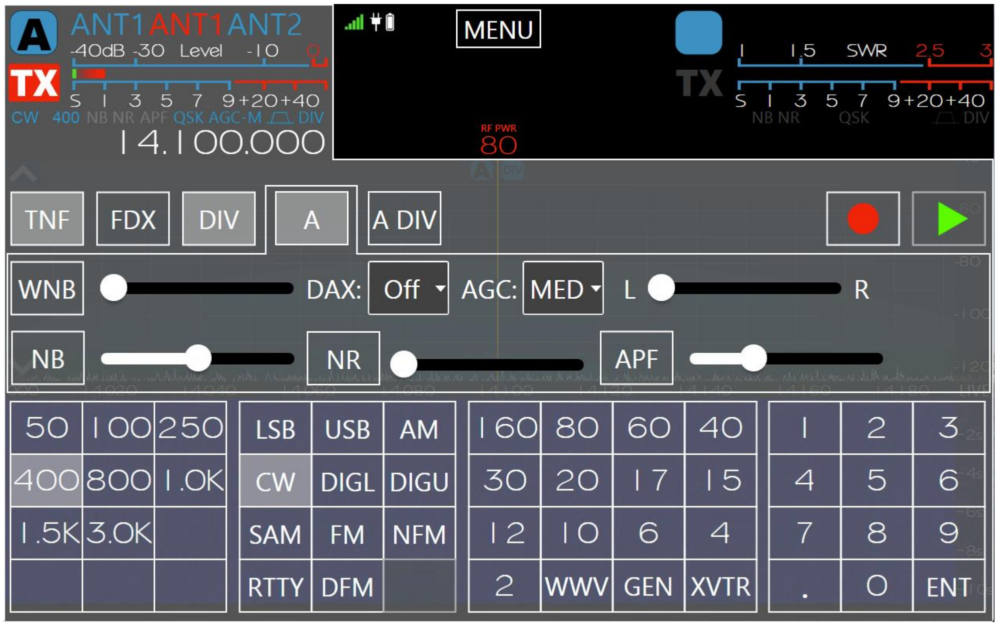
Two common diversity methods are space and polarization. These methods use separate antennas to receive different versions of the same signal. The FLEX-6700 incorporates two fully independent Spectral Capture Units (SCUs) that allow two separate antennas to be simultaneously digitized. The analog to digital converters (ADCs) in the respective SCUs are driven from a single clock source to provide stable synchronous reception.

***Note: Since the FLEX-6500 and FLEX-6300 use a single SCU, they are not capable of diversity reception.***

For best results antennas should be de-correlated in some way so that fading on one antenna is likely to be seen as increased signal strength on the other antenna. De-correlation can be accomplished by using different types of antennas (dipole and vertical), using the same type antenna at wide spacing (e.g. multiple wavelengths), or using the same antenna with different polarizations (horizontal and vertical or right and left). The more de-correlated the antennas the better, but even small amounts can be beneficial. One interesting example of the application of circular polarization diversity on HF is discussed in the December 2010 *QST* article, "Gimme an X, Gimme an O, What's that Spell? – Radio."

The diversity implementation provided in Maestro is intended for use only with headphones. Two Slice Receivers attached to separate antennas are automatically routed to the left and right ears so that the brain can provide discrimination between the signals. Speakers are not recommended because they allow the audio signals to combine in the space between the speakers to cause undesirable peaks and nulls in the sound.

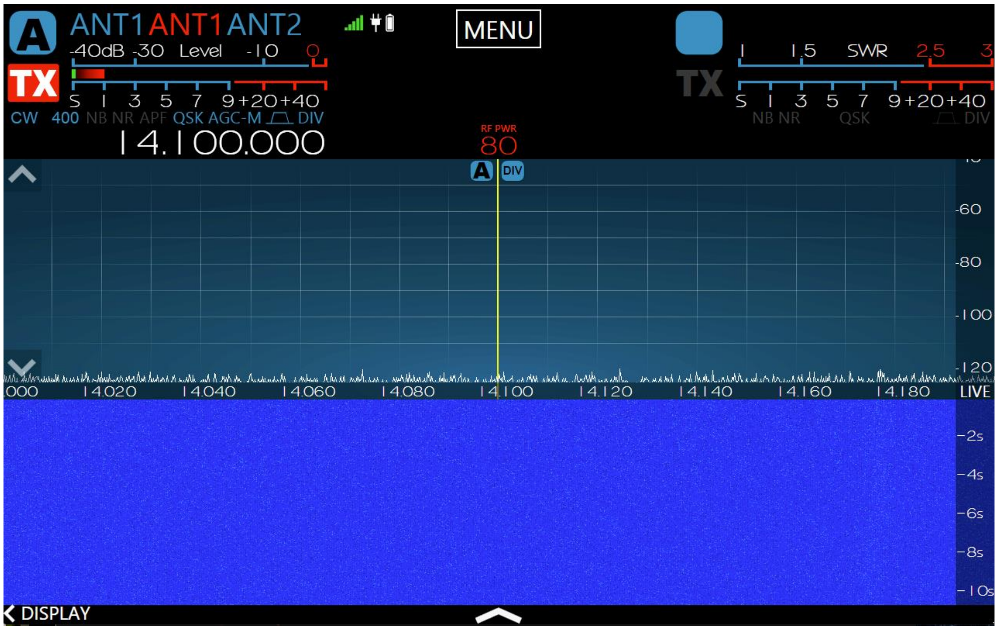
To enable diversity, tap the DIV button in the Slice Receiver control panel as shown below. This will create a diversity slave Slice locked to the same frequency as the master Slice of the diversity pair.




As seen in the screen shot below after diversity has been enabled, a weak SSB signal has been tuned on Slice A attached to ANT1 and the slaved diversity Slice on ANT2 is locked to the same frequency.

***Note: The RXA, RXB, and XVTR ports are also available for receiver inputs.***

Maestro automatically sets the Slice audio faders to place the two antennas in the left and right ears respectively. Your brain does the rest. Remember that the sound will be very different from normal reception since you are literally listening in “stereo” to the same signal on two different antennas.



# 19 HOW TO OPERATE THE ATU

The antenna tuning unit (ATU) is a device in the RF signal path that improves power transfer from the transmitter to the antenna by transforming the apparent antenna impedance seen by the transmitter to a value compatible with the transceiver's power amplifier (PA). An ATU is useful when the antenna's feedline impedance is unknown, complex, or otherwise different from the transceiver's. It's important to remember that the ATU has no effect on the actual SWR of the antenna and feedline. It does however change the impedance presented to the transmitter by the ATU.

Note that the radio software automatically folds back transmitter power so that the power reflected by the antenna and tuner system does not exceed 25 watts. This feature protects the Power Amplifier, but should not be relied upon when operating with a mismatched antenna. Use of the ATU or an external tuner is recommended to match the transmitter to the antenna and minimized power reflected to the Power Amplifier.

The FLEX-6000 ATU is a standard feature of the FLEX-6700 and FLEX-6500 and an option for the FLEX-6300. The operation of the ATU is controlled by the Maestro software.

## 19.1 MODES OF OPERATION

There are two modes of ATU operation, Manual and Memory. In Manual mode the user initiates an ATU tuning operation to attempt find a better match between the PA and the antenna system, but the inductance (L) and capacitance (C) values that are found are not retained and the ATU will revert to Bypass mode if the frequency or band is changed. Memory mode is an extension of Manual mode in which the L/C values are retained and automatically used when the frequency of the transmit Slice is within the ATU Match Frequency Range.

The ATU will try to impedance match the load to as close to a 1.1:1 SWR as possible. If the ATU measures an SWR of 1.1:1 or better at the beginning of the matching process, the ATU stops searching and remains in Bypass mode.

A successful ATU tuning on 6m occurs when the SWR is improved from the initial SWR determined in the Bypass state and is better than 2.32:1. On other bands, a successful ATU match is one where the SWR is improved from the bypass SWR reading and is better than 1.7:1.

The ATU will stay enabled but the **ATU** button will not be lit if the SWR improved from Bypass but does not meet the SWR criteria described above. If the resulting SWR after an ATU tuning operation is not better than when in Bypass and the above SWR criteria is not met, the ATU goes into Bypass mode and the **ATU** button will not be lit.

## 19.2 ATU MATCH FREQUENCY RANGE

After the ATU has found a successful match, the inductance (L) and capacitance (C) values are valid for a 200 kHz frequency span centered at the frequency the ATU tuning operation was initiated, or +/- 100 KHz. Once you tune the frequency of the transmit Slice beyond that range, the ATU will be put into Bypass mode unless there is a previously saved ATU memory at the new frequency.

## 19.3 MANUAL MODE

To operate the ATU in Manual mode, make sure the **MEM** (ATU Memory) button in the **TX Menu** is unlit by tapping it. ATU memories are enabled by default.

Tune the transmitter to the desired frequency. Press the **ATU** button to initiate an ATU tuning operation. The ATU will set the power output to approximately 2W on 6m and 10W on all other bands during the tuning operation. The ATU will tune until it either achieves a successful impedance match or finishes in Bypass mode. Note that if the ATU determines that Bypass provides the best match, and the resulting SWR is less than the criteria for success, this is considered a successful tuning operation.

Tuning the transmit Slice to a frequency outside of the ATU Match Frequency Range or to a different band will disable the ATU, putting it into Bypass mode. The **ATU** button will be off.

The **ATU** button will illuminate in red immediately after it is pressed, while the tuning operation is in progress.

The **ATU** button will illuminate in green when a match is found resulting in an SWR less than the match criteria for the band. This includes Bypass mode when the antenna system is well matched.

If a good match cannot be found, the **ATU** button will be off. If a partial match is found – the ATU can improve the match but can't meet the criteria for a good match -- the ATU will remain engaged with the partial match and the **ATU** button will be off.

## 19.4 MEMORY MODE

To operate the ATU in Memory mode, make sure the **MEM** (ATU Memory) button in the **TX Menu** is lit by tapping it. ATU memories are enabled by default.

Tune to the desired frequency. If the ATU has successfully tuned the selected antenna at or near this frequency in the past, the **ATU** button will illuminate in green indicating the stored result has been applied. This includes Bypass when Bypass is best. If the button is not lit, an acceptable match was not stored and the transmitter should not be used until the problem is corrected.

Pressing the **ATU** button will start a new tuning cycle and the results will replace the previously stored results for that frequency. The ATU will set the power output to approximately 2W on 6m and 10W on all other bands during the tuning operation. The ATU will tune until it either achieves a successful impedance match or finishes in Bypass mode. Note that if the ATU determines that Bypass provides the best match, and the resulting SWR is less than the criteria for success, this is considered a successful tuning operation.

The **ATU** button will illuminate in green when a match is found resulting in an SWR less than the match criteria for the band.

If a good match cannot be found, the **ATU** button will be off. If a partial match is found – the ATU can improve the match but can't meet the criteria for a good match -- the ATU will remain engaged with the partial match and the **ATU** button will be off.

Regardless of the outcome, when in Memory mode, the ATU will update its stored settings so that they can be reapplied when the transmitter is tuned to the frequency again.

For high Q antennas that have a very narrow low SWR range, ATU memories may be saved every 10 kHz for a very granular ATU memory profile for that particular antenna.

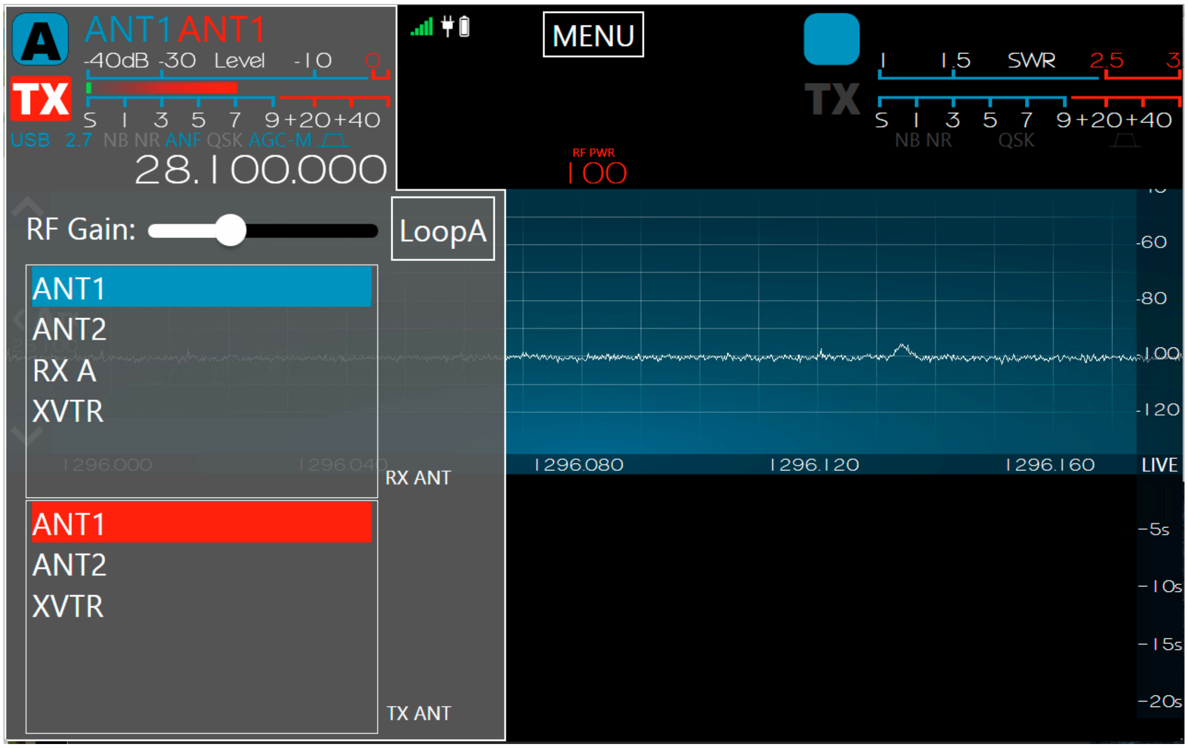
Performing a Reset to Factory Defaults on the FLEX-6000 will clear all ATU memories.

# 20 HOW TO CONFIGURE ANTENNAS

## 20.1 GETTING STARTED

When Maestro starts, it loads a single Panadapter and Slice Receiver with Antenna 1 (ANT1) selected by default. Transmit and receive operations are then functional on ANT1 with no further setup or adjustment required.

## 20.2 SELECTING THE TRANSMIT ANTENNA FOR A SLICE RECEIVER



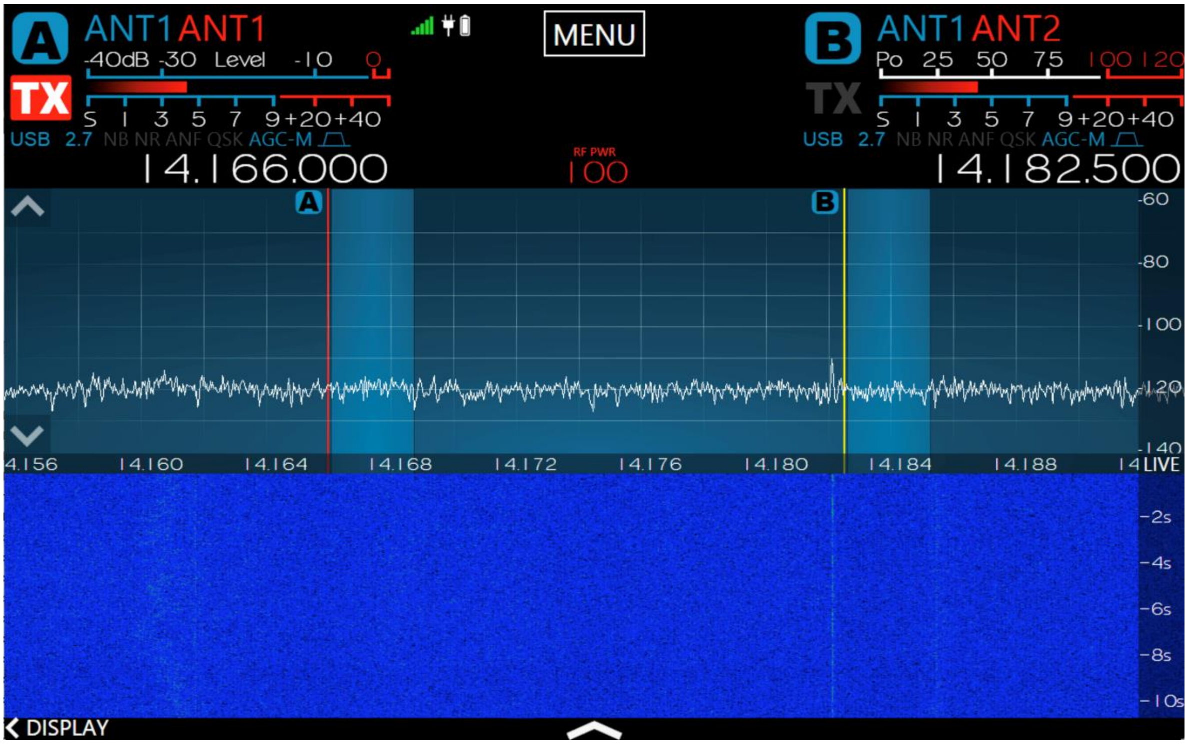

The transmit antenna for each Slice is selected from the drop down menu shown on Slice A above. The transmit antenna selector offers the same ANT1, ANT2, and XVTR options on both the FLEX-6500 and FLEX-6700 models. Each Slice may have its own designated transmit antenna. Open the menu by tapping on the antenna indicators in the Slice Flag.

Loop selection is provided in the Slice Receiver antenna menu and is indicated next to the receive antenna selector on each Slice. The example shown above indicates that the RX A loop is active and connected to ANT1.

## 20.3 ANTENNA OPTIONS FOR PIN DIODE QSK OPERATION

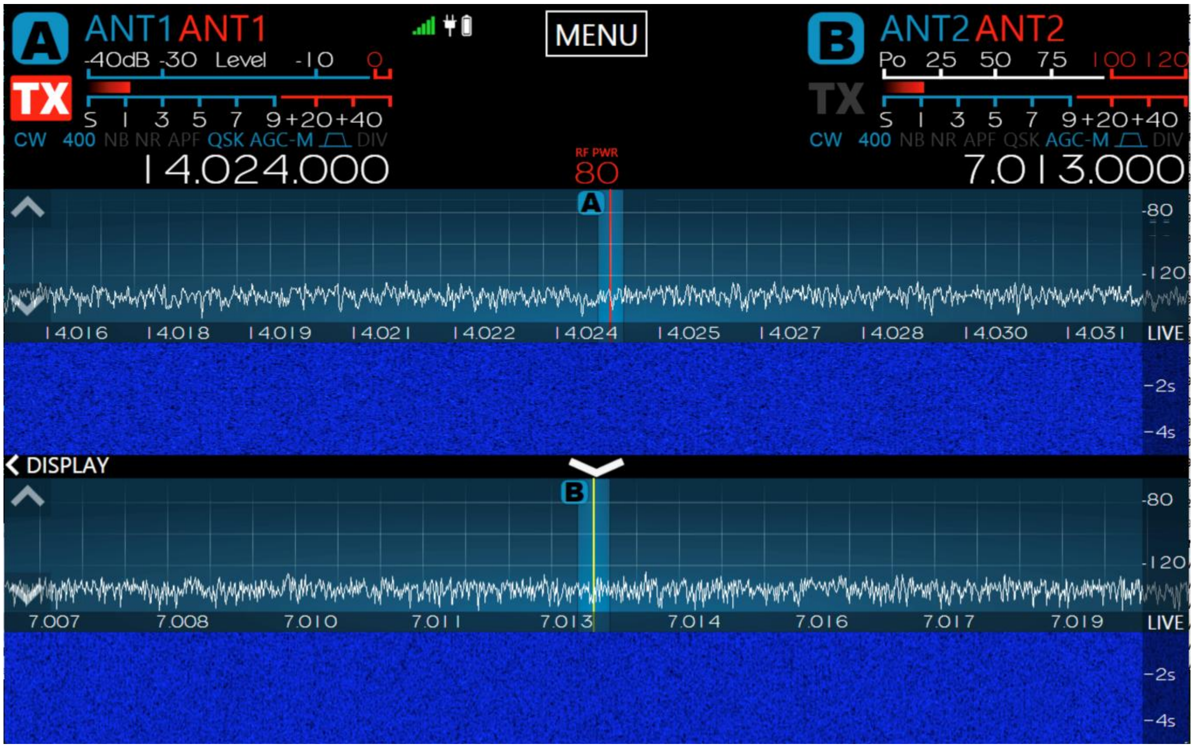
Full QSK operation with reception between individual elements is supported on a single transceive antenna at speeds up to 30 WPM. *QRQ QSK is supported at 100+ WPM when a separate receive antenna is used on RX A, RX B or XVTR.* The QSK annunciator located just above the frequency display on each Slice Receiver Flag indicates that QSK is operational in the selected mode. QSK is not supported with a separate receive antenna set to either ANT1 or ANT2.

## 20.4 USING A COMMON RECEIVE ANTENNA WITH SEPARATE TRANSMIT ANTENNAS



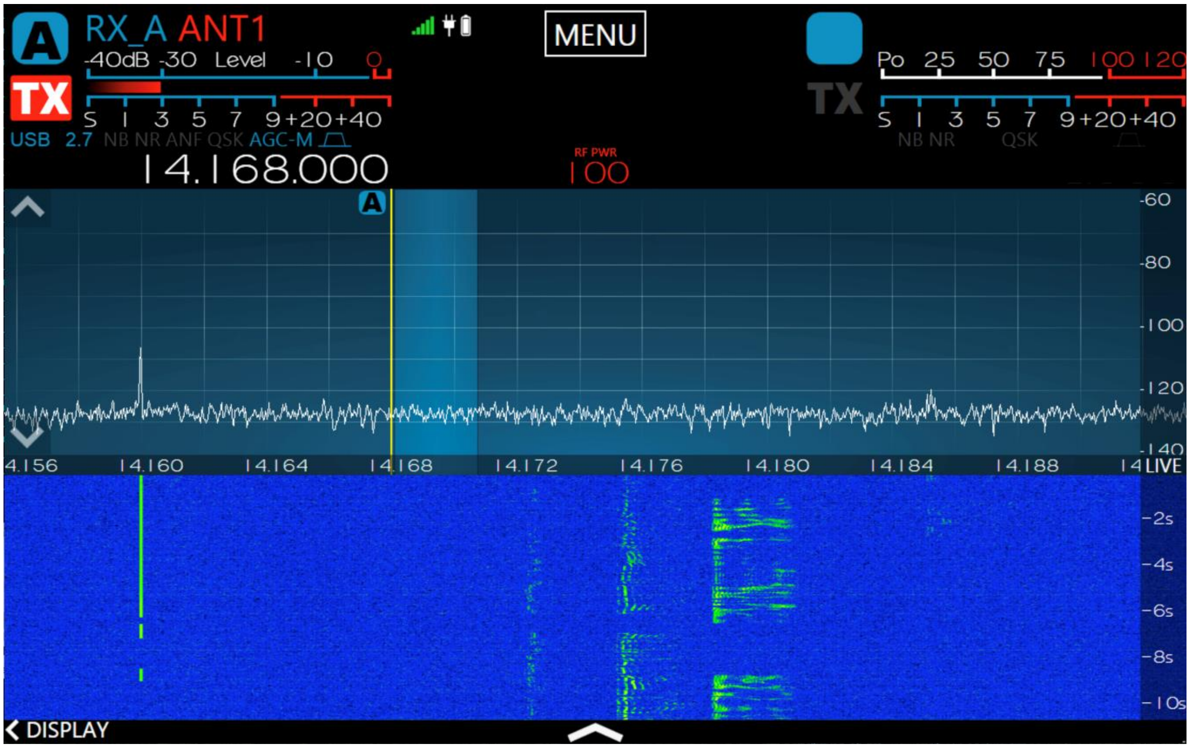

The display above illustrates two Panadapters on a single receive antenna (ANT1) but having separate transmit antennas on ANT1 and ANT2 respectively. Slice A and B both have ANT1 selected. Slice A has ANT1 selected as the TX antenna and Slice B has ANT2 selected as the TX antenna. Tapping the TX indicator in the Slice Flag changes the TX indicator to red and activates the Slice as the transmitter with its TX antenna.

## 20.5 USING TWO TRANSCEIVE ANTENNAS ON THE FLEX-6700



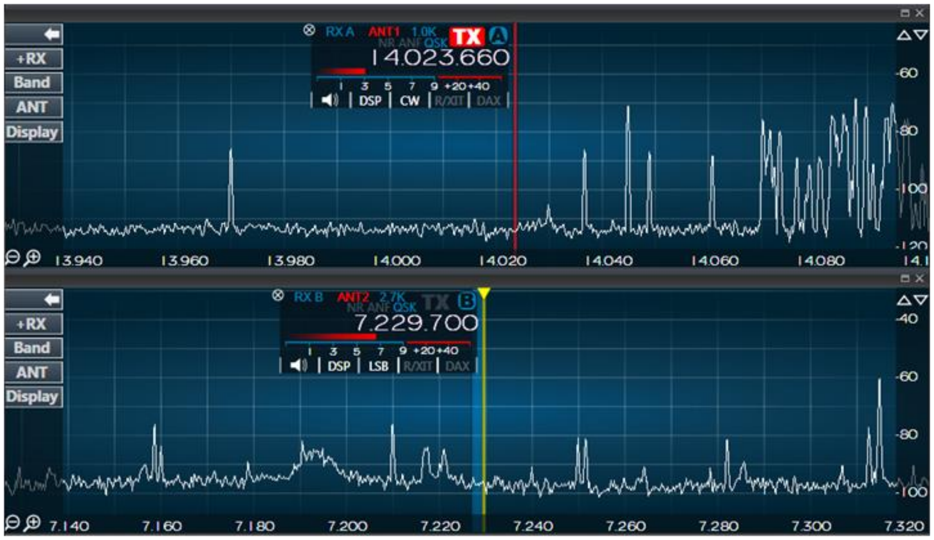

In the display above, Slice A is set to receive and transmit on ANT1. Slice B is set to receive and transmit on ANT2. Slice B is selected as the active transmit frequency of 7.033 MHz on ANT2 as indicated by the red TX button. To move the transmit frequency to 14.225 MHz on ANT1, simply tap the TX button on Slice A, or press the TX A button.

## 20.6 USING A DEDICATED RECEIVE ANTENNA




In the display above, Slice A has a dedicated receive antenna on RX A and is transmitting on ANT1. The FLEX-6700/6700R models have the option of two separate receive antennas on RX A and RX B respectively. The FLEX-6500 has only the RX A option. The FLEX-6300, FLEX-6500 and FLEX-6700 all have the option of receiving from the XVTR port. *The XVTR port is not recommended as a receive antenna port if an external preamp is used on its antenna. Transmission on the XVTR port could put up to +10 dBm of reverse power into the connected preamp.*

## 20.7 RECEIVE ONLY ANTENNA OPERATION



In the display above, a FLEX-6700 is configured so that the Slice A receive antenna is set to RX A and the Slice B antenna to RX B. ANT1 is selected as the transmit antenna for Slice A and ANT2 for Slice B. This configuration allows separate receive antennas on the two independent SCUs. This configuration is not available on the single SCU FLEX-6500 or FLEX-6300.

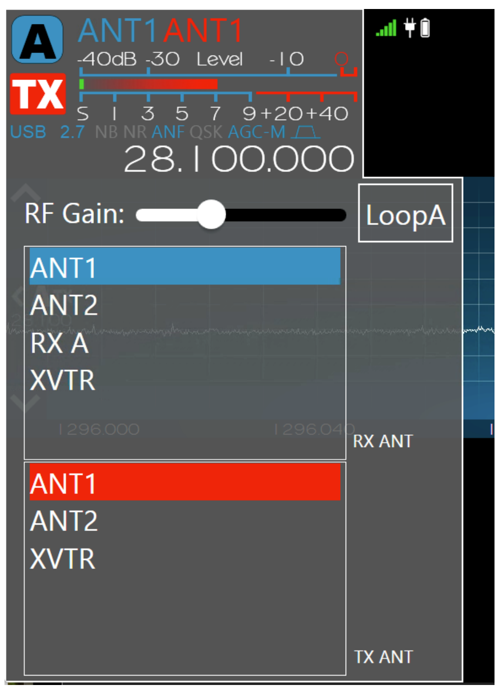
## 20.8 ANTENNA SELECTION FOR TRANSVERTER OPERATION



The Slice Flag shown above on the left shows XVTR selected for both receive and transmit antennas. This provides typical transverter port transceiver operation. The Slice Flag on the right illustrates the configuration in which RX A is set as the receive antenna and XVTR as the transmit antenna. This configuration supports split transmit/receive transverter operation.

## 20.9 USING THE RECEIVE RF GAIN/PREAMPLIFIERS

Each Spectral Capture Unit (SCU) in the FLEX-6000 includes a preamplifier with adjustable gain. The RF gain selector is located near the top of the ANT menu.




The FLEX-6300 can be set to 0dB (default) and +20dB

***Note: Since the FLEX-6300 always operates in wide band mode, the preamplifier incorporates a tapered gain with -3db cutoff located at ~14 MHz. This technique is optimized so that preamp gain and improved noise figure is provided above 14 MHz, and the gain is tapered below 14 MHz to***

***offset the rising noise levels below 14 MHz. At very low frequencies, the preamp will function as an attenuator when enabled.***

The FLEX-6500 can be set to -10dB, 0dB (default), +10dB and +20dB.

The FLEX-6700 can be set to -10dB, 0dB (default), +10dB, +20dB and +30dB.

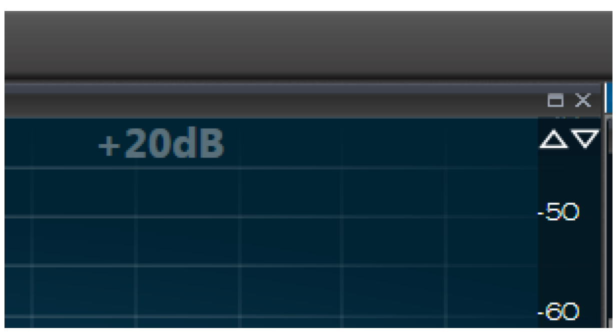
## 20.10 SETTING THE RF GAIN/PREAMPLIFIERS

As described above, each Spectral Capture Unit in a FLEX-6000 receiver includes a preamplifier with adjustable gain. The default setting is 0 dB. For typical HF operation below 12m, the 0 dB setting provides the highest dynamic range and is recommended for most locations. Even in quiet rural locations, gain is not needed or desired unless a low gain/low noise antenna is utilized.

The best way to determine the amount of gain needed for a given antenna and band condition is to disconnect the antenna and measure the receiver noise floor with the Slices dBm meter. Hover the mouse pointer over the S meter to enable the pop up dBm meter indicator. Next connect the antenna. If the band noise measurement without a signal present in the passband is 8 dB or more than that with no antenna, additional gain is not needed. If a directional antenna is used, it should be pointed toward the band opening for this measurement because noise propagates with the opening.

Note: Although the RF gain slider is present in every Panadapter, the gain setting actually controls the RF preamplifier associated with SCU. If you adjust the preamp settings for one Panadapter, all other Panadapters associated with that SCU will also be changed since the change is actually made to the SCU. For operational purposes, this equates to a “per antenna” basis. In the case of the FLEX-6500 and FLEX-6300 with a single SCU, the preamplifier settings affect all Panadapters and receivers.

There is a preamp indicator in the upper right corner of each Panadapter that will be lit whenever the preamp/attenuator is turned on for the band. It will show the requested gain for a FLEX-6500 or FLEX-6700 (such as +20dB). On the 6300, the preamp actually provides different levels of gain by frequency. If there is a net +5dB or better gain, the indicator will show PRE. If there is a net -5dB or less gain (attenuation) then the indicator will read ATTN. If it is in-between these two values, it will read ---- to indicate that the preamp is on, but not providing much change in the band of interest. This means on a 6300 that one Panadapter could have PRE and the other ATTN.



## 20.11 ANTENNA CONFIGURATION BASIC TERMS AND RULES

For more advanced antenna configurations, it is helpful to define terms used to describe the FLEX-6000 Signature Series architecture and the rules associated with its configuration.

- A Spectral Capture Unit (SCU) is a direct sampling, wideband digitizer that captures the entire RF spectrum within its input filter limits.
- The FLEX-6700/6700R models contain two fully equivalent but independent SCUs. The FLEX-6500 and FLEX-6300 contain a single SCU.
- The FLEX-6700/6700R models can simultaneously digitize two antennas, one for each SCU, while the FLEX-6500 and FLEX-6300 digitize a single antenna.
- Each Panadapter spectral display requires selection of an associated receive antenna. The default association for the first Panadapter is ANT1.
- One or more Slice Receivers may be placed on one or more Panadapters.
- Multiple Slices and Panadapters can share a single receive antenna.
- Maestro implements at most two Panadapters and two Slice Receivers.
- All Slices placed on a Panadapter must use the same receive antenna as the Panadapter. Changing the receive antenna for a single Slice will change the receive antenna for its host Panadapter and all Slices within.
- The FLEX-6700/6700R models allow simultaneous reception from two receive antennas. The FLEX-6500 and FLEX-6300 operates from a single receive antenna.
- The receive RF Gain control located on the Slice Receiver’s Antenna menu is tied to its respective SCU/ receive antenna combination.
- Transmit antenna selection is completely independent of the receive antenna. Only one transmit Slice can be active at one time.
- The transmit Slice is selected by tapping the large “TX” button on the Slice Flag, which will illuminate the button in red, or by pressing the corresponding TX button.
- ANT1 and ANT2 ports allow transmission at 100W on 160m through 6m amateur bands. The XVTR port allows continuous coverage low power (+10 dBm max) transverter IF from 100 KHz to 165 MHz.
- Each Slice can have its own transmit antenna selection, which may be the same as or different from the assigned receive antenna.
- Each SCU on the FLEX-6700 has the option of a dedicated receive only antenna designated RX A and RX B respectively. These inputs are hard wired to their respective SCU and may not be switched between SCUs.

  ***Note: This does not preclude using RX A with ANT2 or RX B with ANT1.***

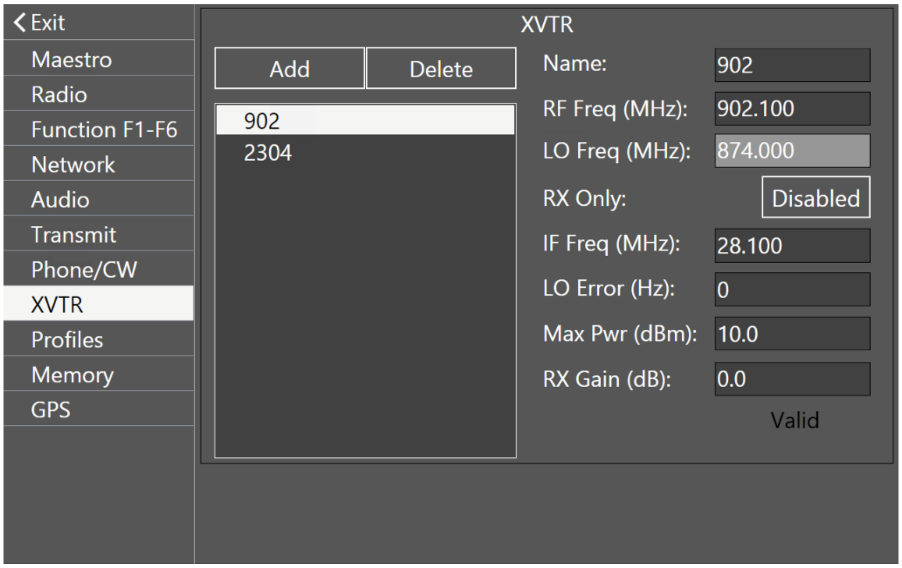
- The single SCU on the FLEX-6500 has the option of the dedicated receive only antenna input RX A.
- LoopA and LoopB on the FLEX-6500 and FLEX-6700 are provided to allow connection of external preamplifiers or preselectors. The internal relay switching is identical to RX A and RX B respectively. However, LoopA and LoopB is a logical designation that assumes that their input is from one or both of ANT1 and ANT2. This means that a preamplifier installed in LoopA will be functional if either LoopA or RX A are selected. Logically RX A will assume a receive-only antenna connected to RX A and LoopA will assume that a device is connected between RX A IN and RX A OUT.
- The XVTR input/output port may be used on the FLEX-6300, FLEX-6500 and FLEX-6700 as another receive only input or may be used as a transverter transmit or common receive port.

RX A and/or RX B on may be used for split transmit receive operation when selected as the receive antenna and XVTR as the transmit antenna.

- PIN diode silent CW QSK operation on ANT1 and ANT2 require that both receive and transmit be on the same antenna or that a dedicated receive only antenna be used on RX A, RX B, or XVTR. If ANT1 and ANT2 are used separately as receive and transmit antennas, the transmitter reverts to mechanical relay TR switching. Each Slice has a QSK annunciator that indicates when PIN diode TR switching is engaged.

# 21 HOW TO CONFIGURE TRANSVERTERS

To configure transverters, open the transverter control panel on the **XVTR** tab of the Maestro **Main Menu**. The transverter setup panel should look like this:




To add a transverter band, tap the **Add** button. A new transverter band tab will appear which has blanks that need to be filled in with information about your transverter. The first blank holds the name of the transverter or transverter band. Generally, you would enter something like "1296" for 1296MHz or "10G" for 10.368GHz, but you may enter any 4-character descriptor for the band that suits you. Next, the RF frequency in MHz is entered followed by the IF frequency in MHz. This is followed by any error in your local oscillator, a maximum output power from the radio and then any IF gain in your transverter. Here's a detailed description of each field and what you would input or see in the field:

**Name**: holds the name of the transverter, generally a reference to the RF frequency of the transverter. This name must be 4-characters or less. The name will be displayed in the Panadapter during transverter use as a reminder that RF will be passing through the transverter. The name is also used on the transverter band selection panel discussed later.

**RF Freq (MHz)**: the output RF frequency of your transverter. This is the frequency that the final antenna will work on. Note that the RF frequency and the IF frequency are directly related by the LO frequency. You must enter an RF frequency that will be directly translated to the IF frequency. For example, if you enter “1296” for a 1296 to 28MHz transverter, you must enter “28” in the IF frequency. Do not use “1296.1” for one and “28.0” for the other unless this is the way your transverter is configured. If you have any doubts, be sure that the LO frequency calculated by Maestro matches the LO frequency of your transverter.

**LO freq (MHz):** the calculated value of the local oscillator in your transverter. This number should match the transverter manufacturer's specifications. If it does not, check the RF and IF entries again and make corrections.

**RX Only:** Enable this if you do not want to transmit through your transverter. It will lock-out the transmit capabilities in Maestro.

**IF Freq (MHz):** the IF frequency that corresponds to the RF frequency previously entered. Currently Maestro only understands high-side injection so the IF frequency must be below the LO frequency of your transverter.

**LO error (Hz):** If your radio's local oscillator is off-frequency by a known amount, enter that amount here and Maestro will make the proper adjustments to properly read transmit and receive frequencies in Maestro. If you are using a GPS or 10MHz locked transverter, this number should be set to zero.

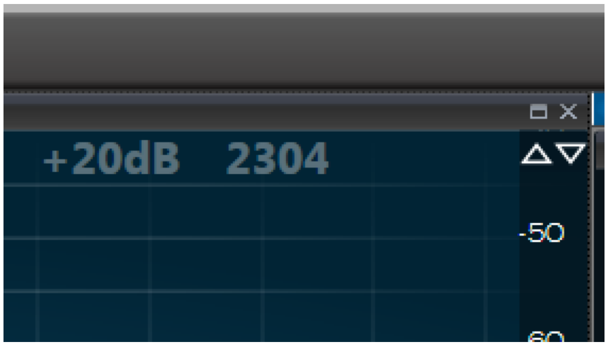
**Max Power (dBm):** Enter the IF input power level to the transverter to achieve maximum output power of the transverter. This will limit the output power that Maestro allows to be provided to the transverter. This value may be up to +15dBm for IF frequencies below 80MHz and up to +8dBm for IF frequencies above 135MHz (default: 0dBm). The value set in this field, should match the power output when the RF Power slider is set to 100. The lower end (values near 1 on the RF Power slider) will be approximately 20dB lower than the Max Power setting.

Note: This power range may be different than using the IF frequency directly (i.e. not using the XVTR RF frequency).

**RX Gain (dB):** this field is optional, but will correct the receive signal level reading in the Panadapter and Slice Receivers. To properly set this, you should enter the IF gain for the transverter. If you do not know this value, ask your transverter manufacturer. If you do not have this number available, it may still be calculated by inputting a known value signal into the transverter, reading the receive level in Maestro and then adjusting the RX Gain until the values are equal.

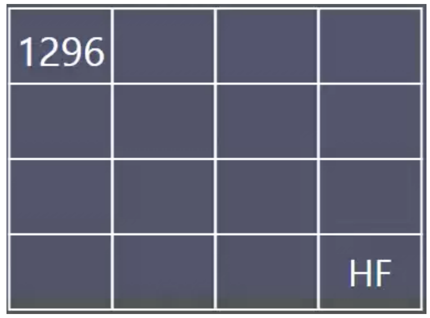
**Valid** indicates that Maestro has enough information to use the transverter which will be set automatically by Maestro and the FLEX-6000.

When operating in a Transverter band the Transverter name will appear in the top right corner of the Panadapter as shown below:

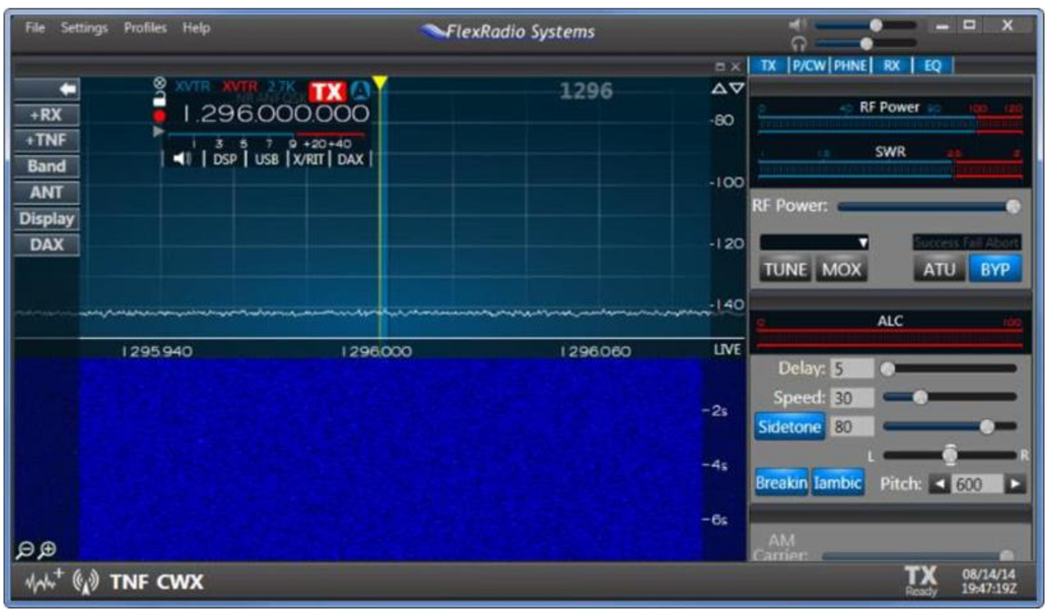


## 21.1 USING A TRANSVERTER

There are two ways to tune to a transverter. The first way is to use the band select panel in the Slice Receiver Control Panel. Open the control panel and then tap the XVTR button at the lower right of the band selection buttons. The band selection buttons will change to a set of buttons that correspond to the defined transverter bands. Tap the transverter band you wish to use. The buttons in the panel use the name of each transverter specified in the transverter setup form.




When the band button for a transverter is tapped, the radio will change the frequency of the Panadapter to the transverter frequency. Below you can see that we are now on 1296.0MHz and there is now a band indicator in the upper left of the Panadapter that indicates that we are on the 1296 transverter.




The FLEX-6000 is actually receiving on the IF frequency and performing a frequency translation in the Slice and the Panadapter to indicate the frequency being listened to.

If you have more than one transverter on the same band, you can name them differently and then access them with different transverter buttons. Each transverter band behaves just like an HF band in that it remembers settings used for that band. If you were to change frequency to 1296.1, Maestro will remember that this is the last frequency used on the 1296 transverter band. All other features of Maestro including multiple Slices, wide bandwidth views of the spectrum, etc. are all available on the transverter band.

The second way to select a transverter band is to directly enter the frequency of the desired operation into the Slice Receiver. For example, entering “1296.” (don’t forget the decimal point to tell Maestro that we want to go to 1296MHz) will move the Panadapter and Slice to 1296MHz.

To return to an HF band, simply enter the HF frequency that you wish to change to or select the HF bands with the **HF** band button.

## 21.2 MULTIPLE COPIES OF A BAND

In some situations, it may be desirable to have multiple copies of a signal frequency in the radio. For example, if you have a high power 144 to 28MHz transverter in use on a FLEX-6700, the radio will not know whether to tune to the internal 144MHz band or to the external transverter. This ambiguity is resolved in two ways: First, if the band is selected using the band buttons, the radio will always know which band to switch to. In the event that direct frequency entry is used, the following rules are used to select the band of operation:

- If the Panadapter is currently in a band that would match the entered frequency, Maestro remains on the current band.
- The most recently used band that matches the frequency entered will be selected.

Example:

- The current Panadapter is tuned to 50.125MHz
- There is an external 144 to 28MHz transverter on a FLEX-6700 with an internal 2m band
- The most recently used 144MHz band is the external 144-28MHz transverter
- A direct frequency entry of “144.2” is typed
- The radio will select the external 144-28MHz transverter and tune to 144.200MHz
- The Panadapter will clearly indicate the selected band by placing a “144” (or whatever name was given to the transverter band) in the upper right of the Panadapter If this is not the desired result -- if you intended to switch to the internal 2m band -- just use the Band selection to switch to this band in the Panadapter. At this point, the radio will switch to the correct band and it will become the “favorite” band next time a direct frequency is entered.

## 21.3 TRANSVERTER POWER SETTINGS

The operation of the RF power slider in Maestro is set by the **Max Power** setting in the transverter setup. Setting the RF power slider to 100 will set the power to the **Max Power** setting. The zero setting will shut off all RF power from the transverter port. A setting of 1 results in a power 20dB below the max power. For example, if a Max Power setting of +5dBm was configured, the slider “0” position will be no power, “1” will be +5dBm - 20dB = -15dBm. The 50% setting on the slider will be +5dBm - 10dB = -5dBm.

## 21.4 TRANSMITTING ON A TRANSVERTER

When transmissions occur on the transverter, the radio will reconfigure internal relays to connect the exciter in the FLEX-6000 to the XVTR port on the radio. If a split IF is in use, the RXA or RXB port may continue to be used for receive provided that your transverter continues to provide receive RF (check with transverter manufacturer).

When a common IF transverter is used, the XVTR port normally being used for transmit will be switched away from the FLEX-6000 SCU and connected to the exciter. As a side-effect, the relay may connect the SCU to one of the HF antenna ports which causes the Panadapter to show HF signals in the HF IF band in addition to the transverter band when transmitting.

In addition, when transmitting on a split IF transverter configuration, because the transverter RF output is low power it will not be dramatically visible on the transverter Panadapter like it is shown when transmitting on HF at high power.

Both of these conditions during transmit can be quite confusing as they do not accurately represent the transmitting state of the radio properly. For this reason, the Panadapter will pause when using IF transverters while transmitting.

## 21.5 WEAK SIGNAL CONSIDERATIONS

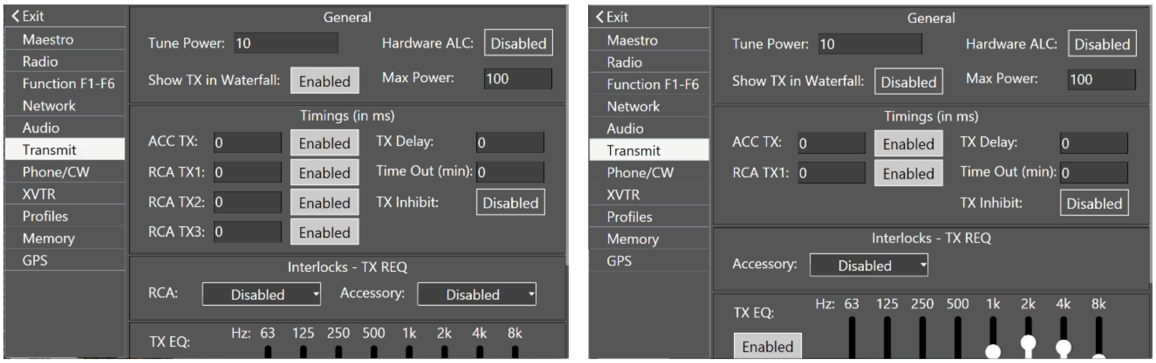
When using Maestro for weak signal operations, three kinds of receiver resources will be in use: Panadapters, Waterfalls and Slice Receivers. The noise floor of the Panadapter may be changed to facilitate seeing signals that are weaker than the "noise floor." Amateurs generally refer to the noise floor as the noise floor in a 500Hz bandwidth receiver. For a Maestro Panadapter, the receiver is variable width for a single "bin" or pixel in your display. The further you zoom in the Panadapter, the lower the bin size in use and the lower the noise floor. The processing gain achieved in this way is 3dB for each reduction in the bandwidth of a bin by two --- or each time the magnifying glass '-' is depressed. To show this control, tap on the panadapter and it will appear in the upper right of the panadapter.

On a FLEX-6700 fully zoomed in, the bin size will be 1.5Hz. This represents a 25dB gain over the 500Hz noise floor. The Waterfall and Panadapter both derive data from the same receiver so for best weak signal viewing, zoom the Panadapter to one of the last few zoom levels. On a FLEX-6500 or FLEX-6300, the minimum bin size is 5.9Hz.

The noise floor of the Slice Receiver is independent of the Panadapter and is adjustable by adjusting the filter width of the Slice Receiver. Your ears and brain provide their own type of processing gain and so the Slice Receiver should be adjusted for best listening experience. In general, the **AGC-T** should be set to a fairly low value for best listening on transverted bands. In other words, it should be adjusted for a relatively quiet receiver.

# 22 HOW TO CONNECT AN EXTERNAL AMPLIFIER

The FLEX-6000 has hardware interfaces for connecting an external power amplifier. There are four PTT outputs on the FLEX-6700 and FLEX-6500 and two outputs on the FLEX-6300, each with independently configurable time delays, a transmit hold-off input for amplifiers that have QSK hold-off outputs, and a standard zero to negative four Volt hardware ALC input. These interfaces are controlled from the **Transmit** tab in the Maestro **Main Menu**. (Left: FLEX-6700/6500 Right: FLEX-6300)




On the FLEX-6700 and FLEX-6500 there are four PTT outputs. Three are RCA jacks on the rear panel, labeled TX1, TX2, and TX3. The FLEX-6300 has one RCA jack labeled TX. On each of the radios there is an output on Pin 11 of the Accessory connector on the rear panel as well. These outputs are isolated, and each one can have a specific delay. Some users will want to utilize the delay settings to sequentially switch external equipment.

For external amplifier use, the delay should be set to zero for any output that keys the external amplifier.

The TX Delay setting can be used if the external amplifier has slow T/R relays and requires a longer time between PTT and RF Emission. Unless you are noticing problems with the radio emitting RF before the amplifier has switched to transmit mode, you should leave the TX Delay set to zero.

The TX Delay will have a negative impact on QSK operation. If the intent is to operate QSK then Delay should be set to zero.

The Interlocks settings are used for amplifiers that have a hold-off output for QSK CW. There are two interlock inputs. One is an RCA jack on the rear panel, and the other is Pin 13 of the Accessory connector on the rear panel. On the FLEX-6300 this is only available on the Accessory connector

If your amplifier does not have one of these outputs, or you do not use it in your station, leave these settings disabled. If you need to use the hold-off, select Active High or Active Low to enable the interlock and set the proper polarity of the signal provided by the amplifier.

# 23 HOW TO OPERATE IN DIGITAL MODES

Digital modes such as JT65 and PSK31 are implemented in third party programs that must run in a computer separate from Maestro. There are two principal ways to run digital modes with Maestro. The first, and generally most desirable method, is to use DAX and CAT on a PC to connect the digital mode program to the FLEX-6000. This is accomplished in the same way that CAT and DAX are used with *SmartSDR for Windows*, with the noted exception that SmartSDR and Maestro perform the same basic functions and cannot be running simultaneously.

The DAX channel for audio output from the radio can be selected in Maestro in the Slice Receiver Control Panel. This audio channel, the DAX TX Audio channel and a CAT port are generally required for each band where the digital mode will be run. When using this method, Maestro may be used to tune the radio, observe the spectrum for likely operating locations, etc., but the DAX and CAT software communicate directly to the radio. Maestro is designed to operate in conjunction with a digital mode program operating in this manner.

The second, and least desired method, is to run a PC sound card and connect the input and output of the sound card to the audio in and output jacks on the Maestro. This is generally not recommended because there is more loss and distortion possible using analog cables instead of digital data already on the platform.

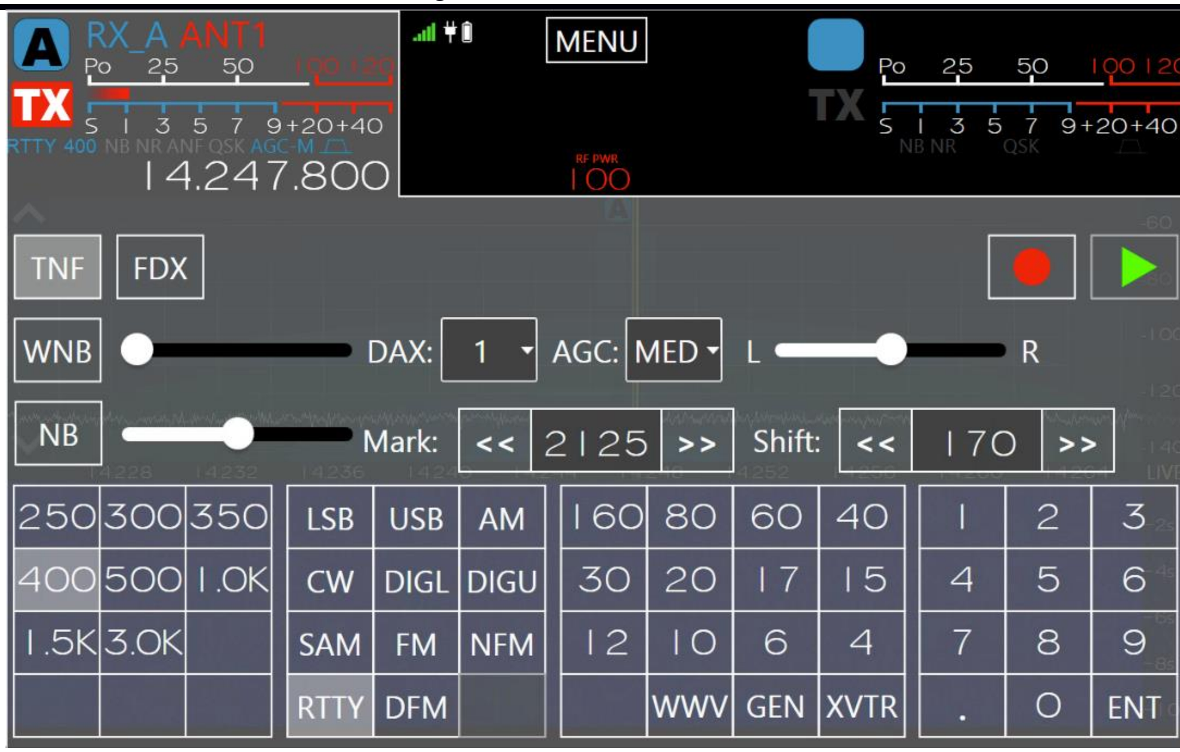
When running digital modes, the computer screen can be effectively extended by running the FLEX-6000 transceiver with Maestro instead of with *SmartSDR for Windows*. The computer screen can be dedicated to running the digital mode programs.

## 23.1 PTT OVERRIDE WHEN OPERATING DIGITAL MODES

When operating in a non DIGx mode, use of a hardware PTT such as the RCA PTT input on the back panel will override the DAX channel input. This feature allows the user to override the DAX input with a PTT switch connected directly to the radio, or to Maestro.

## 23.2 RTTY MODE

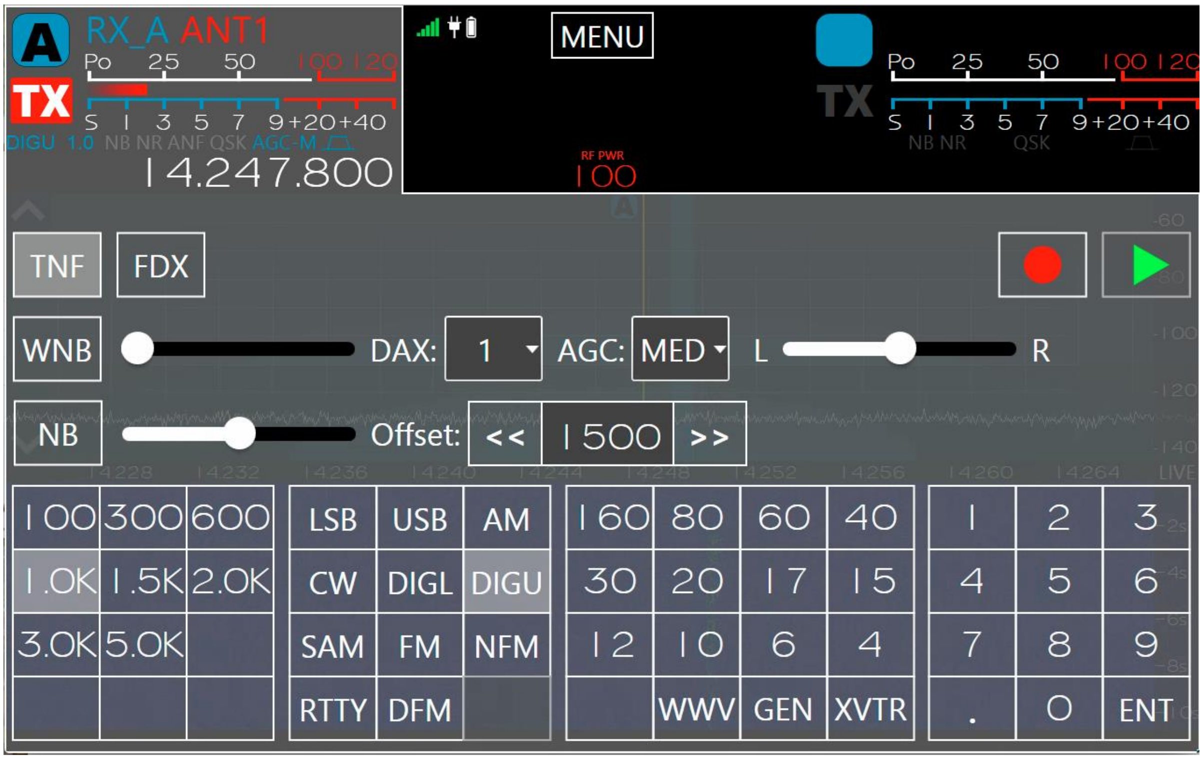
RTTY mode is a variant of DIGL mode, optimized to facilitate tuning and reporting of a RTTY Mark frequency via CAT or the FlexLib API. In RTTY mode two controls appear in the Slice Receiver Control Panel. These are the RTTY Mark and RTTY Shift values:




These values default to 2125 and 170 Hz respectively for operating at 45.5 baud, the standard for HF RTTY. The RTTY Mark is an IF shift of the Slice Receiver indicated frequency which allows knob tuning and spot frequency reporting to third-party programs that expect the reported frequency to be the RTTY Mark frequency. For knob tuning, move the frequency centerline (the higher frequency yellow line) on the Mark frequency (higher of the two tones). RTTY mode can also be tuned by double tapping on the Panadapter display at the desired Mark frequency. To the user, the IF shift at the RTTY Mark frequency is transparent since the Slice seems to be tuned to the RTTY Mark. The Slice Receiver filter is also IF shifted and the default filter presets are centered between the RTTY Mark and Space frequencies.

## 23.3 DIGI MODE AUDIO OFFSETS

When operating the radio in DIGU or DIGL mode a receive filter Offset control is available in the Slice Receiver Control Panel. This control allows the operator to set the audio offset in Hertz of the center of the receiver's bandpass preset filters. When tap tuning a Slice Receiver with an Offset set to a non-zero value, the Slice Receiver's frequency will be adjusted so that the center of the receiver's bandpass filter will be tuned to the frequency that was Tap Tuned. The default offset for DIGU is 1500Hz and the default for DIGL is 2210 Hz.




This feature allows the operator to configure a narrow filter in DIGU or DIGL mode, then conveniently drop it over a signal of interest by simply double tapping on the signal.

# 24 HOW TO OPERATE IN FULL DUPLEX (FDX) MODE

All FLEX-6000 Signature Series Transceivers are inherently capable of full duplex operation. In normal simplex operation, all Slice Receivers are muted when transmitting. When Full Duplex (FDX) is enabled, the transmitting Slice Receiver is muted along with all other Slice Receivers on the same antenna. Receivers located on *different antennas* from the transmitter are not muted during transmission.

FDX is only possible if the two Slice Receivers are using separate physically isolated antennas. Since two receivers are used, two signals may be heard simultaneously when in receive. When the radio is switched to transmit, the transmitting Slice Receiver will no longer emit receive audio, but the other receiver will continue to receive.

The transmitting Slice Receiver is muted primarily because it contains a delayed version of the radio's transmit signal. This delayed transmit signal results in operator confusion if heard at the same time transmit audio is being produced. In the event that hearing this signal is the desired goal, another Slice Receiver may be placed on the same frequency as the transmit Slice. This receiver will not be muted and delayed transmit audio can be heard provided that the receiver's receiving antenna is different from the transmit antenna.

Select Full Duplex mode by tapping the **FDX** button in a Slice Receiver Control Panel.

## 24.1 FDX REQUIREMENTS

In order to use FDX mode, the following requirements must be met:

- The transmitting antenna and receive antenna must be different
- The transmitting Slice Receiver and receiving Slice Receivers must be different (two or more receivers must be used)
- The radio must be placed into FDX mode
- The signal level of the received transmit signal coming into the receive antenna must be below the overload threshold of the Spectral Capture Unit (SCU, details below)

The first three steps involve setting up the radio properly, but the fourth step requires understanding your antenna system and signal level environment in detail by performing the necessary calculations to ensure proper operation. A detailed explanation of this and working examples are provided below.

## 24.2 FDX APPLICATIONS

There are two initial applications of FDX mode:

- FLEX-6700 Single Operator Two Radio (SO2R) operation
- Full Duplex amateur satellite operation using appropriate transverters

SO2R mode is used by single operator contesters to boost scores by listening on two bands simultaneously and alternating the transmit band, interleaving listening and transmitting tasks. As always, consult the contest rules for any requirements or restrictions on operating in this manner. Presently, SO2R operation is only possible on the FLEX-6700. A future add-on hardware product will enable SO2R operation on both the FLEX-6500 and FLEX-6300.

## 24.3 FDX CAPABILITIES BY RADIO MODEL

The capabilities and rules for FDX operation vary by model as defined by its respective hardware capabilities. Specifics for each model are as follows.

### 24.3.1 FLEX-6700 SO2R Operation

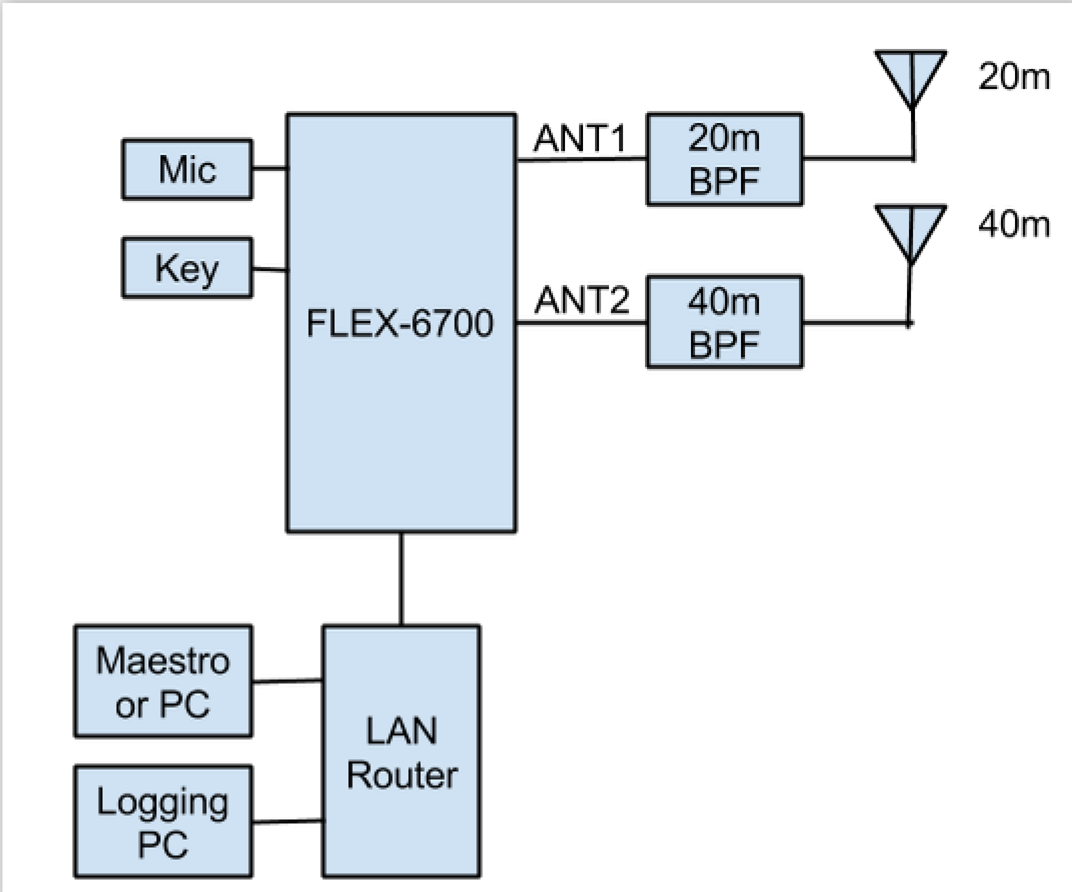
The FLEX-6700 incorporates two independent, full performance Spectral Capture Units (SCUs), each with its own band pass filter preselectors. This means that the FLEX-6700 can simultaneously receive on two separate antennas. With FDX engaged, it is possible to listen on one antenna/band while transmitting on another - given sufficient antenna isolation is provided.

Alternately, RX A, RX B, or XVTR may be used as receive only ports. The internal preselectors on the FLEX-6700 provide a minimum of 20 dB band to band rejection. With antenna isolation of at least 40 dB, cross-band SO2R operation without external filtering is practical. For high power operation and sites with less antenna isolation, external transmit band pass filters must be added to increase isolation.

Please refer to the SO2R Mode with N1MM for the FLEX-6700 How to Guide for step-by-step setup instructions for operating a FLEX-6700 with N1MM in SO2R mode.

A default Global profile, *SO2RDefault*, is provides a starting point for configuring the radio for SO2R operation.

The image below illustrates an example SO2R configuration using the FLEX-6700.




### 24.3.2 FLEX-6300 and FLEX-6500 Full Duplex

Both the FLEX-6300 and FLEX-6500 models are enabled for full duplex operation using XVTR as a receive only port so long as at least 70 dB of port to port isolation is provided for a 100W station. This may be provided through a combination of antenna isolation and external band pass filtering for cross-band operation. RX A may alternately be used on the FLEX-6500. This feature can also be used for satellite operation with suitable transverter support.

## 24.4 SCU OVERLOAD FUNDAMENTALS

All radios are susceptible to overload. Overload conditions caused by a signal level that is too high can result in compromised performance, the inability to receive or even receiver damage. An understanding of how overload occurs and methods to avoid it is required for proper operation of a radio in full duplex mode.

The Spectral Capture Units (SCU) in the FLEX-6000 transceivers contain three primary component blocks:

- Preselection band filters (except in FLEX-6300)
- A preamplifier / attenuator
- A high-performance analog to digital converter (ADC) also known as a digitizer

Each of these blocks plays a role in receiver performance and must be considered when planning full duplex operation.

### 24.4.1 Preselection Band Filter Block

Preselection band filters, when present and active, can reduce out of band signal levels by 20dB or more. Preselection band filters are enabled by default in the FLEX-6500 and FLEX-6700 any time the radio is not in the WIDE mode. An indicator in the upper right corner of the Panadapter will show when the radio is in the WIDE mode and preselectors are not enabled. The FLEX-6300 is always in WIDE mode since it does not have preselection band filters, but this is not indicated in the Panadapter.

For the purposes of calculations, assume a 20dB reduction in out-of-band signals when the preselection band filters are enabled.

**Example 1:** FLEX-6500 with two Slice Receivers on 20m in a single Panadapter. Both receivers are set to listen on RXA and transmit on ANT1. The WIDE indicator is not present in the Panadapter. In this case, the preselector filter for 20m is enabled, but the receiver and transmitter are on the same band. The preselector will not reduce the transmit signal (it is in-band) and no 20dB reduction in signal can be used for calculations.

**Example 2:** FLEX-6500 with two Slice Receivers, one on 20m, one on 40m in two Panadapters. Both Slice Receivers are set to receive on RXA and transmit on RXB. Because two different bands are received on the same antenna, WIDE mode is indicated in both Panadapters. Preselection band filters are not used and a 20dB reduction in signal cannot be used for calculations.

**Example 3:** FLEX-6700 with two Slice Receivers, one listening on 20m and one on 40m in two Panadapters. Slice A is set to receive on RXA and transmit on ANT1. Slice B is set to receive on RXB and transmit on ANT1. Neither Panadapters indicate WIDE. In this case, preselection band filters are enabled on both bands and a 20dB reduction can be used in calculations.

### 24.4.2 Preamplifier / Attenuator Block

The preamplifier / attenuator block can raise or reduce signals before they are sampled in the ADC block. The overload of the SCU is reduced by any gain that is added by the preamplifier. For example, if 10dB of gain is selected using the preamplifier selection under the antenna controls in the Panadapter, this 10dB addition must be factored into the overload calculations. The same holds for other amplification levels: if +20dB or +30dB are selected, the respective value must be added to overload calculations. You should only use pre-amplification when necessary and only what is required to raise the noise level in the receiver by 8-10dB over the noise level when the antenna is disconnected.

The preamplifier has protection circuitry to prevent damage above levels of +10dBm. This protection circuitry will cause distortion in received signals if the level exceeds 10dBm. For this reason, pre-amplification should not be used when the input signal level will meet or exceed +10dBm. When performing all testing of a full duplex configuration, it is highly recommended that the preamplifier be disengaged until it can be determined that the power level from the transmitter will not reach +10dBm in any operating scenario.

### 24.4.3 High-Performance Analog to Digital Converter Block (ADC)

The ADC block, or digitizer, converts the received signals into digital data. All ADCs have overload points and damage points, but there is some variability in overload symptoms. With the FLEX-6000 Signature Series radios, the ADC overload point varies from +7dBm (FLEX-6300) to +9dBm (FLEX-6500 and FLEX-6700). This overload point is a “soft overload” meaning that at this point the receiver will begin to show a drop in performance. The ADC generally functions better with increasing signal levels up to this point. At the soft overload point, the receiver will begin to develop spurs that will appear in the Panadapter and these spurs will grow as power is increased. A digital overload point will be reached around +12dBm, but varying by receiver, at which point the receiver will cease to function normally, producing substantial distortion in received signals and rendering reception difficult.

At levels above +15dBm, the ADC can be damaged so the FLEX-6000 contains circuitry to disengage the ADC from the SCU. While circuitry should protect the radio from a damaging signal, it is highly recommended that station configuration be designed such that signal levels above the soft overload point are prevented from entering the antenna connector of the radio. FlexRadio Systems assumes no responsibility for damage incurred from high signal levels entering the receiver.

## 24.5 FULL DUPLEX ANTENNA ISOLATION REQUIREMENTS

For successful FDX operation, it is essential to understand and plan for sufficient transmit to receive antenna isolation to prevent receiver overload and/or damage. The FLEX-6000 FDX Power Calculation Worksheet can aid in the calculation of antenna isolation and power levels that are suitable for a specific station.

The FLEX-6000 Signature Series transceivers are designed to disconnect the receiver from the antenna when signal levels are +18 dBm to +22 dBm depending on frequency. The front-end protection circuits will begin to engage at approximately +15 dBm. Front-end overload of the SCU will occur with a single tone in the range of +8 dBm with the preamp off. Increasing preamp gain will lower the overload point by the amount of the added gain.

To provide suitable headroom to prevent SCU overload, we recommend that transmit to received signal strength be limited to a worst case of -20 dBm or lower at the antenna input. With 20 dB of preamp gain, this would provide a single tone input of 0 dBm to the A/D converter leaving about 8 dB of headroom. More isolation is better.

One of the best resources for information on achieving antenna isolation is:

"Managing Interstation Interference, Revised Second Edition" by George Cutsogeorge, W2VJN.

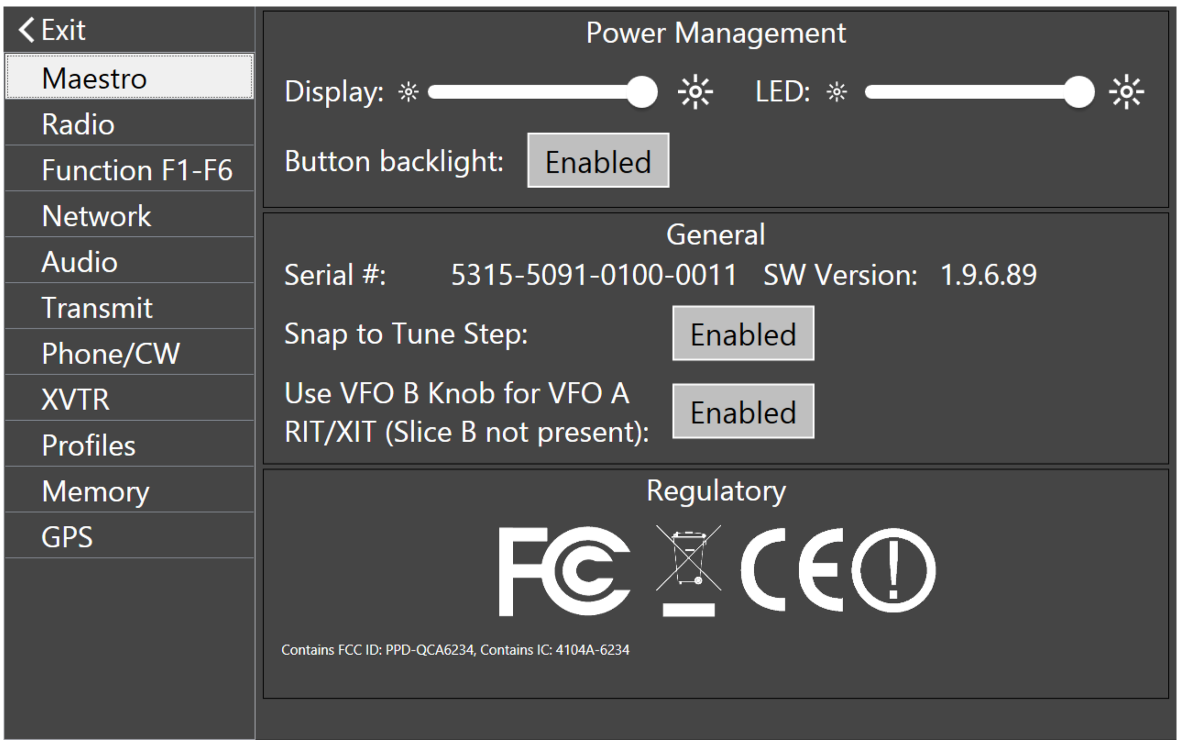
# 25 MAIN MENU

## 25.1 INTRODUCTION

A button that opens the Maestro **Main Menu** is located at the top center of the Maestro display. Tapping this button opens the **Main Menu**. A list of menu tabs appears down the left side of the menu. When tapped, each of these tabs opens a sub-menu that can be used to configure some aspect of Maestro operation.

## 25.2 MAESTRO TAB

Located in the **Maestro** tab are basic controls for the display and LED button backlight levels. The serial number and software version information is shown.



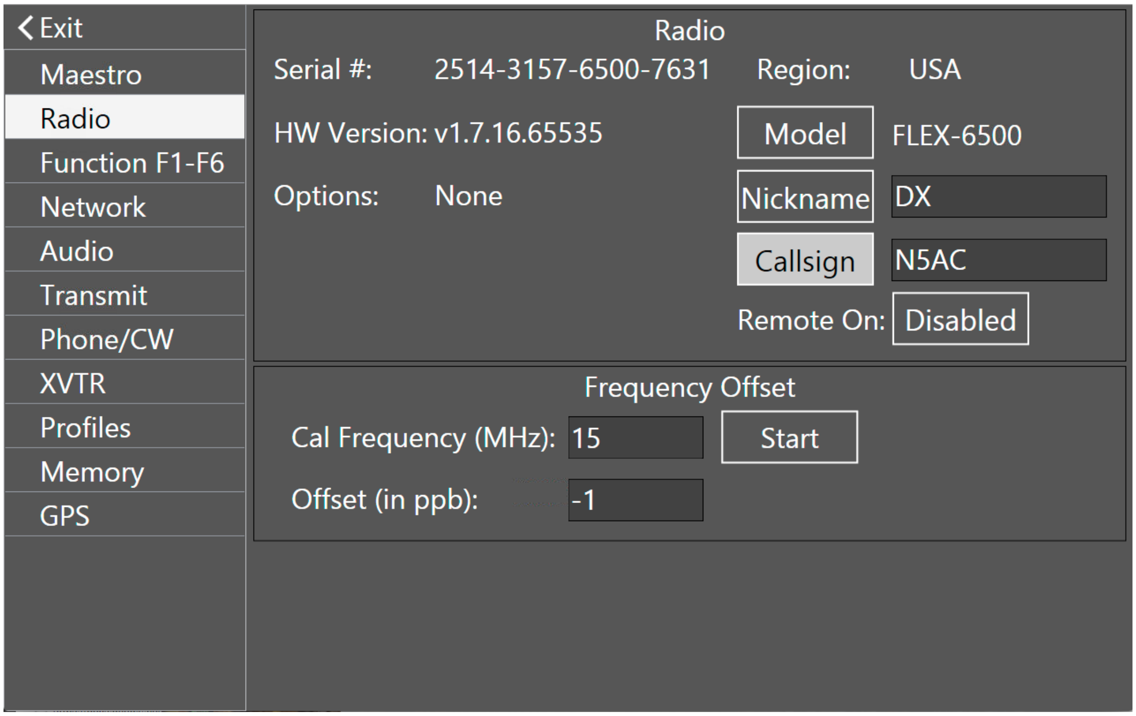

The **Button backlight** button controls the white backlight of the Maestro front panel buttons. Turning the backlight off does not affect the button colors that are displayed as various functions change.

The **Snap to Tune Step** button controls the Drag Tune and Tap Tune behavior. When enabled, tuning operations will round to the nearest tune step size. For example, if the tune step is set to 10Hz then the Slice Receiver will snap to every 10 Hz (i.e. 14.100.000, 14.100.010, 14.100.020) increment regardless of the tuning method when tuning outside of the Slice Receiver passband. When this feature is disabled it will allow the receiver to be tuned in 1 Hz steps.

The **Use VFO B Knob** button changes the RIT/XIT behavior. See section **28.1, Slice Receiver Activation Buttons** for details.

## 25.3 RADIO TAB

Located in the **Radio** tab is basic information about the selected radio. The tab contains the radio **Hardware Version** and installed **Options** of the radio.




The **Region** indicator displays the country for which the radio's transmit capabilities are based.

A set of three buttons provide a means to change the contents of the OLED front panel display on Flex-6500 and Flex-6700 transceivers. When the **Model** button is selected, the radio's model name is displayed. When the **Nickname** button is selected, the nickname text is displayed. Tapping on the nickname field opens a keyboard so that the nickname can be changed. When the **Callsign** button is selected, the call sign text is displayed. Tapping on the call sign field opens a keyboard so that the call sign can be changed.

Next is the **Remote On** enable/disable control. Tap the button to enable and disable this feature. When enabled, closing the RCA connector on the rear panel of the radio will power up the radio. Opening the connector will power down the radio.

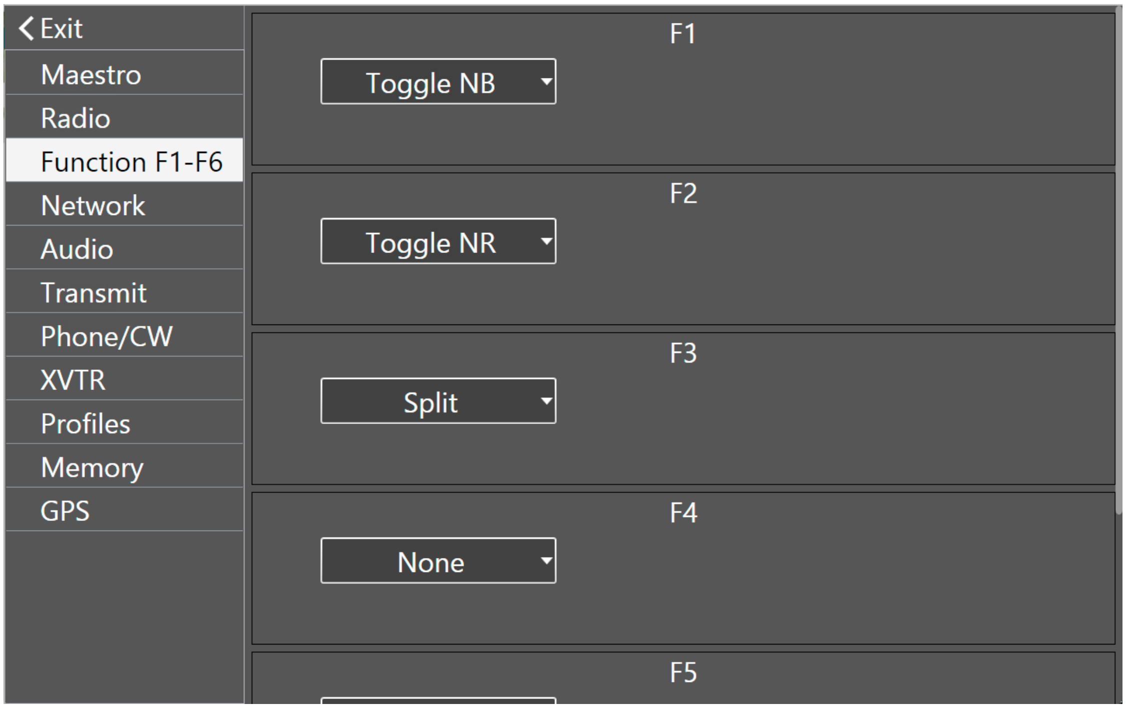
The **Frequency Offset** controls are used to compensate for the error in the radio's local oscillator.

**Cal Frequency:** This is the frequency of the source that you are using for the calibration.
**Offset:** Resulting offset in parts per billion. This value can be changed manually by tapping the value.
**Start:** Initiates the automatic estimation of the offset based your calibration frequency.

***NOTE: When running the frequency calibration, the radio uses Slice A and ANT-1 regardless of the radio's slice/antenna configuration.***

## 25.4 FUNCTION F1-F6 TAB

The **Function** tab contains controls used to assign functions to the six front panel function buttons.

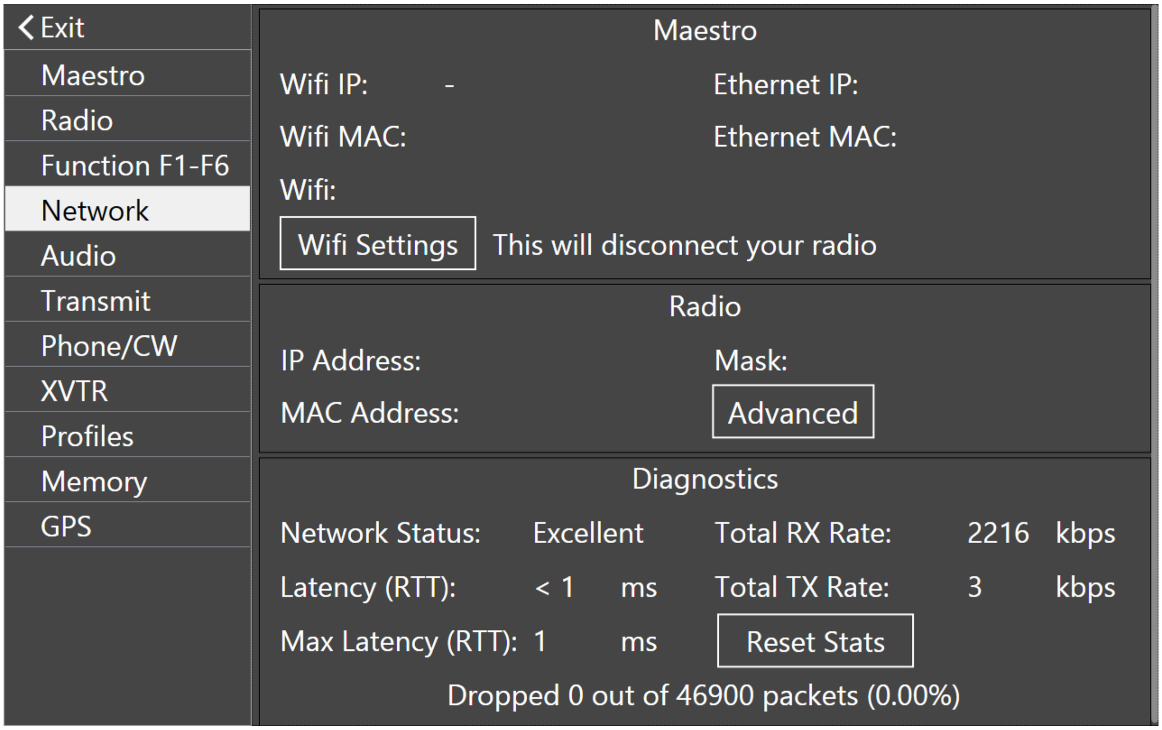



To assign a function to a function button, tap the appropriate drop-down menu box, move the selections up and down with a finger swipe, then tap on the desired function. When the drop-down menu closes, the function is assigned.

See section **28.7, Function Buttons** for a discussion of the use of the Function buttons.

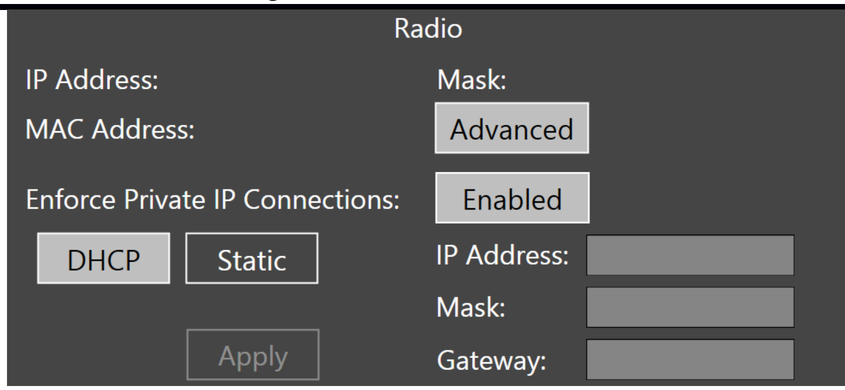
## 25.5 NETWORK TAB

The **Network** tab contains information about Maestro's connection to the communication network, the attached radio's network connection and network diagnostics.



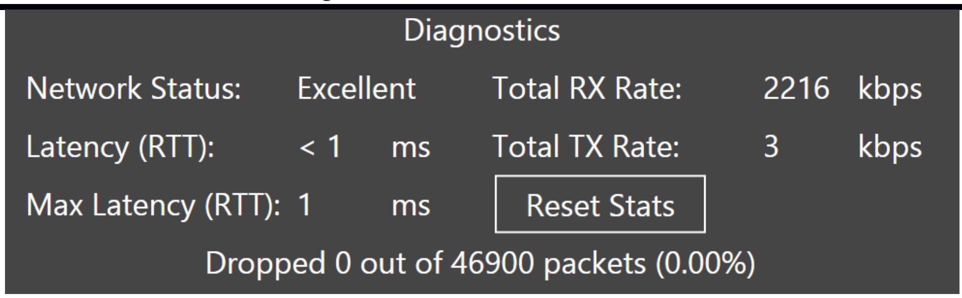

The **Maestro** and **Radio** sections of this tab show the IP addresses of the Maestro wireless and wired Ethernet interfaces, the radio's wired Ethernet interface and other associated information. When a Wi-Fi connection has been made, the **Wi-Fi IP** field will contain the IP address associated with that connection. When the field is empty, no Wi-Fi connection has been made. Similarly, when a wired Ethernet connection has been made, the **Ethernet IP** field will contain the IP address associated with that connection. When the field is empty, no Ethernet connection has been made.

Pressing the **Wi-Fi Settings** button terminates Maestro's connection to the radio and returns user control to the *Choose a Wi-Fi Network* startup screen. The user can choose a Wi-Fi network and connect to it, or can choose to break a Wi-Fi connection using the **Forget** button. See section **4.6**, **Wi-Fi Network Setup** for more information.




Pressing the **Advanced** button reveals controls that allow the user to assign a fixed IP address to the radio. Press the **Static** button then tap the **IP Address** field to bring up a keyboard. Enter the desired IP address, sub-net mask and gateway address, then press **Apply**. Maestro will disconnect from the radio, the radio will reboot and Maestro will return to the *Select Radio* screen. The radio can be returned to dynamic IP address assignment by use of the **DHCP** button.

The **Enforce Private IP Connections** button enables and disables a network security feature. When enabled, only private network IP addresses may connect to the radio when the radio is connected to a private network. These are the 10.0.0.0 - 10.255.255.255, 172.16.0.0 - 172.31.255.255 and 192.168.0.0 - 192.168.255.255 address blocks. When disabled, any address may connect.




The **Diagnostics** section show several types of diagnostic data.

The **Network Status** indicator describes a summary of the quality of the network connection to the radio.

**Latency (RTT)** is the round trip time in milliseconds for a keep-alive packet to be sent between the Maestro and the radio. A smaller number indicates better network quality. On a wired LAN, **Latency (RTT)** should be no more than a few milliseconds and should not vary greatly. On a wireless network link, this number may be much higher and can vary depending on factors inherent to wireless networks such as signal attenuation and multipath reflections.

**Max Latency (RTT)** is the greatest observed value of **Latency (RTT)**. If this number is much higher than the real-time **Latency (RTT)** values, this indicates a network link that has a lot of quality variability, which in general is not desirable.

**Remote RX Rate** and **Remote TX Rate** show the rate of information flow between Maestro and the radio, in thousands of bits per second.

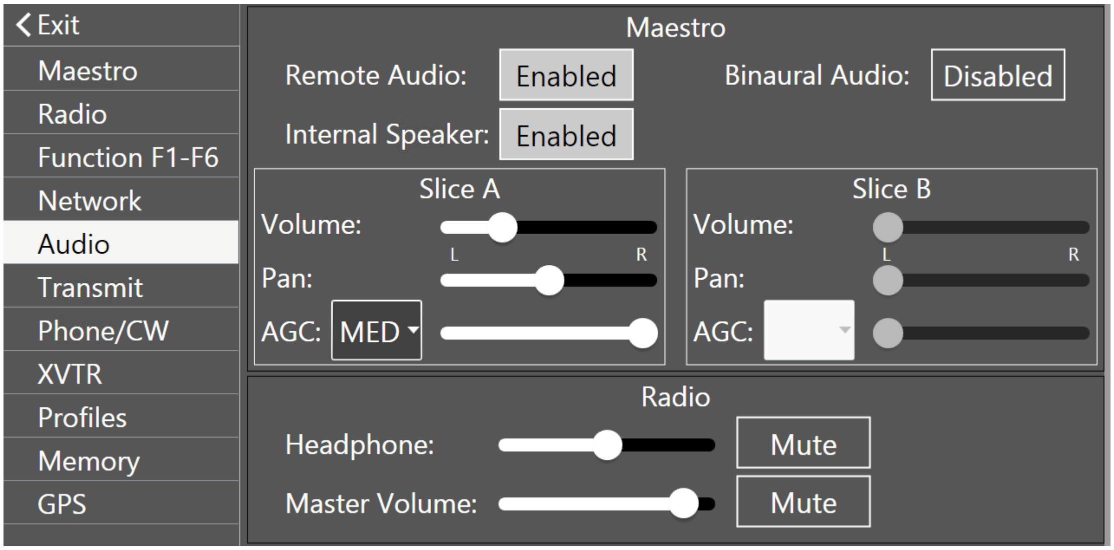
Tapping the **Reset Stats** button resets the network performance statistics shown in the next line.

The network statistics show the number of lost network data packets from the radio to Maestro. Loss of packet may cause interruptions in the receiver audio stream. On a wired LAN, packet losses should be very small, if any. On a wireless LAN, packets may occasionally be lost due to factors such as signal attenuation and multipath reflections.

Total packets and lost packets are tracked by the type of the stream, Audio, Waterfall, Panadapter, Meters, etc. When a Panadapter is closed, its packet statistics contribution is removed from the displayed statistics. This can make the statistics appear to “go backwards”.

## 25.6 AUDIO TAB

The **Audio** tab provides a number of controls for audio output.



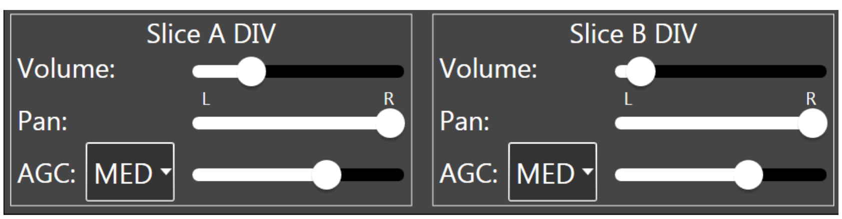

The **Main Audio Out** button controls Maestro's access to audio from the radio. When enabled, audio is sent to Maestro for reproduction in speakers or headphones. When disabled, audio is kept at the radio where it may be sent to attached speakers or headphones.

The **Front Speaker** button turns Maestro's front panel speaker on and off.

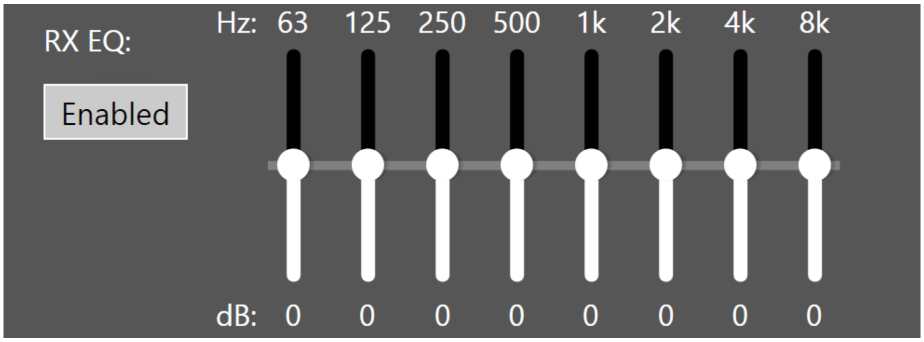
The **Binaural Audio** button controls the production of a virtual 3D spatial depth of field listening experience by shifting the phase of the recovered audio relative to one channel of the speakers or headphones. The effect may enhance weak signal reception. This effect can only be heard in headphones attached to Maestro.

The **Slice A** and **Slice B** sections of the tab contain controls reproduced from the A and B Slice front panel knobs and display controls. **Volume**, left to right **Pan**, **AGC** recovery rate and threshold are available for adjustment by tapping and sliding the controls. When the Slice is in an FM mode, the AGC controls are replaced with a Squelch enable button and Squelch level. Changes made to these values are reflected throughout Maestro.

When Maestro is connected to a FLEX-6700, diversity mode controls appear between the Slice A and Slice B volume controls and the Radio section. These controls provide adjustments for audio volume and AGC for each of the Slices in diversity mode.



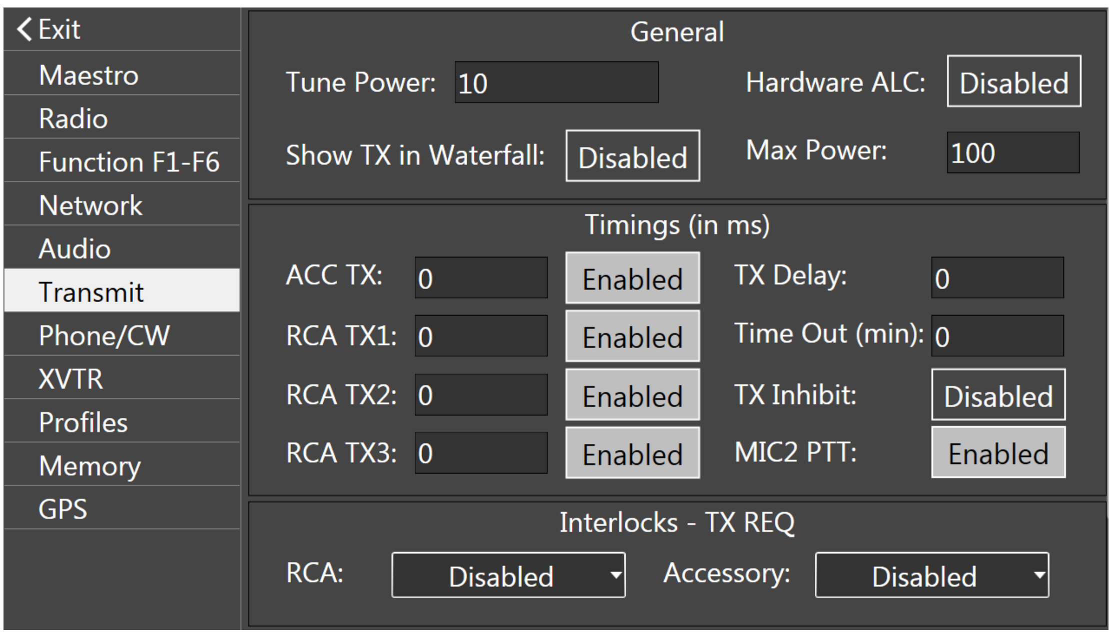
The **Radio** section sliders and buttons control the audio volume at the radio when the **Main Audio Out** control is set to **Radio**. When it is set to **Maestro**, these controls have no effect.




The **Receiver Equalizer** can be used to optimize the reproduced audio for different listening conditions and operating styles. The sliders provide a +/- 10 dB adjustment range over eight octaves. A button is available to enable and disable the equalizer. Note that a separate **Transmit Equalizer** is available on the **Transmit** tab.

## 25.7 TRANSMIT TAB

The **Transmit** tab offers adjustments for many parameters associated with the transmitter.




In the **General** section the **Tune Power** control sets a limit on the transmitter power level when the **TUNE** button is pressed on the front panel. Tapping this field opens a keyboard so the value can be changed.

The hardware ALC can be enabled and disabled by tapping on the **Hardware ALC** button.

**Δ – Please note this input is provided as a safety measure for external amplifiers. It is NOT meant to be used in regular operation as an active power control input or to modify the "attack" of an**

**external amplifier. Almost all modern HF amplifier manufacturers discourage the use of ALC in normal operation. In fact, many amplifiers do not have ALC implemented.**

The **Show Tx in Waterfall** button enables and disables the display of the transmitted signal in the Panadapter waterfall. When disabled, a single white line is added to the waterfall when transmitting. When enabled, the transmission data is added to the waterfall.

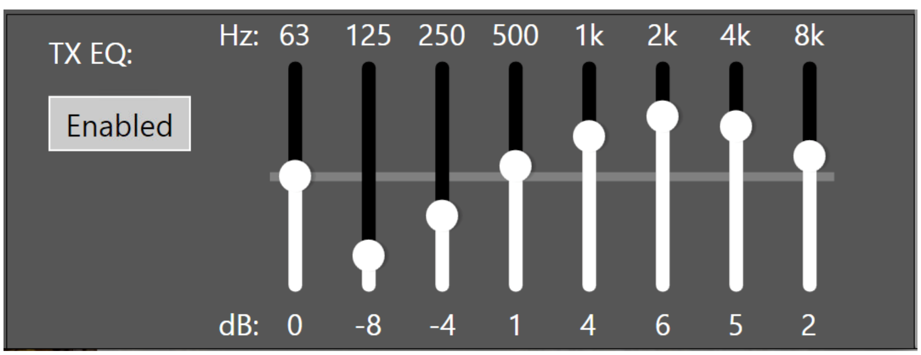
The **Max Power** control allows the user to manually set the radio's maximum output power on ANT1 and ANT2, when using the PA. This control sets the maximum value of the RF Power front panel knob. Transmit power set by third party programs will be limited to this value.

The **Timings** section has adjustments for **RCA TX1**, **TX2** and **TX3** (**TX1** only on a FLEX-6300) as well as the **Accessory TX**, **TX Delay** and **TX Timeout**. Each of these controls is measured in Milliseconds (MS). The **TX1**, **2**, and **3** timings are independent and start measuring from the moment the transmitter is engaged. When **TX Delay** is zero, RF will be produced as soon as the largest of **TX1**, **2**, **3** and **ACC_TX** has elapsed. Otherwise **TX Delay** is added to the maximum of **TX1**, **2**, **3** and **ACC_TX**.

When **TX Inhibit** is enabled, the transmitter is prevented from operating, regardless of other settings and inputs.

The **MIC2 PTT** button allows the user to disable the PTT input on the MIC2 back panel jack. This is useful when a microphone without a PTT switch is used.

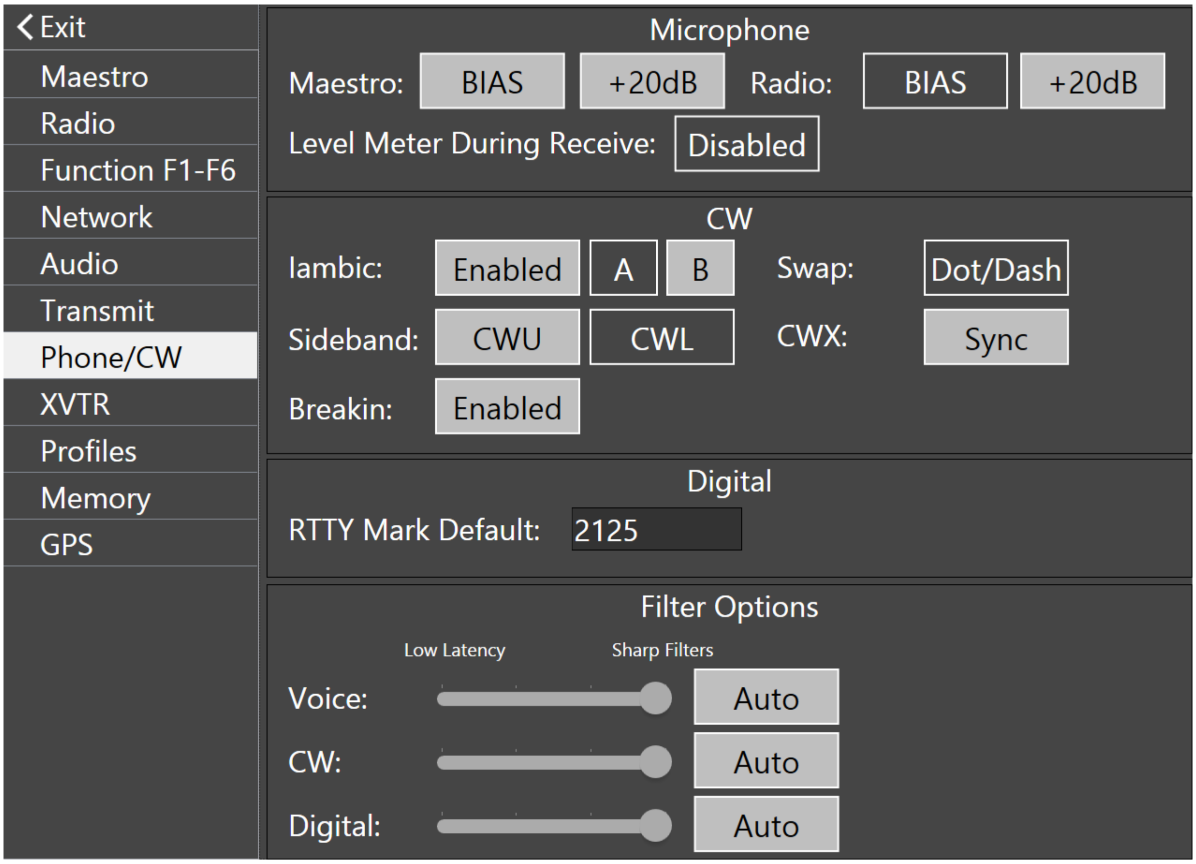
The **Interlocks** section offers three settings for **RCA** and **Accessory** timings: **Disabled**, **Active High** and **Active Low**. The FLEX-6300 does not have interlock settings for RCA.




When the **Transmit Equalizer** is enabled, the transmitted audio can be optimized for different microphones and operating styles such as DX, contesting and ESSB. The sliders provide a +/- 10 dB adjustment range over eight octaves. The settings shown above provide very good audio quality for many dynamic microphones.

## 25.8 PHONE/CW TAB

The **Phone/CW** tab provides a number of controls for managing the microphone and CW key interfaces.




In the **Microphone** section, the **Maestro BIAS** button enables the +5 VDC microphone bias voltage on the Maestro **MIC 2** connector. Enable this bias voltage only if required by the microphone. The **Radio Bias** button enables the bias voltage on the radio's front panel microphone connector.

The **Maestro +20dB button** enables the 20 dB gain microphone preamp on the MIC connector. The **Radio +20 dB** button enables the 20 dB gain microphone preamp on the radio's front panel microphone connector.

***Note: The +20 dB microphone preamp option should always be enabled whenever a microphone is directly connected the FLEX-6000. This option is not available when LINE is selected as the audio input.***

The **Level Meter During Receive** button enables or disables display of the microphone signal level on the microphone signal level meter when the transmitter is not engaged. This can be used to set the microphone level without transmitting.

In the **CW** section, the **Iambic**, **A** and **B** buttons enable and disable iambic key mode in Maestro in either mode A or Mode B configurations.

The **Dot/Dash** button swaps dot for dash when paddles are connected. **Dot/Dash** indicates the left paddle is the dot and the right is the dash. When **Dash/Dot** is selected the paddle assignments are reversed.

The **CWU** and **CWL** buttons alter CW tone pitch with tune direction in a similar way to upper and lower sideband decoding.

When the **Breakin** button is selected the transmitter is engaged by a key or paddle closure rather than a PTT signal.

In the Digital section, the RTTY Mark Default control sets the default value of the RTTY IF offset when new RTTY slice receivers are created. See section 23.2, RTTY Mode for more information about RTTY operation.

The three sliders in the Filter Options section control the RX filter sharpness/latency for the three mode groups, Voice (USB/LSB/AM/SAM/FM), CW and Digital (DIGU,DIGL,DFM,RTTY). The processing time, or latency, of the digital RX filters increases as the slider is moved to the right. Sharper filters require more processing time. In applications requiring fast turnaround of signals (e.g. certain contest environments), faster filtering of the received signal may be more desirable than adjacent signal rejection.

When Auto is selected for a mode group, the sharpness of the filter depends on the bandwidth of the filter. In general, the filter gets sharper, but slower, as the bandwidth narrows. In the following, Level 0 is the lowest latency (least sharp) and Level 3 is the highest latency (most sharp).

- DIGU/DIGL
  - Bandwidth from zero to 500 Hz: Level 3
  - Bandwidth from 500 to 1000 Hz: Level 2
  - Bandwidth from 1000 to 2000 Hz: Level 1
  - Bandwidth from 2000 to 10000 Hz: Level 0
- RTTY
  - Bandwidth from zero to 400 Hz: Level 3
  - Bandwidth from 400 to 1000 Hz: Level 2
  - Bandwidth from 1000 to 1200 Hz: Level 0
- CW
  - Bandwidth from zero to 400 Hz: Level 3
  - Bandwidth from 400 to 1000 Hz: Level 2
  - Bandwidth from 1000 to 1500 Hz: Level 1
  - Bandwidth from 1500 to 10000 Hz: Level 0
- USB/LSB/AM/SAM
  - Level 3 for all bandwidths
- FM/NFM/DFM
  - Level 0 for all bandwidths

All TX filtering is performed with low latency (less sharp) filters.

## 25.9 XVTR TAB

The XVTR Tab allows the user to set up transverter bands for the FLEX-6000. Tapping the **Add** button creates a new tab for a new transverter band definition. Refer to the section **21**, **How to Configure Transverters** for detailed information on configuring transverters.

## 25.10 PROFILES TAB

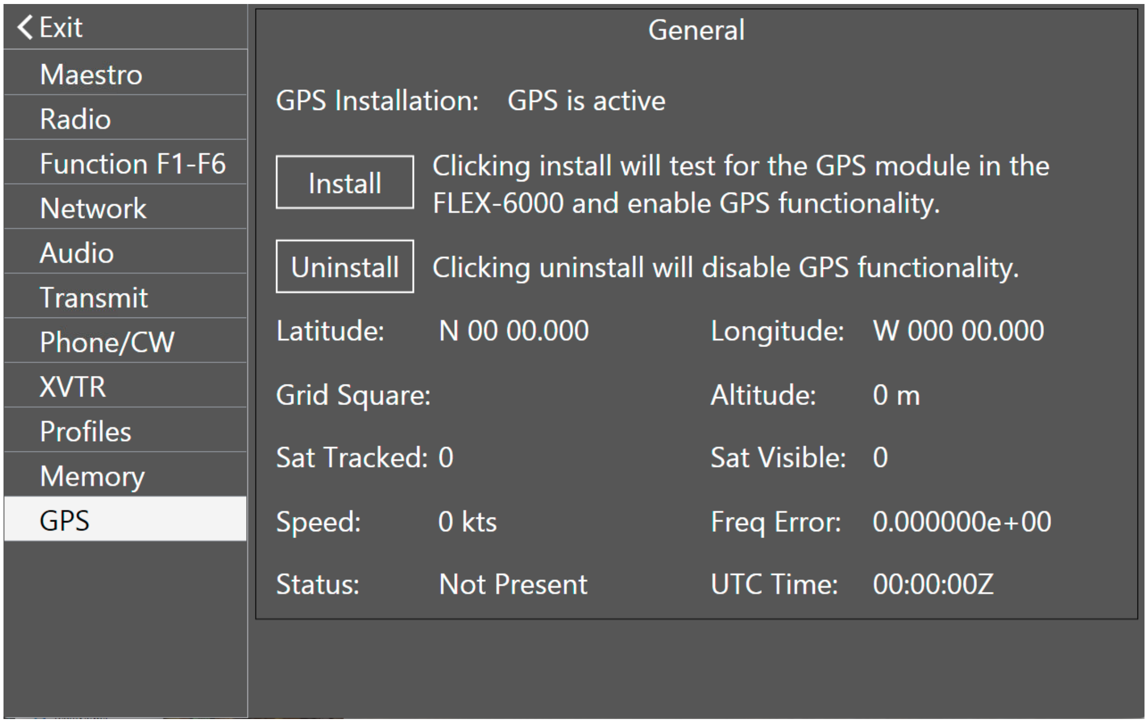
The **Profiles** tab loads, saves and deletes global, transmit and microphone profiles. See section **12**, **How to Use Profiles**, for full details.

## 25.11 MEMORY TAB

The **Memory** tab loads, adds and deletes sets of radio configuration information for rapid recall. See section **17.2**, **Memory Channels** for full details. While section **17.2** describes the use of Memories with the FM modes, Memories can be used with any mode.

## 25.12 GPS TAB

The **GPS** tab provides controls to manage a GPS Disciplined Oscillator. This option is not available in Flex-6300 models.




If your radio has a factory installed GPS module, this tab should display data from the GPS module and no further changes should be needed.

If you are installing the GPS module, tap the **Install** button to test for the GPS module and enable its operation. If the installation was successful, **GPS is active** should be displayed at the top of the panel. When removing the GPS or bypassing the module, tap the **Uninstall** button to disable GPS functionality.

If no GPS device is present in the radio, the **Install** and **Uninstall** buttons have no effect.

The lower portion of the GPS tab displays information collected from the GPS module. This information includes:

- **Latitude**
- **Longitude**
- **Grid Square**
- **Altitude**
- **Sat Tracked** - Number of Satellites being tracked by the GPS
- **Sat Visible** - Total number of satellites that should currently be visible to the GPS
- **Speed** - Speed of your radio in knots along the surface of the Earth
- **Freq Error** – The average error in the frequency of the 10MHz output from the GPS. The radio's frequency error is this value multiplied by the currently tuned frequency.
- **UTC Time**

- **Status** - Displays the current status of the GPS Module. One of six modes will be displayed:
    - Not Present
    - Holdover
    - Locking
    - Locked
    - Holdphase
    - Warm up

# 26 SLICE RECEIVER

## 26.1 DEFINITION

A Slice Receiver is a software resource which represents an independent, full performance, receiver. Maestro can operate a maximum of two Slices at one time, with fully independent controls. Each Slice is designated by a letter indicator 

which increments with each additional Slice.

## 26.2 CARRIER FREQUENCY

A Slice consists of a center Carrier Frequency displayed by a solid yellow  or red  vertical bar. A yellow bar indicates the Slice is "Active", suggesting that this is the Slice that you are currently manipulating. The active Slice will have the focus of radio features that are applied to Slice Receivers.

## 26.3 RECEIVE FILTER

Surrounding the Carrier Frequency bar is a blue Receive Filter bar  which represents the filtered receive audio. The portion of spectrum that is highlighted by the Receive Filter bar will be output as audio.

The position of the Receive Filter relative to the Carrier Frequency will correspond to the selected mode. A Receive Filter to the right of the Carrier indicates an Upper Sideband mode. A Receive Filter to the left indicates a Lower Sideband mode. A Receive Filter that spans both the left and right of the Carrier will indicate a double sideband mode.

The Receive Filter width can be adjusted manually by use of the associated bandwidth front panel control. The lower frequency limit and higher frequency limit can be adjusted in a number of ways.

## 26.4 DYNAMIC FILTER DEPTH

In most SDR systems, the number of filter taps employed to carry out the filtering task are set by a buffer size in the system. In order to change the filter tap depth, the system must be stopped before the adjustment can be made. As more taps are added, filtering is better but latency also increases. In Maestro, the number of filter taps employed changes based on the mode and filter width to achieve the best compromise between latency and filtering for the task at hand. Ultimately, the filtering capability and the latency are a function of the total duration of samples inside the filter at any time. The table below shows based on mode and filter size how many samples are used in the filter. The more samples (and consequently time) inside the filter, the greater the filter and the higher the latency.

| Mode | Filter Width | Filter time | Filtering | Latency |
|---|---|---|---|---|
| **USB / LSB** | Any | 85ms | Excellent | Highest |
| **CW** | <= 400Hz | 85ms | Excellent | Highest |
| | <= 1kHz | 43ms | Very Good | Medium |
| | <= 1.5kHz | 21ms | Good | Low |
| | > 1.5kHz | 11ms | Good | Very Low |
| **AM** | Any | 85ms | Excellent | Highest |
| **FM** | Any | 11ms | Good | Very Low |
| **DIGU / DIGL** | <= 500Hz | 85ms | Excellent | Highest |
| | <= 1kHz | 43ms | Very Good | Medium |
| | <= 2kHz | 21ms | Good | Low |
| | > 2kHz | 11ms | Good | Very Low |
| **Waveform Mode** | Any | 43ms | Very Good | Medium |

When using low latency ARQ mode digital programs such as PACTOR, a filter width greater than 2kHz is recommended to avoid adding extra latency inside the radio to the demodulation time.

# 27 FRONT PANEL DISPLAY

## 27.1 INTRODUCTION

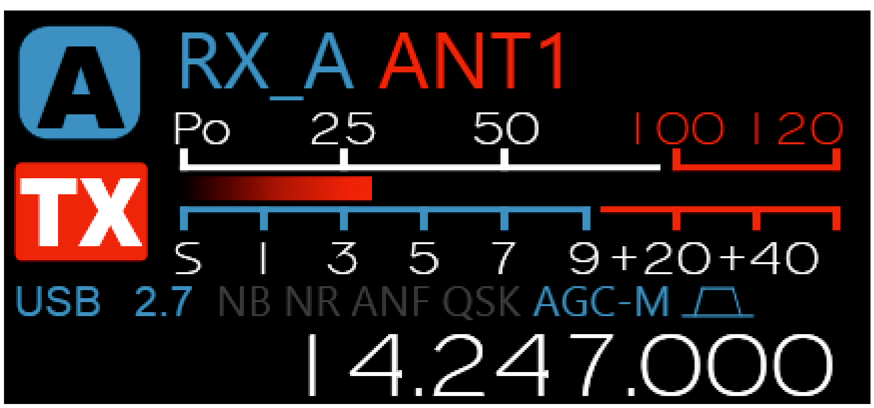
The Front Panel Display is a full color high resolution touch sensitive device. In operation, Maestro displays one or two Panadapters and one or two Slice Receivers. The user can interact with and control the radio by touching graphic elements of the display such as the **Main Menu** button, Slice Receiver Antenna control panels, Slice Receiver meters, Slice Receiver Control Panels and Slice Receiver tuned positions.

## 27.2 DISPLAY UPPER BAR


Located in the upper bar of the display are the two Slice Receiver Flags, the A Slice on the right and the B Slice on the left. In the center of the bar are the **Main Menu** button, the RF power level indicator, the power supply indicators and the network signal strength indicator.

### 27.2.1 Slice Receiver Flags

The Slice Receiver Flags contain many controls and annunciators associated with the operation of a Slice Receiver. These include a basic on/off control, an antenna selection menu, transmitter assignment, multiple meters, operational mode, tuned frequency and annunciators for filter width, noise reduction options, CW options and AGC state.




Elements of the Slice Flag, top to bottom, left to right:

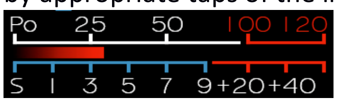
- 

The Slice Receiver identifier, A or B. When the Slice Receiver is active, A or B will be displayed. When the Slice is inactive a vacant blue background is shown. Tap the identifier to turn the Slice on or off. The corresponding front panel **RX** buttons will illuminate indicating that the Slice is receiving.

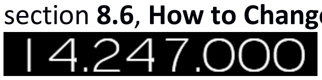
If two Panadapters are active in the Maestro display, tapping a Slice Receiver identifier button creates a Slice Receiver in the upper Panadapter if it doesn't already exist. Tapping the button again removes the Slice Receiver from the upper Panadapter and creates it in the lower Panadapter. Another tap removes the Slice Receiver altogether. Either the A or B Slice Receiver can be moved to either Panadapter this way.

- 

The Slice Receiver Antenna menu. Tap this indicator to open the antenna control panel. Using this panel, choices can be made for reception and transmit antennas. Tap the indicator again to close the control panel. A complete discussion of the control panel is found in section **20**, **How to Configure Antennas**.
- 

Transmitter indicator. Tap this indicator to move control of the transmitter to or from the associated Slice Receiver. The front panel TX buttons will illuminate as the changes are made. Note that it is possible to assign the transmitter to Slice A, Slice B or to neither Slice by appropriate taps of the indicator.
- 

Signal Meters. A choice of several meters is available in the middle of the Slice Flag. An "S" meter showing the received signal strength is always displayed in the lower half of the meter. Tapping the meter reveals a choice of meters for the upper half of the meter display. Choices include transmitted power level, SWR, microphone level, audio signal compression level, and ALC signal level.
- 

Annunciators. Below the signal meter is a row of annunciators. From left to right, these show the Slice Receiver operational mode (LSB, USB, CW, etc.), the receiver filter width in kHz, and a list of annunciators for options such as noise blanking (NB), noise reduction (NR), automatic notch filters (ANF), QSK mode and AGC recovery rate. At the right of the list, a graphic indicates the mode of the bandwidth control. When the graphic appears as it does above, the bandwidth control is in Low/Hi mode. When a vertical bar appears in the middle of the graphic, the control is in Center/Width mode. See section **8.6**, **How to Change the RX filter of a Slice Receiver** for more details.
- 

The tuned frequency. The bottom element of the Slice Flag shows the tuned frequency. Tapping this element opens the Slice Receiver Control Panel which covers the entire Panadapter portion of the display.

## 27.2.2 Slice Receiver Control Panel

The Slice Receiver Control Panel contains the controls associated with a Slice Receiver. These include the receiver mode, band, frequency, filter width, noise reduction, DAX channel assignment, AGC recovery time and others.

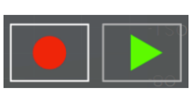
Open the control panel by tapping on the frequency in the Slice Flag, or by pressing the tuning knob inward until it clicks. The control panel covers the Slice Flag and all of the Panadapter. Close the control panel by tapping the frequency display, tapping outside of the control panel, or by another tuning knob press.


The elements of the control panel from top to bottom, left to right are:

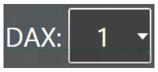
- 

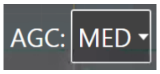
Tracking Notch Filter button. Enables and disables tracking notch filters.
- 

Full Duplex button. When enabled, allows certain receivers to operate in full duplex mode. See section **24**, **How to Operate in Full Duplex (FDX) Mode** for details on using this mode.

-  The red Quick Record button records the receive or transmit audio of the Slice Receiver. Pressing the green Quick Play button will play back the recorded audio. When the radio is transmitting, the recorded audio will be played through the transmitter.

- 

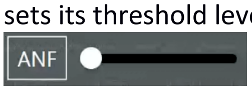
Wideband Noise Blanker. Enables the wideband noise blanker. Note that this noise reduction feature operates on the entire RF spectrum captured by the SCU, so enabling this feature in one Slice may enable it in another. See section **11.3**, **Wideband Noise Blanker (WNB)** for full details.
- 

DAX channel assignment. Assigns the audio produced by the Slice Receiver to the indicated DAX channel. The **Off** setting disconnects the Slice from the DAX system.
- 

AGC recovery rate. Controls the speed that the Automatic Gain Control recovers from sudden changes in the audio level. See section **11.1**, AGC Threshold for full details.
- 

L/R pan. Adjusts the audio level in stereo headphones from left to right. Each Slice Receiver can be set independently so it is possible to listen to a different Slice with each ear.
- 

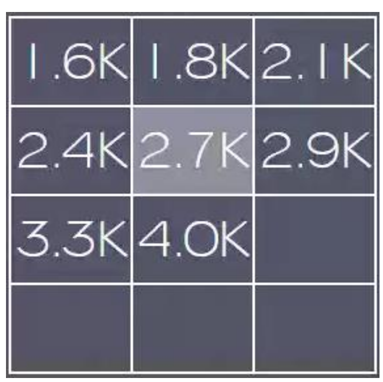
Slice Specific Noise Blanker. Enables the Slice specific noise blanker and sets its threshold level. See section **11.4**, **Slice Specific Noise Blanker (NB)** for full details.
- 

Noise Reduction. Enables the noise reduction system for the Slice and sets its threshold level. See section **11.5**, **Noise Reduction (NR)** for full details.
- 

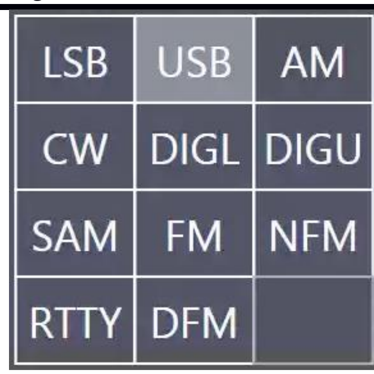
Automatic Notch Filter. Enables the Automatic Notch Filter and sets its threshold level. When the Slice is in CW mode the ANF button and slider will switch to an APF button and slider. See section **11.6, Automatic Notch Filter (ANF)** for full details.
- 

When operating a FLEX-6700 an additional control will appear to enable Diversity Reception. See section **18**, **How to Operate Diversity Reception (FLEX-6700 Only)** for complete details.

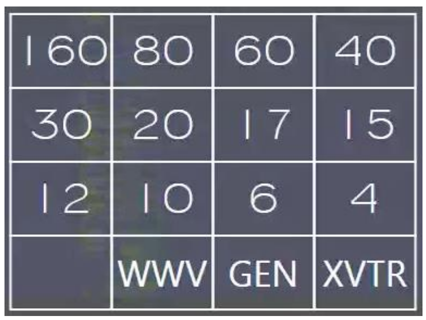
Across the bottom of the control panel are four menus for receiver filter selection, receiver mode, band and frequency input.



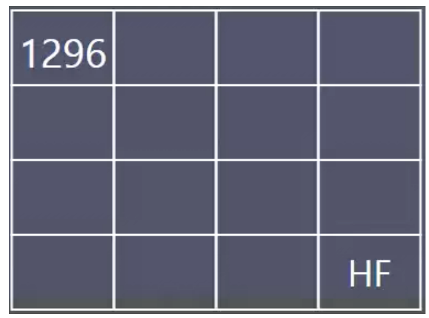

The Receiver Filter menu provides a number of commonly used filter widths, coordinated with the mode of the Slice Receiver. Tap a filter button to select a filter. Note that custom adjustments can be made with the front panel band width knobs.




The Mode menu provides a selection of the available operational modes. Sideband, AM, CW, digital, FM and RTTY modes are available. Tap a mode button to invoke the mode in the receiver.




<->




Selecting a band from this menu will adjust the Panadapter to display all or part of the corresponding amateur radio band. Selecting band buttons allows for rapid switching between views of the amateur radio bands. Tapping on the **XVTR** button in the lower right swaps the buttons to a list of **XVTR** bands. When the **XVTR** bands are shown an **HF** button will also be shown. Tap the **HF** button to swap back.


The tuned frequency of the Slice Receiver can be controlled with the keypad. Tap the number buttons to enter a frequency in MHz, tap ENT to enter the value into the Slice Receiver.

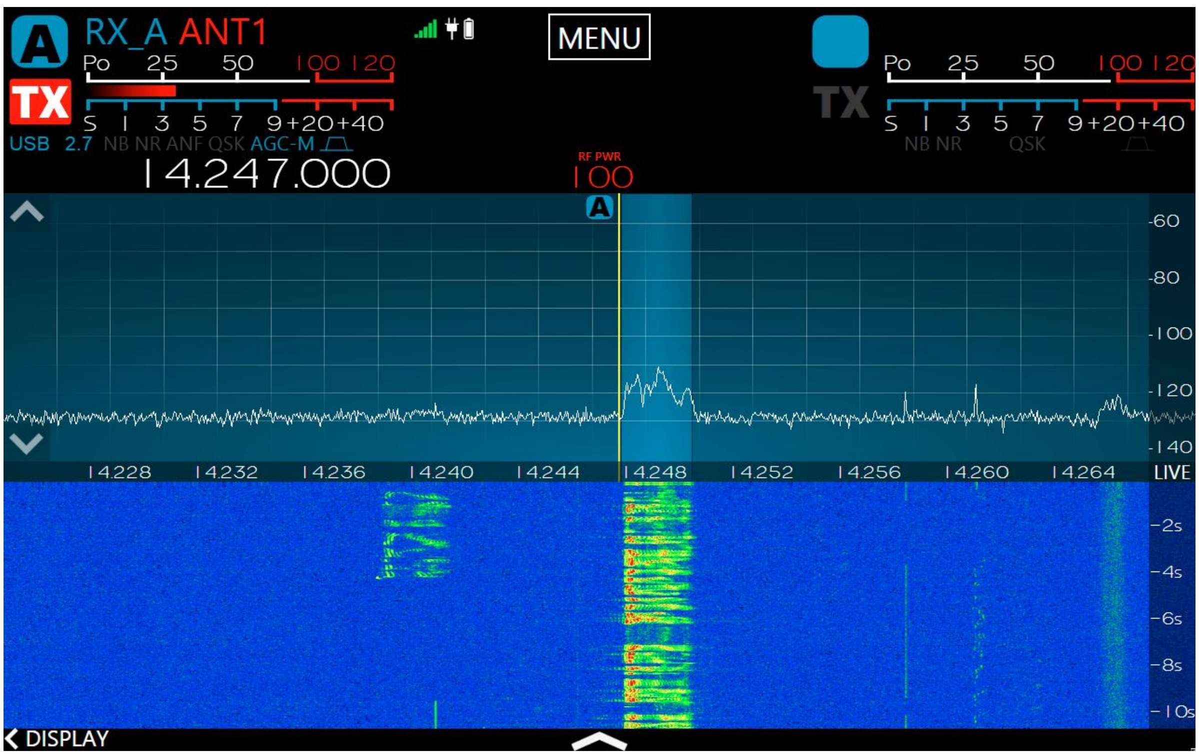
### 27.2.3 Power and Network Indicators


The center of the Maestro display upper bar features indicators showing the signal strength of the Ethernet connection, the battery charge status, the RF Power Amplifier output level and a button to open the **Main Menu**. See section **25, Main Menu** for full details about the **Main Menu**.

Tapping the RF output level indicator opens the Transmitter Control Panel.

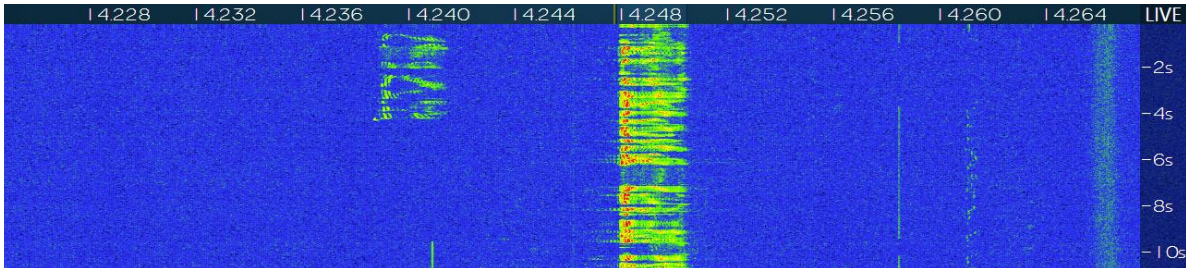
## 27.3 DISPLAY PANADAPTERS

### 27.3.1 Panadapter Definition




A Panadapter is a visual spectrum display of radio frequencies (RF). Frequency is listed along the horizontal axis from lower to higher frequency, from left to right, measured in Megahertz (MHz). Amplitude is shown on the vertical axis measured in decibels (dBm). The moving white line represents RF coming into the radio at the indicated frequency. The Panadapter is where the majority of typical operation occurs. Maestro is capable of displaying two Panadapters simultaneously, each with its own frequency and bandwidth.

### 27.3.2 Waterfall Definition

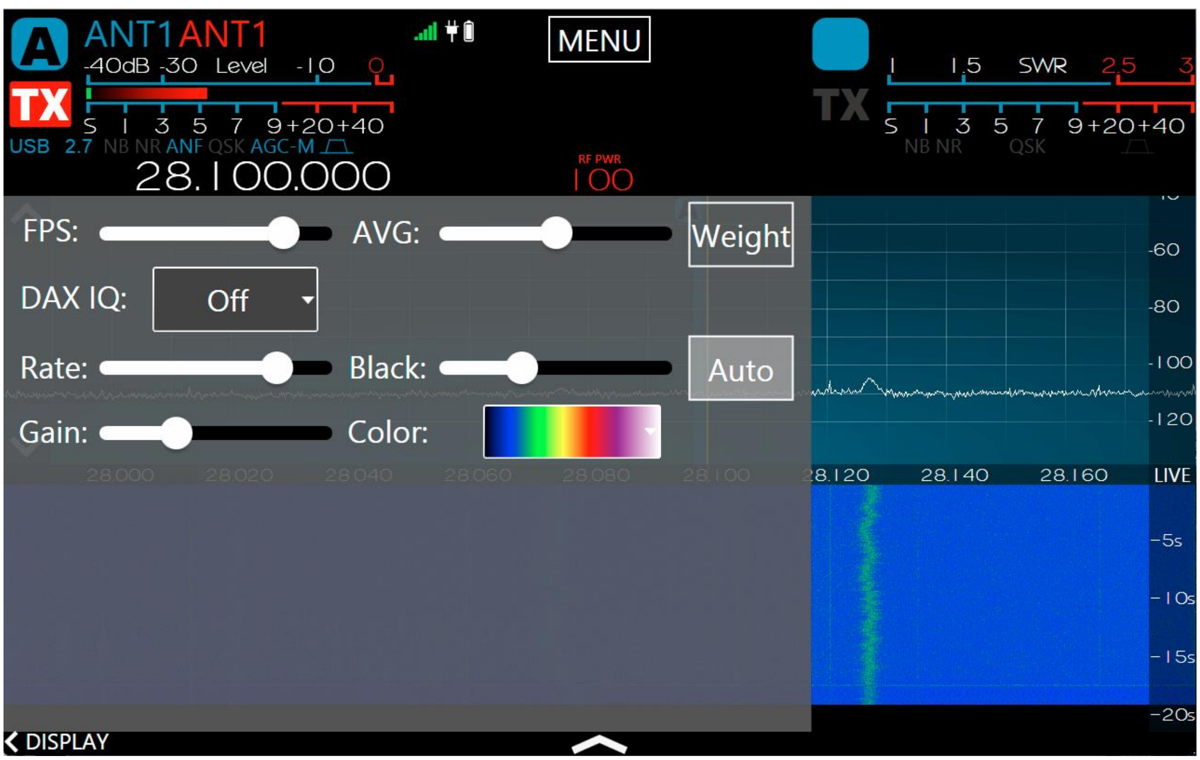



A Waterfall is a historical representation of RF data over time. Frequency is listed along the horizontal axis from lower to higher frequency, from left to right, measured in Megahertz (MHz). Time is measured on the vertical axis where the most recent data is at the top and the oldest data is on the bottom.

Tapping the **Live** button in the upper right corner of the waterfall changes the mode of operation from real-time to recent history. In the recent history mode, the waterfall displays selected data from the most recent several minutes. The displayed data can be moved up and down with finger swipes along the right edge of the display. Tap the red **Live** button to return to the real-time display.

### 27.3.3 Panadapter Display Menu

Tapping the **Display** menu button at the left side of the Panadapter will expose the display control panel.



Each Panadapter has its own controls. When one Panadapter is active, the upper half of the control panel is populated with controls, the lower half is blank. The controls are superimposed on the Panadapter they are associated with.

The **FPS** slider controls the framerate of the Panadapter display. Lowering the **FPS** control has several effects:

- It reduces the rate at which both the Panadapter and the Waterfall are updated.
- It reduces the network bandwidth required of data sent from the radio to the client, which may be important in situations in which limited bandwidth is available.
- As the framerate is reduced, the extra data not displayed is averaged and so the variance of the data is lowered, making both the Panadapter and the Waterfall smoother

If you prefer a faster updating display, but a more averaged or smoother one, adjust the **FPS** setting for the update speed you prefer and then raise the **AVG** (averaging) control. The **AVG** control increases the number of frames that are averaged, lowering the variance and smoothing the display.

The weighted average control, **Weight**, emphasizes signals that are increasing in amplitude over those that are declining. This has a tendency to continue to show locations where signals have been and show a more precise view of their full amplitude when they first appear.

The **DAXIQ** control allows the user to select the DAXIQ channel (1-4) that will stream IQ data from the Panadapter. Tap this control to display a selection of channels, or **Off.**

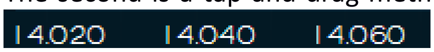
The **Rate** control adjusts how quickly the Waterfall advances on the screen. At the lowest setting, many minutes of data can be displayed. At its highest setting, the Waterfall displays a rapidly changing spectrum in the most detail.

The **Gain**, **Black** and **Auto** controls work together to adjust how different signal levels are displayed in the Waterfall. The **Black** control sets the level below which all pixels will render as black. In other words, it sets the level at which signals are no longer of interest. The **Auto** control automatically sets the black level to just below the noise level as band conditions, preamplifier changes or antenna changes alter the noise floor.

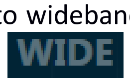
The **Gain** control adjusts how rapidly the Waterfall will advance through the color spectrum for minimal changes in signal level. Lowering the gain gives the Waterfall a broader dynamic range, but lessens its ability to show small variations signals. Raising the gain lowers the dynamic range, but provides more detail in the variances in smaller signals' magnitudes.

### 27.3.4 Horizontal Zoom

Each Panadapter has a zoom range up to a maximum of 14 MHz in bandwidth displayed at one time on the FLEX-6500 and FLEX-6700 and up to 7 MHz on the FLEX-6300. There are two methods for adjusting the zoom of the Panadapter.

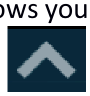
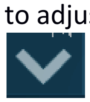
- The first is by use of the plus and minus buttons  located in the upper right corner of the Panadapter. Tap on the upper half of a Panadapter display to reveal the buttons. Zooming out (-) will double the bandwidth presented in the Panadapter while zooming in (+) will halve the bandwidth. The frequency at the center of the Panadapter will remain the same after tapping a zoom button. The buttons are removed from the display a few seconds after their last use.
- The second is a tap and drag method using the horizontal axis for more precise zooming. 

The tap and drag method will zoom in by dragging to the right and vice-versa. With this method the frequency at the point where your finger was located at the tap event will remain stationary in the Panadapter.

When zooming out with a FLEX-6000 radio there are certain points where the size of the data used to create the display on the screen will need to be doubled. As this occurs there will be more noise taken into account while processing the display which will cause a noticeable increase in the noise floor. The reverse occurs when zooming in on a Panadapter. After zooming out to a certain point, the hardware will switch to wideband mode. When this occurs, any Panadapters that are affected by this change will display 

in the top right corner to indicate that it is in wideband mode. In Wideband mode the radio will open the Bandpass Filters to their maximum for any Panadapter using the associated antenna.

### 27.3.5 Vertical Zoom

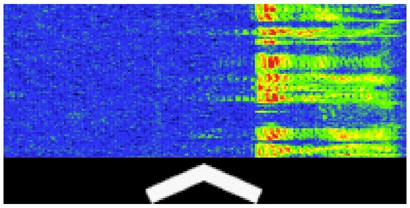
Each Panadapter allows you to adjust the maximum and minimum amplitude displayed. Tapping the up or down arrows   displayed at the left edge of the Panadapter will increase or decrease respectively the maximum amplitude displayed, in 10 dBm increments. You may also adjust the minimum amplitude by tapping and dragging the vertical axis at the right edge. This will effectively adjust where the noise floor is positioned within the Panadapter.

### 27.3.6 Panning Method

Each Panadapter can be panned left or right to adjust the frequency range that is viewed. Tapping and dragging within the Panadapter grid will reorient the frequencies being viewed on the Panadapter in the direction that your finger moves. By moving your finger to the right you will display lower frequencies and vice-versa.

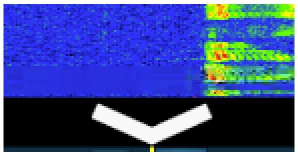
### 27.3.7 Add / Remove the Second Panadapter

When a single Panadapter is displayed on Maestro, a second Panadapter can be added by tapping the up-arrow symbol at the bottom of the Maestro display.



If both Slice Receivers are active when the second Panadapter is added, it is created without a Slice Receiver. If either the A or B Slice Receiver is inactive, it will be activated in the new Panadapter.

When two Panadapters are displayed, the second (lower) Panadapter can be removed by tapping the down-arrow symbol between the upper and lower Panadapters.



Maestro supports at most two Panadapters.

# 28 FRONT PANEL KNOBS AND BUTTONS

## 28.1 SLICE RECEIVER ACTIVATION BUTTONS

The Maestro front panel provides two sets of buttons that activate and deactivate the Slice Receivers.


Pressing an **RX** button when the corresponding Slice is inactive causes the Slice Receiver to become active. The button will illuminate green. Pressing the button again causes the Slice Receiver to become inactive. With appropriate button presses, it is possible for zero, one or two Slice Receivers to be active.

Pressing a TX button causes the transmitter control to move to the corresponding Slice Receiver, if the receiver is active. If the Slice Receiver is inactive, the transmitter cannot be assigned to it. At most one of the Slice Receivers can control the transmitter.

If two Panadapters are active in the Maestro display, pressing an **RX** button creates a Slice Receiver in the upper Panadapter. Pressing the button again removes the Slice Receiver from the upper Panadapter and creates it in the lower Panadapter. Another press removes the Slice Receiver altogether. Either the A or B Slice Receiver can be moved to either Panadapter this way.

Note that when no Slice Receiver is active, pressing the B **RX** button will not create the B Slice Receiver. When no Slice Receiver is active, the A Slice Receiver must be created first.

As a special case, if the A Slice is active and the B Slice is inactive, pressing the B TX button creates a conventional "split operation" configuration. The B Slice is created at a higher frequency, appropriate to the mode, and in the same mode as the A Slice. The transmitter control is moved to the B Slice.

A long press of either **RX** button, when the Slice is active and the button is green, activates the **RIT** (Receiver Incremental Tuning) feature. **RIT** allows the Slice Receiver's reception frequency to be adjusted up and down with the tuning knob while holding the transmit frequency constant. In this mode the reception bandpass is shown on the Panadapter as a light blue band while the transmit bandpass is shown as a light red band. If the transmitter is not assigned to the Slice, a vertical dotted red line marks the transmit frequency. The **RIT** indicator is green when **RIT** is active. Another long press of the **RX** button disables **RIT**.

Similarly, a long press of the **TX** button in an active Slice, activates the **XIT** (Xmit Incremental Tuning) feature. **XIT** allows the Slice Receiver's transmit frequency to be adjusted up and down with the tuning knob while holding the reception frequency constant. In this mode the reception bandpass is shown on the Panadapter as a light blue band while the transmit bandpass is shown as a light red band. The **XIT** indicator is red when **XIT** is active. Another long press of the **TX** button disables **XIT**.

The **Use VFO B Knob for VFO A RIT/XIT** button on the **Maestro** tab of the **Main Menu** (see section **25.2**, **Maestro Tab**) controls the details of **RIT/XIT** operation. When the option is not selected, the VFO A and VFO B controls work independently as described above. When the option is selected, and when Slice B is not active (**RX** button is off), then adjusting the Slice B **Tuning** knob will move the Slice A transmit or receive frequency while holding the other constant. Adjusting the Slice A **Tuning** knob moves both frequencies while holding the difference between them constant. When in **RIT** mode, pressing the VFO B knob resets the received frequency to the transmit frequency. Similarly, when in **XIT** mode, pressing the VFO B knob resets the transmit frequency to the received frequency.

The **A>B** button copies the settings of the A Slice to the B Slice. If no B Slice exists when the button is pressed, a B Slice is created in the same mode as the A Slice but at a higher frequency determined by the mode. In AM and FM modes, the new slice is located 10 KHz higher, in sideband modes, it is 5 KHz higher, in CW and RTTY modes, it is 1 KHz higher and in DIGU mode it is 500 Hz higher. If a B Slice exists when the button is pressed, its frequency is set to the same value as the A Slice, but its mode does not change.

A long press of the **A>B** button activates the A>>B constant frequency difference feature. The A and B Slices are locked together so that a change to the frequency of one of them changes the other by the same amount in the same direction. The difference in the frequencies remains constant. Another long press of this button disables this feature.

## 28.2 SLICE RECEIVER TUNING KNOBS AND BUTTONS

The Maestro front panel provides two knobs and two sets of buttons for tuning Slice Receivers.


The larger of the knobs, to the left, tunes the A Slice Receiver while the smaller of the knobs, to the right, tunes the B Slice Receiver. Tuning is completely independent. Each knob generates 64 tuning pulses per rotation and each pulse moves the frequency by an amount determined by the Slice's frequency step size and the direction of rotation of the knob.

Pressing the **A** or **B Step** button pops up a display of the step size in Hertz. Repeated presses cycle through a range of steps appropriate to the Slice's mode. Pressing and holding the button causes the step size to cycle in reverse.

The **A** and **B Lock** buttons lock the frequency of the corresponding Slice Receivers so that any attempt to change the frequency is ignored. When the frequency is locked, the button illuminates in red.

## 28.3 SLICE RECEIVER AUDIO KNOBS

The Maestro front panel provides two sets of knobs for managing the audio levels of Slice Receivers.


These multi-function knobs control audio level, AGC threshold and solo channel operation.

The inner knob controls the audio level of the associated Slice Receiver. This signal is produced either at the Maestro front panel speaker, or in headphones plugged into the back panel jack. When headphones are plugged in, the speaker is muted. Note that audio from both of the Slice Receivers can be mixed into the speaker or headphones.

When operating on battery power, the audio level is limited to a lower level than when operating on external power. This is done to increase battery life.

The outer knob controls the AGC-Threshold in SSB, digital and AM modes and squelch level in FM modes. See section **11.1**, **AGC Threshold** for full details.

Pressing the inner knob activates the solo channel/mute feature. When two Slice Receivers are active, a short press of the knob mutes the opposite Slice Receiver. Another short press returns Maestro to two channel audio operation. A longer press of the knob mutes the Slice Receiver. Changing the audio level unmutes the Slice Receiver.

## 28.4 SLICE RECEIVER BANDWIDTH KNOBS

The Maestro front panel provides two sets of knobs for managing receive filters.


These multi-function knobs control Slice Receiver filter lower and upper bounds and the manner in which they are changed.

The controls operate in two modes, High/Low mode and Center/Width mode:

- In High/Low mode, the inner knob controls the lower frequency bound of the filter and the outer knob controls the upper frequency bound.
- In Center/Width mode, the inner knob controls the center frequency of the filter and the outer knob controls the width of the filter.

In both cases, pop-up displays show the filter edge and center values as they are changed.

Pressing the inner knob inward performs one of two functions:

- A short press cycles the filter through the list of preset filters, appropriate to the Slice Receiver's mode.
- A long press changes the knob mode from High/Low to Center/Width and back. When the knob mode changes, the annunciator in the Slice Flag changes accordingly.

## 28.5 TRANSMITTER KNOBS AND BUTTONS

The Maestro front panel provides a number of knobs and buttons to control the transmitter.


The multi-function knob at the right side of the front panel controls microphone level, CW keyer speed, transmitter power level and opens the **TX Menu**:

> The inner knob controls the microphone audio level when the transmitter is operating in a voice mode. When the transmitter is operating in CW mode, the inner knob controls the keyer speed. A pop-up display shows the microphone level or keyer speed as it is adjusted.
>
> The outer knob controls the transmitter power level. A pop-up display shows the power level, as a percentage of full power, as it is adjusted.

Pressing the inner knob inward opens the **TX Menu**. Pressing the knob a second time closes the menu. Note that the menu can also be opened and closed by tapping the RF PWR annunciator in the middle of the upper bar of the main display.

Pressing the **MOX** button keys the transmitter. The button does not operate like a Push-To-Talk button. Press the button and release it to engage the transmitter. Press and release again to disengage the transmitter. The button illuminates in red when the transmitter is active.

Pressing the **TUNE** button causes the transmitter to output a low power sinusoidal tone useful for adjusting external antenna tuners and amplifiers. The power level is controlled by the **TUNE** slider on the **TX Menu**. Like the **MOX** button, the **TUNE** button does not operate like a Push-To-Talk button. Press the button and release it to engage the transmitter. Press and release again to disengage the transmitter. The button illuminates in red when the transmitter is active.

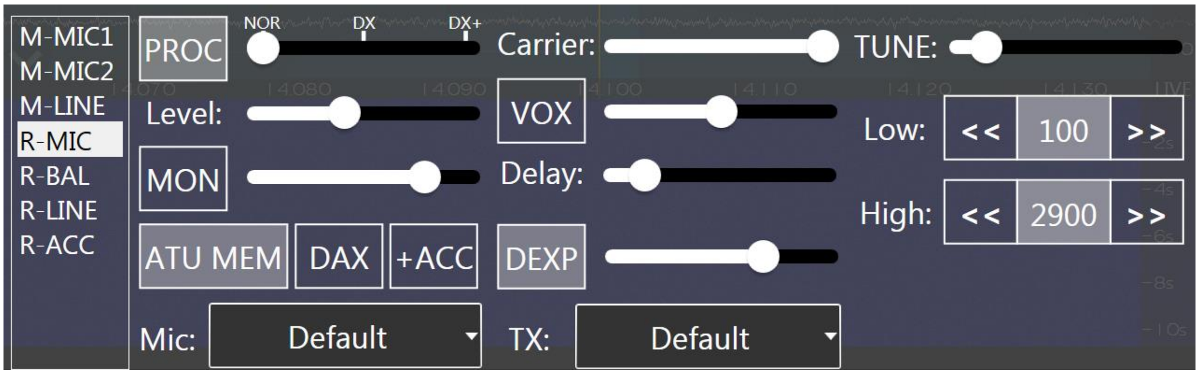
The **ATU** button engages and disengages the Automatic Tuning Unit. Please see section **19, How to Operate the ATU** for complete details on the usage of this device.

## 28.6 TX MENU

The Maestro **TX Menu** contains the controls and metering required for optimal FLEX-6000 RF transmission. The menu is displayed in a number of configurations depending on the demodulation mode of the Slice Receiver that controls the transmitter.

To display the **TX Menu** press the inner knob of the transmitter multi-function knob inward, or tap the RF PWR annunciator in the middle of the upper bar of the main display. Press or tap again to remove the menu.

### 28.6.1 Audio Modes Transmitter Menu




In the audio modes configuration, the transmitter menu contains microphone selections, audio processor, monitor, DAX, VOX, Downward Expansion, bandwidth filter and other controls:

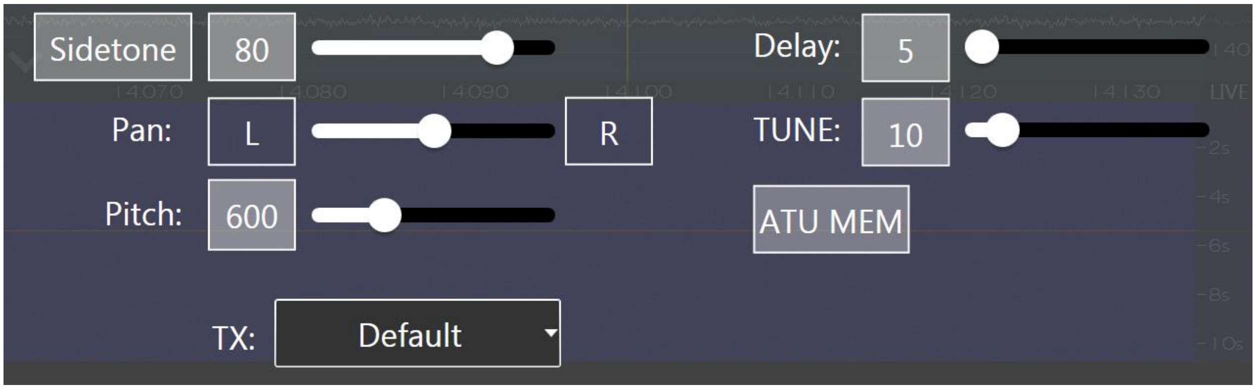
- The **Microphone Selection Menu** at the left of the transmitter menu provides the operator with a choice of microphone inputs on the Maestro device and on the FLEX-6000 transceiver. Tap on a choice to select it.
  - **M-MIC1** is the RJ45 **MIC 1** input on the back panel of the Maestro.
  - **M-MIC2** is the 1/8$^{th}$ inch TRS **MIC 2** input on the back panel of the Maestro.
  - **M-Line** is the 1/8$^{th}$ inch TRS **Line Input** on the back panel of the Maestro.
  - **R-MIC** is the 8 pin Foster microphone input on the front panel of the FLEX-6000 transceiver.
  - **R-BAL** is the balanced XLR input on the back panel of the FLEX-6000 transceiver.
  - **R-LINE** is the balanced ¼ inch TRS input on the back panel of the FLEX-6000 transceiver.
  - **R-ACC** is the line level input that is part of the D-Sub accessory connector on the back panel of the FLEX-6000 transceiver.
- **Processor (PROC) button:** Tapping this button will enable the W9GR Controlled Envelope Single Sideband (CESSB) DSP algorithm resulting in additional talk power. The speech processor may be on or off and has three different settings when on. In the NOR or normal setting, the processor provides minimal additional gain and simply prevents audio peaks from clipping or producing power in excess of the set level. In the DX setting, some compression is provided to the audio to increase the overall sideband envelope which results in a stronger signal that may be more readily heard at a distance. The DX+ setting adds even more compression increasing your talk power or "punch" without incurring significant audio distortion. DX+ is most effective if you increase the low cut TX filter to between 200-400 Hz

in order to concentrate your talk power in the audio frequency range that has the greatest intelligibility. This feature is available only in SSB, AM and FM modes.

- **Level control**: Moving the slider to the right increases the amount of transmitter audio input gain. Moving the slider to the left decreases the audio input gain. This level can also be adjusted using the inner knob of the transmitter multi-function control.
- **MON button and Slider:** Tapping this button enables the audio input monitor while transmitting, allowing the operator to hear the audio signal being sent to the transmitter in real time. Moving the slider to the right increases the monitor volume of the transmit audio. Moving the slider to the left decreases the monitor volume.

- **ATU MEM button:** Enables the ATU memories. See section **19**, **How to Operate the ATU** for complete details.
- **DAX Button:** Tapping the DAX button enables audio input from the Digital Audio eXchange (DAX) channel in place of the microphone or other audio source. See section **15.4.7**, **DAX TX Channel and Microphone Interaction** for more information on the coordination of DAX and microphones.
- **ACC button:** Tapping this button enables audio input and output on the ACC connector on the rear panel of the FLEX-6000 at the same time as a different primary audio source.
- **Carrier:** This slider adjusts the level of the AM carrier generated by the radio. Sliding the control to the right will increase the carrier level while sliding to the left will decrease the level.
- **Voice-Operated Transmit (VOX) button and slider**: When VOX mode is enabled, the operator's voice will automatically switch the transceiver into transmit mode. When moved to the right, the slider increases the audio level at which transmit is engaged, and reduces the level when moved to the left.
- **Delay slider:** This slider adjusts the delay between the end of the voice input and the point in time when the radio switches back to receive mode. Sliding the control to the right increases the delay while sliding to the left decreases it.
- **Downward Expander (DEXP):** A downward expander variably attenuates the mic gain by a certain percentage below a threshold setting rather than gating it on and off. This results in filtering out background noise without the abrupt on/off or chattering of a noise gate. The effect of a downward expander is to increase the *apparent* dynamic range of the system by decreasing the gain during the relatively quiet times thereby moving the apparent noise floor downward. See section **15.4.6**, **How to Configure the Downward Expander (DEXP)** for full details.
- **Tune Pwr Slider:** The Tune Pwr (Power) slider sets the output power level when **TUNE** is enabled. Moving the slider to the right increases the RF power output. A value of 0 will not produce any RF output. The scale, from 0 – 100 approximates RF output wattage.
- **TX Low Cut and High cut:** allows the user to set the low end cutoff and the high end cutoff of the transmit bandwidth.
- **Mic and TX Profiles**: The operator may choose from a list of microphone and transmit profiles defined in the radio. See section **12**, **How to Use Profiles** for complete details.

### 28.6.2 CW Mode Transmitter Control Panel




In the CW configuration, the transmitter control panel contains controls for:

- **Sidetone Button:** Tapping this button enables or disables the CW Sidetone.
- **Sidetone Slider:** Adjusts the volume (or amplitude) of the CW note. Moving the slider to the right increases the volume. Moving the slider to the left decreases the volume.
- **Sidetone Pan Slider:** Moving the Sidetone Pan Slider adjusts the sidetone from left to right channel audio, for use with headphones or stereo speakers.
- **Pitch control:** The pitch slider adjusts the pitch of the CW signal.
- **Delay Slider:** Moving the control to the right increases the time delay in milliseconds (ms) between the end of a keying element and the point in time when the radio transitions from transmit to receive. This effectively controls the QSK characteristics of the radio, where a value of 0ms is full break. Increasing this value will allow different degrees of QSK (semi break), such as listening between letters or words while sending.
- **Tune Pwr Slider:** The Tune Pwr (Power) slider sets the output power level when **TUNE** is enabled. Moving the slider to the right increases the RF power output. A value of 0 will not produce any RF output. The scale, from 0 – 100 approximates RF output wattage.
- **ATU MEM button:** When illuminated, this button turns on the ATU memories. See section **19**, **How to Operate the ATU** for complete details.
- **TX Profiles**: The operator may choose from a list of transmit profiles defined in the radio. See section **12**, **How to Use Profiles** for complete details.

## 28.7 FUNCTION BUTTONS


The function buttons provide a means to map a selection of radio operations to front panel buttons for convenient access. Mapping of the operations to the buttons is performed on the **Main Menu** Function Buttons tab. See section **25.4, Function F1-F6 Tab** for complete details.

A short press of the F1, F2 or F3 button invokes the function mapped to F1, F2 or F3 respectively. A longer press of one of the buttons invokes the function mapped to the F4, F5 or F6 button. A second long or short press reverses the action of the first press.

# 29 RESTORING TO FACTORY DEFAULTS

Restoring the radio to factory defaults will clear any installed waveform modules, persistence and profile data in the radio and return it back to its original state. Default profiles are restored if they had been deleted. It is recommended that you make a backup of your Global, Transmit and MIC profiles before resetting the radio back to factory defaults.

***NOTE: This should only be used as a last resort. If you are having trouble with your radio, please submit a HelpDesk support request.***

**FLEX-6700 and FLEX-6500 Reset Procedure**

With the radio powered off, press and hold down the "OK" button on the front panel of the radio. Momentarily press and release the power button to power on the radio. Continue holding in the OK button until the front display counts down to 0, the power LED starts blinking white and the "CALIBRATING…" message is displayed, then release the OK button. Allow the radio to continue booting normally.

**FLEX-6300 Reset Procedure**

With the radio powered off, press and hold down the power button until the Power LED blinks white, then release the power button. Allow the radio to continue booting normally.

# 30 ERROR AND STATUS MESSAGES

Various error and status messages regarding the operational state you your radio may be displayed to inform you of conditions that require attention. The following section describes these messages. If any of these errors occur frequently, immediately contact FlexRadio Support by submitting a HelpDesk support ticket for assistance.

## 30.1 THERMAL OVER TEMPERATURE

If the temperature of the FPGA exceeds 122F (50C) the following fatal error message will be displayed and radio will become unresponsive, requiring a reboot of the radio to recover. An FPGA over temperature condition can be due to high ambient operating temperatures or insufficient cooling by the FPGA cooling fan.

## 30.2 REVERSE RF POWER DETECTED

When a large amount of RF power is detected coming into the receiver, the receiver will automatically be disconnected and the transmitter will be unkeyed. Review your radio and antenna setup.

## 30.3 INTERLOCK IS PREVENTING TRANSMISSION

This message means that there is a certain interlock condition that is preventing transmission. Details on this interlock condition can be found near the bottom left corner of the Maestro display.

## 30.4 TRANSMIT SLICE HAS NOT BEEN SELECTED

A transmit Slice must be selected in order for the radio to transmit. To select a transmit Slice, press the **TX** button on the Slice Flag.

## 30.5 MAX POWER SET TOO LOW FOR ATU

This message indicates the Max Power setting for the radio is set too low for proper ATU operation. Refer to section **25.7, Transmit Tab** to increase this value.

# 31 TROUBLESHOOTING TIPS

In the event that you encounter problems running your Maestro, please use the following troubleshooting tips. If these tips do not solve the problem, please submit a HelpDesk support ticket for assistance from FlexRadio Systems.

## 31.1 FLEX-6000 DOES NOT SHOW UP IN THE RADIO CHOOSER

If the FLEX-6000 does not show up in the *Select Radio* screen, the most probable fault is network related. There are several network components that can be at fault.

### 31.1.1 Physical Layer Issues

After connecting your FLEX-6000 to either a network router, an Ethernet switch or directly connected to your Maestro, make sure the FLEX-6000 is properly connected at the network physical layer.

Looking at the back of the FLEX-6000 at the Ethernet connection, below the connector on the left you will find the link state LED. It should be illuminated yellow when the radio is powered on. If not, you do not have a physical layer connection and you should check or try the following:

- Make sure the Ethernet cable is plugged all the way in on both ends. A click should be heard when it is seated completely.
- Make sure the network router, Maestro or Ethernet switch is powered on before powering up the FLEX-6000.
- Most network routers and Ethernet switches will have their own link state LEDs associated with the port to which the FLEX-6000 is connected. Make sure the link state LED for the port connected to the FLEX-6000 is illuminated. If the port connected to the FLEX-6000 is blinking at a steady rate, this can indicate that the port is partitioned. Please refer to your network hardware manual for additional information
- Power cycle the FLEX-6000 to re-initialize the Ethernet port.

### 31.1.2 Firewalls Preventing Network Access from the FLEX-6000

The FLEX-6000 broadcasts a network discovery packet (message) that is received by Maestro. Maestro uses this information to populate the *Select Radio* screen. If the FLEX-6000 is not displayed in the *Select Radio* screen, or, after connecting to a FLEX-6000 there is no spectrum displayed, a firewall running on a network router, which is referred to as a “hardware” firewall, may be the source of the problem.

The action to resolve this condition is to modify the firewall configuration to allow access from any host on your local network to Maestro by allowing all TCP and UDP port access to Maestro.

### 31.1.3 MAC Address Filtering

Some hardware firewall / router / Wireless access point products have a feature that restricts access to the network based on the connected device’s media access control (MAC) address. If this feature has been enabled, failure to add the FLEX-6000 to the permitted MAC address access control list will prevent the FLEX-6000 from showing up in the *Select Radio* screen.

## 31.2 MAESTRO BECOMES UNRESPONSIVE

If your Maestro becomes unresponsive to button presses and turned knobs, power cycling the unit usually restores normal operation. Press the power button momentarily. If the unit shuts down, wait at least 10 seconds for all of the internal components to stop, then restart the Maestro.

If your Maestro does not respond to the momentary power button press, press and hold the power button until the unit powers off. Wait at least 10 seconds after releasing the button before restarting Maestro.

## 31.3 RADIO WILL NOT BOOT OR SMARTSDR-WIN WILL NOT COMPLETELY LOAD

If you get into a situation where the radio or Maestro will not boot or load properly, please open a HelpDesk ticket to resolve this. Alternatively, you can reset the Persistence database by doing a Factory Reset as described in section **29**, **Restoring to Factory Defaults**. Before doing this procedure, it is recommended to export your current settings if possible using the Import/Export menu in the SmartSDR-Win client.

## 31.4 FLEX-6000 NOT PERFORMING WELL AFTER AN UPGRADE TO NEW FIRMWARE

If you observe unexpected behavior or your radio is not performing well immediately after an upgrade to a new version of the Maestro software, it is possible that not all of the internal processors rebooted properly during the upgrade process. If this is the case, the first troubleshooting step is to "cold" boot the radio by turning the radio off using the power button. If the radio will not shut down, press and hold the power button until the radio turns off. Then remove all DC power from the radio for 10 to 15 seconds by unplugging the DC power cable. Replace the DC power cable and turn the radio back on. This will ensure a complete restart of all internal processors.

## 31.5 RF SPECTRUM NOT DISPLAYED PROPERLY AFTER SELECTING A FLEX-6000 OR AUDIO STUTTERING

After a FLEX-6000 has been selected, a default Panadapter is displayed showing active RF spectrum. If no spectrum is displayed, the display is not updating properly or remote audio is stuttering, check for the following problems:

- **Low bandwidth connection between the FLEX-6000 and Maestro** – If Maestro is connected to the FLEX-6000 via a wireless network connection, there is a possibility that a combination of low data streaming throughput and packet loss can result in a spectrum display that momentarily freezes or will not be displayed at all. If you experience this behavior, connect the FLEX-6000 directly to the Maestro via the Ethernet cable and reboot the system. If the direct connect method resolves the problem, then the wireless network probably lacks the capacity to run the FLEX-6000.
- **Panadapter resource not available** – If a Panadapter resource is not available in the radio, it is possible that the resource has been orphaned by an abnormal termination of Maestro. In this case, power cycling the radio will free the locked Panadapter resource.

## 31.6 AMBER FRONT PANEL LIGHT STUCK ON

If the LED on the front panel of the radio stays amber after powering down the radio, the radio has been configured to hold power on a GPS device. This configuration can exist even if no GPS device is present. This situation can be corrected by uninstalling the GPS using the **Uninstall** button on the **GPS** tab in the **Main Menu**. See section **25.12, GPS Tab** for details.

# 32 LEGAL NOTICE



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