

Excitement to go!™



FLEX-1500™

HF-6m Transceiver

Owners Manual

Version 2.0

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SOFTWARE DEFINED RADIO

The FLEX-1500 Owner's Manual


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Preface

Welcome to the exciting world of software defined radio. The FLEX-1500™ software defined transceiver is the culmination of many years of experience gained with FlexRadio's ground breaking series of transceivers. The experience gained and lessons learned have resulted in an SDR platform that is truly state of the art, yet extremely compact. And unlike most other transceivers, which once acquired, rarely if ever change, the FLEX-1500 will continue to (rapidly) evolve, offering future capabilities currently only dreamed of.

This operating manual attempts to both guide the user step by step through the setup process (both hardware and software) and to act as a reference once the radio has been set up. Additionally, the PowerSDR software will install with default settings that, in most cases, will require little adjustment. Any adjustments that you make are automatically saved and can be imported into an updated version of the software.

Due to the nature of the FLEX-1500, the largest part of this operating manual, by far, will refer to software. The operating manual has numerous screenshots of windows and forms to detail the various steps. Although the manual describes the latest official release of the PowerSDR software, you may occasionally notice an earlier version identified in the title bar of a screenshot. This is because FlexRadio Systems® has decided to only update a screenshot if it changes.

If you have any ideas on how to improve the FLEX-1500, please feel free to contact us, or better still, to join our email reflector (see <http://kc.flex-radio.com/KnowledgebaseArticle50024.aspx>). Not only is the FLEX-1500 a software defined radio; it is also a user defined radio.

FlexRadio Systems is committed to ensuring that your experience with the FLEX-1500 will be one of the most enjoyable you have with Ham radio. If you have any questions, issues or problems operating PowerSDR and/or the FLEX-1500, you may be able to find the solution on the Support Pages of our website (<http://support.flex-radio.com/>), in our Knowledge Center (<http://kc.flex-radio.com/search.aspx>), our Forum (<http://forums.flex-radio.com/>), or through our highly active email reflector (<http://kc.flex-radio.com/KnowledgebaseArticle50024.aspx>). If none of these sources provide you the assistance required, please contact FlexRadio Systems using the information provided on the Contact Page of our website (<http://www.flex-radio.com/About.aspx?topic=contactus>).

Acknowledgments

FlexRadio Systems could not be as successful, nor could the FLEX-1500 radio be what it is today without the many selfless contributions from our users all over the world. These contributions have spanned and continue to span improvements to our hardware and software, ranging from bug reports and feature requests to actual design and implementation of certain functionality.

Identifying contributors by name would only risk leaving out others with equally valuable contributions. We therefore wish to suffice with a heartfelt thank you for your support and continued commitment.

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Using This Manual in its PDF Form

If you are viewing this manual on your computer screen, you can use a combination of built-in features of Adobe® Reader^{®1} as well as the many cross-references and hyperlinks within the text:

- ❑ To find a word within the manual, type **ctrl + F** on your keyboard (or in the menu click **Edit - Find**), enter the desired word in the text box that opens and click **Next**.
- ❑ To jump to a chapter or section in the manual, click on the corresponding Bookmark, shown to the left of this page. (If not shown, click on the vertical tab labeled **Bookmarks**). To make them as useful as possible, we have made the bookmarks very detailed.
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 - Similarly click on the "Next View" arrow to go forward to a subsequently viewed page. (Alternatively, in the menu, click **View – Goto – Next View**, or on your keyboard type **Alt + Right Arrow**).
- ❑ Within the text there are many cross-references. Although not obvious, these are all hyperlinks within the manual. Click on the referenced **Table n**, **Figure n**, **above**, **below** or page **n** (bold indicates the hyperlink) and you will immediately jump to the referenced Table/Figure/page of the manual.
 - To return to where you came from, use the "Previous View" arrow.
- ❑ Within the text there are also external hyperlinks, shown in blue and underlined. Click on these to open your browser and view the referenced website page. Many of these relate to articles in our expansive Knowledge Center.
 - If the hyperlink has been previously clicked, it will be shown in magenta instead of blue.

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Reference to Software Controls

In this manual many types of software controls will be referred to. The myriad of various bells and whistles can sometimes be a bit overwhelming. Figure 1 below is a key that will help to introduce the basic controls for those less familiar with windows software.

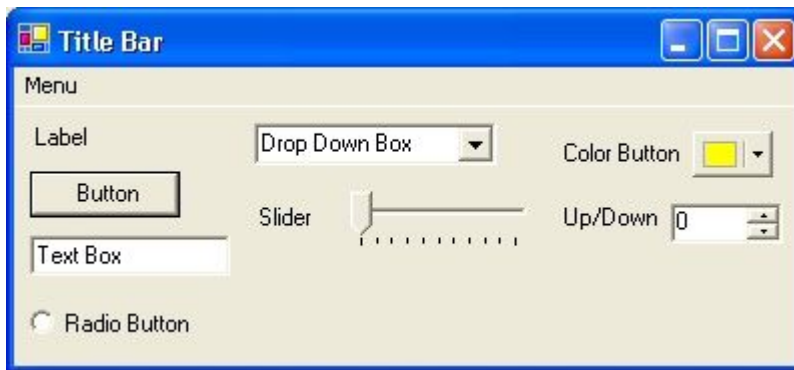


Figure 1: Control Key

- ❑ The **Form** refers to the entire window with the **Title Bar** showing the Form Name.
- ❑ The **Menu** is just under the Title Bar. Menu controls generally open other forms.
- ❑ **Labels** are callouts usually for other controls.
- ❑ **Buttons** can trigger events or act like an On/Off switch.
- ❑ **Text Boxes** allow text to be entered or displayed.
- ❑ **Radio Buttons** allow the user to choose between several options.
- ❑ **Drop Down Boxes** (also called Combo Boxes) enable the ability to offer many options without taking up as much window space as a Radio Button.
- ❑ **Sliders** allow easy modification of a numerical value.
- ❑ **Color Buttons** are used as color selectors. You can pick a generic color (yellow or green) or even make your own using the drop down menu.
- ❑ **Up/Down** controls are similar to a Text Box, but are limited to numeric input. They also have arrows for simple increment/decrement behavior.

Hardware Installation

To install the FLEX-1500, you will need to:

- ❑ Unpack and decide on a location
- ❑ Physically connect the radio to a power supply, antenna, microphone, key, etc. Although not necessary, you should preferably make all these connections in advance. However, you must at least connect the FLEX-1500 to a 13.8 VDC power supply and connect the USB cable
- ❑ Install the FlexRadio Driver, required to enable the computer to interface with the FLEX-1500.

Unpacking and Deciding on a Location

Contents of the Carton

Inside the carton you should find the following items:

Table 1: Contents of Carton for each FLEX-1500 Model

Item	
FLEX-1500 Transceiver	✓
USB cable (6 feet)	✓
Unterminated power cable (4 feet)	✓
PL259/BNC adapter	✓
Quick Start Guide	✓
CD ROM/USB Flash Drive with Owner's manual, Quick Start Guide, PowerSDR 2.0 or later, FlexRadio Installer	✓

(Other items may be included that are not listed above)

The FLEX-1500 power cable is unterminated at one end so that you can adapt it to various DC power connectors, such as Anderson Power Poles, Banana plugs, screw terminals or spade lugs. Connect the black wire with white stripe and red sleeve at the end to the positive terminal and the black wire to the negative terminal of your power supply.

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Note 1: Do not apply power to the FLEX-1500 until you are instructed to do so.

Note 2: Retain the FLEX-1500 packaging for future use. This packaging was specially designed for the radio to prevent damage which may occur during shipping. If you ever need to ship your FLEX-1500 anywhere, especially back to FlexRadio Systems, this is the preferred packaging to use.

Location Considerations

To facilitate integrating your FLEX-1500 into your shack you may want to consider the following:

- ❑ Place your FLEX-1500 in close proximity to your computer. It is best to use the shortest USB cable possible to connect to your computer to minimize data errors and limit possible RFI getting into the computer.
- ❑ Ensure convenient access to the back panel. The FLEX-1500 back panel is where several of your connections will be made. Having easy access to the back panel without moving the transceiver is optimal while getting started.
- ❑ Avoid contact with liquids. Although this is usually not a problem unless you are operating maritime mobile, accidental spills of liquids on the FLEX-1500 could result in voiding the warranty. Placing the FLEX-1500 away from food and drinks is highly recommended.

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Physical Connections

We will now first discuss the front panel and then the back panel connections.

Front Panel

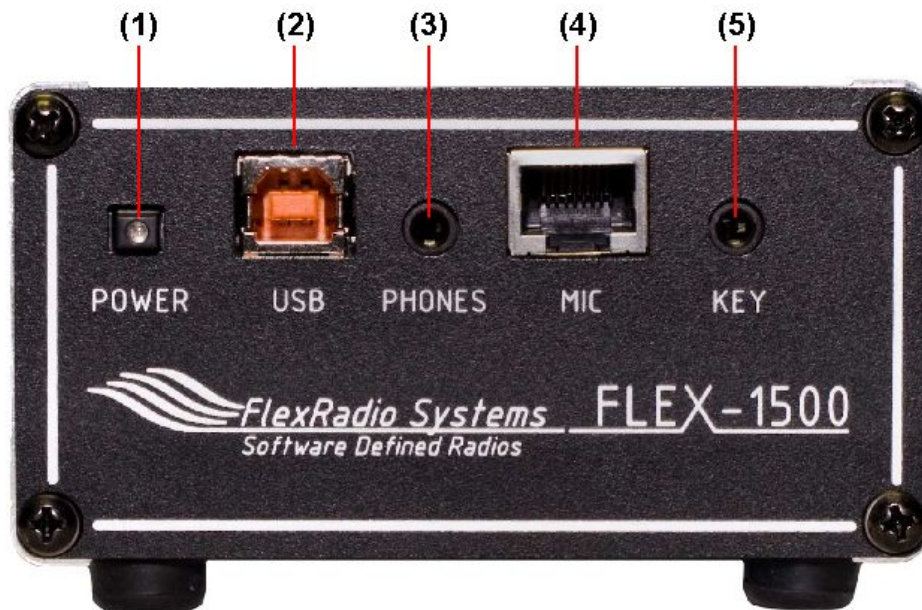


Figure 2: FLEX-1500 Front Panel

(1) Power Switch

The FLEX-1500 uses a delayed start push-to-latch/push-to-release switch to power up the radio.

- ❑ To turn on the radio, push the switch in fully to latch it in the on position. After a few seconds you will hear the power relay click and see the LED illuminate to indicate that the radio is powered up.
- ❑ To turn off the radio, again push the button fully to unlatch it in the off position.

Note: Make sure PowerSDR is shut-down first before turning off the radio.

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(2) USB Jack

Connect the ferrite core end of the supplied USB cable to this jack and connect the other end to your computer's USB jack.

CAUTION: Do not remove the ferrite core as it is required for CE compliance and to minimize RFI at this ingress point.

(3) Phones Jack

Accepts headphones with standard 1/8" stereo (TRS) plug. Recommended ratings for headphones are 40 mW into 8 Ohm load or higher.

The phones jack can also be connected to an external audio amplifier or computer-type powered speakers. It provides two-channel (stereo) audio to enable binaural audio and MultiRX™. The audio level can be set on the FLEX-1500 Mixer Form (see page 94). Additionally the FLEX-1500 can drive an unpowered mono speaker at 1 W with the speaker wired to the tip and ring of the stereo plug, leaving the speaker ungrounded and selecting the Speaker Option on the Mixer Form. Table 2 summarizes the plug connections.

Table 2: Possible Phones Plug Connections

Connector	Headphones/ Powered Speakers	Unpowered Speakers
Tip	Left	Speaker (+)
Ring	Right	Speaker (-)
Sleeve	Ground	Not Connected

CAUTION: Do not use a mono (TS) plug as this will short the ring to ground.

For more information on powered speakers used with FlexRadio products, refer to the Knowledge Center article [What Kind of Speakers Should I buy for my SDR?](#) (search for *speaker* in our Knowledge Center at <http://kc.flex-radio.com/search.aspx>).

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(4) Microphone Connector

The 8-pin RJ-45 connector offers the ability to connect a microphone and to key the radio via a PTT line. The pin-out is shown in Figure 3 below¹. To engage PTT, pin 6 must be grounded to pin 7 (Shield Ground) and not to pin 4, which is the microphone ground.

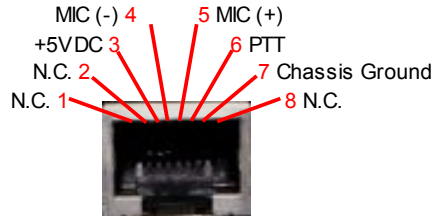


Figure 3: Pin-out of the MIC Jack

(5) Straight Key or Paddles (KEY)

For CW operation, the 1/8" TRS **KEY** jack will accept a TRS plug for operating a keyer with paddles or a TRS/TS plug for a straight key. The pin-out is shown in Table 3 below.

Table 3: Key Jack Pin-Out

Connector	Keyer Signal	Straight Key
Tip	Dot	Key
Ring	Dash	N/C
Sleeve	Common	Common

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¹ The pin-out is similar to that normally found on Yaesu mobile radios

Back Panel

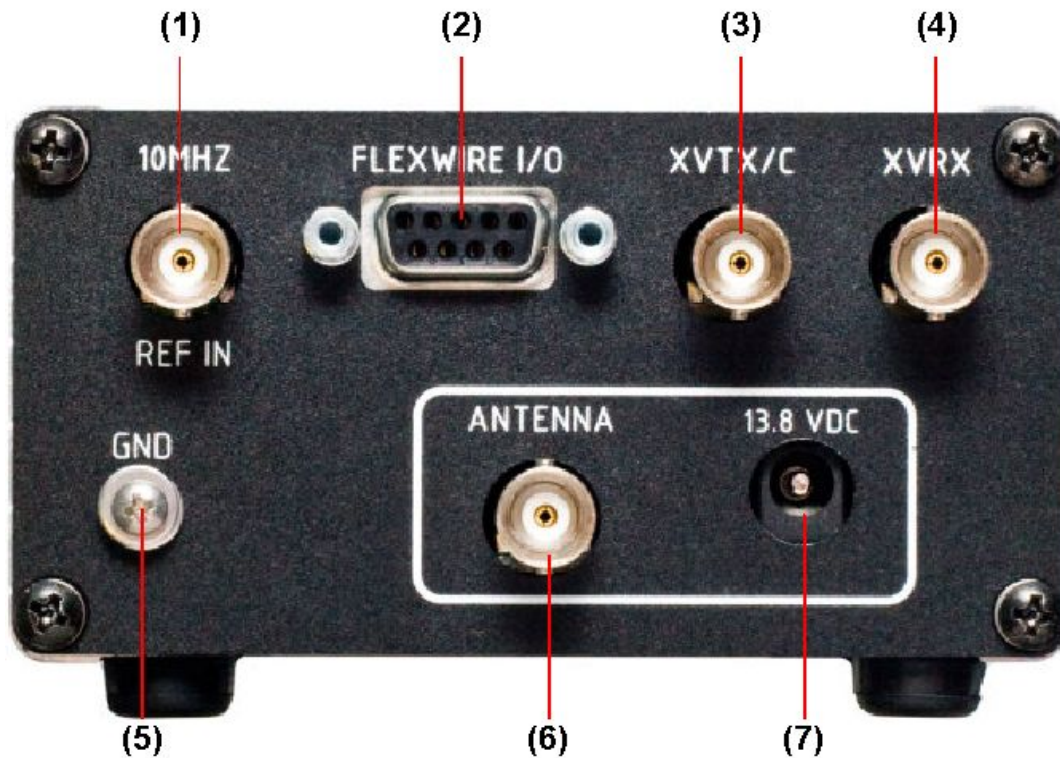


Figure 4: FLEX-1500 Back Panel

(1) External Frequency Reference Input

Accepts input from an optional 10 MHz, 0 to +15 dBm reference source, such as a GPS disciplined or high precision clock source. This enables greater frequency stability for those operators requiring such, e.g. for VHF+ operators operating in the GHz range. Selection of the frequency reference occurs on the Setup Form, General Tab, Hardware Config Sub-tab (see page 101).

(2) FlexWire™ Peripheral Interface Bus

This connector includes a PTT output for switching external amplifiers or relays, a PTT input, and line level audio input and output (mono) as well as a FlexWire intelligent, high speed, bi-directional communications interface that allows PowerSDR to communicate with a host of peripheral devices such as antenna tuners, rotor controllers, band switchers, etc. A family of FlexWire peripherals will be forthcoming from FlexRadio Systems. This is not another CAT port, but an industry standard bidirectional communications bus based on the I²C (pronounced *I squared C*) protocol along with AF I/O lines.

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Table 4 below Shows the FlexWire connector pin-out. Complete specifications and the programming interface will be published to allow home brew and third-party add-on products.

Table 4: FlexWire Connector Pin-Out

Pin #	Signal	Diagram
1	Ground	
2	Line In	
3	PTT Out (250 mA/30 V max)	
4	PTT In	
5	Ground	
6	I ² C Clock (SCL)	
7	I ² C Data (SDA)	
8	+5 V, 250 mA max	
9	Line Out	

WARNING! Do NOT attempt to connect a PC serial port to the FlexWire connector. Doing so may void your warranty and severely damage your FLEX-1500.

WARNING! The PTT Out is an open drain that will switch a positive voltage to ground when transmitting. If you are driving a relay you must make sure it draws no more than 250 mA. You MUST also place a diode across the relay to absorb the relay's inductive "kick" so that the open circuit maximum voltage of 30 V is not exceeded.

(3) Transverter Transmit or Common Port (XVTX/C)

This is the transverter transmit, or transverter common (both transmit and receive) connection. The output level equals 0 dBm at a drive level setting of 30. Use the Antenna Form to select whether this port is to be used as a Transmit Only, Transmit and Receive or auxiliary Receive port.

(4) Transverter Port (XVRX)

This is the transverter receive connection. Use the Antenna Form to select whether this port is to be used as a Receive Only or auxiliary Receive port.

(5) RF Ground Terminal

Connect to the single point ground system in your shack. Alternatively, if you have no single point grounding system, ground the FLEX-1500 to the metal chassis of your computer with a low impedance ground strap, such as a 1" braid or copper strip (the screws that hold the computer power supply in place make an excellent grounding point).

(6) Antenna Port

Connect a 50 Ohm antenna or dummy load to the BNC antenna port.

(7) 13.8 VDC Power Socket

The FLEX-1500 requires a stable 13.8 VDC power source rated for at least 1.5 A and 2.0 A peak for proper operation. Supplied with your radio was an unterminated 2.5mm coaxial power plug (+ on center pin, ground on sleeve) and cable set. Terminate this cable in the appropriate connector (if needed) for your DC power source such as Anderson PowerPoles®, banana plugs, spade or ring lugs. Connect the black wire with white stripe to the positive terminal and the plain black wire to the negative terminal of your power supply.

The FLEX-1500 has an internal 3 A fuse for protection of the unit, and has internal polarity protection, such that if DC polarity is reversed, the internal fuse will blow.

Note 1: In receive only, or transverter mode, the unit will function over the range of 8 Volts to 15 Volts at this power input.

Note 2: When transmitting, full specification operation is at 13.8 V, but the 5 Watt transmitter will still function over the range of 11.5 V to 15 V.

WARNING! The internal fuse is for protection of the radio. Additional protection must be provided by the user to protect the supply cord and connectors. This can be in the form of a current limited power supply, or an additional fuse (5 to 10 Amps recommended) at the power source if you are operating the unit from a source, such as a battery, capable of delivering high currents.

WARNING! A "Wall-Wart" is not an appropriate power source for operating this radio with the 5 Watt amplifier active. For best linearity and power output, the radio should be operated from a regulated, or voltage stable power supply.

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Specifications and Architecture

Specifications are subject to change without notice or obligation, and specifications are guaranteed only within the amateur radio bands.

FLEX-1500 Transceiver Specifications

Table 5: Overview of FLEX-1500 Specifications

General	
Receiver Frequency Range	10 kHz – 60 MHz (operating – requires external, customer provided filters below 1.8 MHz to eliminate images); 160 m – 6 m (specified Amateur bands only)
Transmitter Frequency Range	160 m – 6 m (specified Amateur bands only)
Frequency Stability	± 2.5 ppm
Operating Temperature Range	14 °F to 122 °F (–10 °C to +50 °C)
Frequency Steps	1 Hz minimum
Antenna Impedance	50 Ohms, unbalanced
Max Rating PTT Out	30 VDC, 250 mA
Recommended Headphones	40 mW, 8 Ohms or higher
Power Consumption	Rx 400 mA (typ); Tx (5 W) 2.0 A (max.)
Supply Voltage	DC 13.8 V ± 10%
Maximum Interconnect Cable Length	10 feet (3 m), No restriction on DC cable within voltage tolerance limits under load.
Special EMI/RFI Requirements – CE Compliance Cable Requirements	1 snap on ferrite bead on USB cable (supplied)
Dimensions:	(WxHxD): 4.0" x 2.0" x 6.0" (10.2 cm x 5.1 cm x 15.2 cm)
Weight (approx.):	2 lbs (0.9 kg)
Receiver	
Circuit Type	Direct conversion, low IF
Intermediate Frequency	Software selectable from DC to 20kHz
MDS	50 MHz: -138 dBm in 500 Hz bandwidth (Preamp = +30) 14 MHz: -127 dBm in 500 Hz bandwidth (Preamp = +20) 14 MHz: -116 dBm in 500 Hz bandwidth (Preamp = 0)
IP3	+21 dBm at 14 MHz, Preamp = 0 (S5 IM3 Method)
Selectivity (–6/–60 dB)	CW: 500 Hz –6/–60 dB: 500/640 Hz SSB: 2.4 kHz –6/–60 dB: 2.39/2.54 kHz AM: 6.6 kHz –6/–60 dB: 6.60/6.74 kHz All measurements at 48 ksps/2048 Buffer Size
Image Rejection	>100 dB with Wide Band Image Reject active
Transmitter	
Power Output	0.05-5 W nominal
Emission Modes	A1A (CWU, CWL), J3E (USB, LSB), A3E (AM), F3E (FM), DIGITAL
Harmonic Radiation	Better than –48 dB (160 – 10 m Amateur bands) Better than –60 dB (6 m Amateur band)
SSB Carrier Suppression	At least 55 dB below peak output
Undesired Sideband Suppression	At least 55 dB below peak output
Audio Response	(SSB): Flat Response 10 Hz to 20 kHz, 3-band or 10-band Software EQ
3 rd Order IMD	Better than 32 dB below PEP @14.2 MHz 5 W PEP
Microphone Impedance	600 Ohms (200 to 10 kOhms)

FLEX-1500 Architecture

The FLEX-1500 architecture is shown in Figure 5 below.

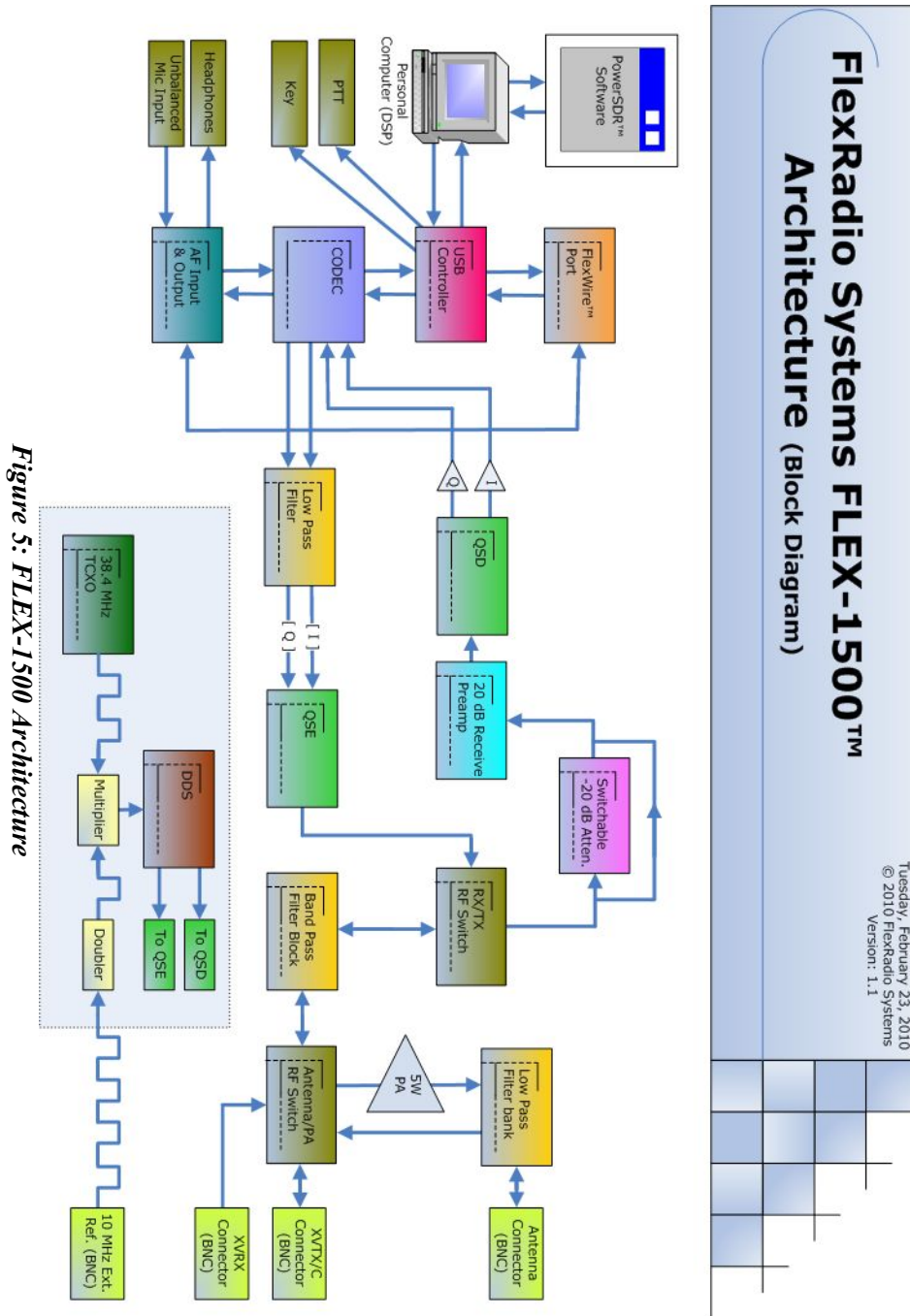


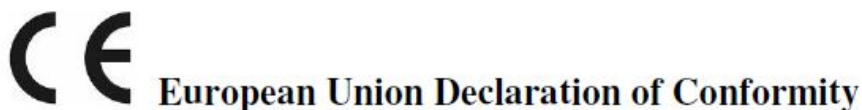
Figure 5: FLEX-1500 Architecture

Declarations of Conformity

FCC

The FLEX-1500 complies with FCC Part 97 rules for the Amateur Radio Service.

EU Compliance



Flex-1500 Amateur Radio Transceiver Series

According to
Radio and Telecommunication Terminal Equipment Directive,
(R&TTE) 1999/5/EC – using the Standards

ETSI EN 301 489-1 v1.8.1

ETSI EN 301 489-15 v1.2.1

ETSI EN 301 783-1 v1.1.1

ETSI EN 301 783-2 v1.1.1

TYPE OF EQUIPMENT: Base Station

EQUIPMENT CLASS: B

WE, THE UNDERSIGNED HEREBY DECLARE THAT THE
EQUIPMENT SPECIFIED ABOVE CONFORMS TO THE
ABOVE STANDARDS.

FlexRadio Systems Date of testing: May 3, 2010

FlexRadio Systems
8900 Marybank Drive
Austin, TX 78750

Person Responsible: Gerald Youngblood (Signature on File)



Software Installation

Switch Off the FLEX-1500 and Run the Installer

Note: To install the software, you must at least connect the FLEX-1500 to a 13.8 VDC power supply and USB computer port.

Make sure the power switch on **the FLEX-1500 is turned off** (Power switch LED is **not** illuminated, see Figure 2 on page 3). Alternatively, disconnect the USB cable between your FLEX-1500 and the computer. It is also a good idea to close all other applications.

All the software required for the FLEX-1500 is installed through the PowerSDR Setup application.

Navigate to the home page of our website (<http://www.flex-radio.com>), locate the table of Current Versions of Software and Documentation and click on the appropriate link to download the PowerSDR Setup Application.

Note: We recommend that you leave older versions of PowerSDR installed when upgrading from a previous version. After reviewing the new version and verifying that your setup works, uninstalling previous versions is fine (but not necessary).

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Collecting Your Information

Double click the downloaded application to start the InstallShield Wizard (Figure 6¹).

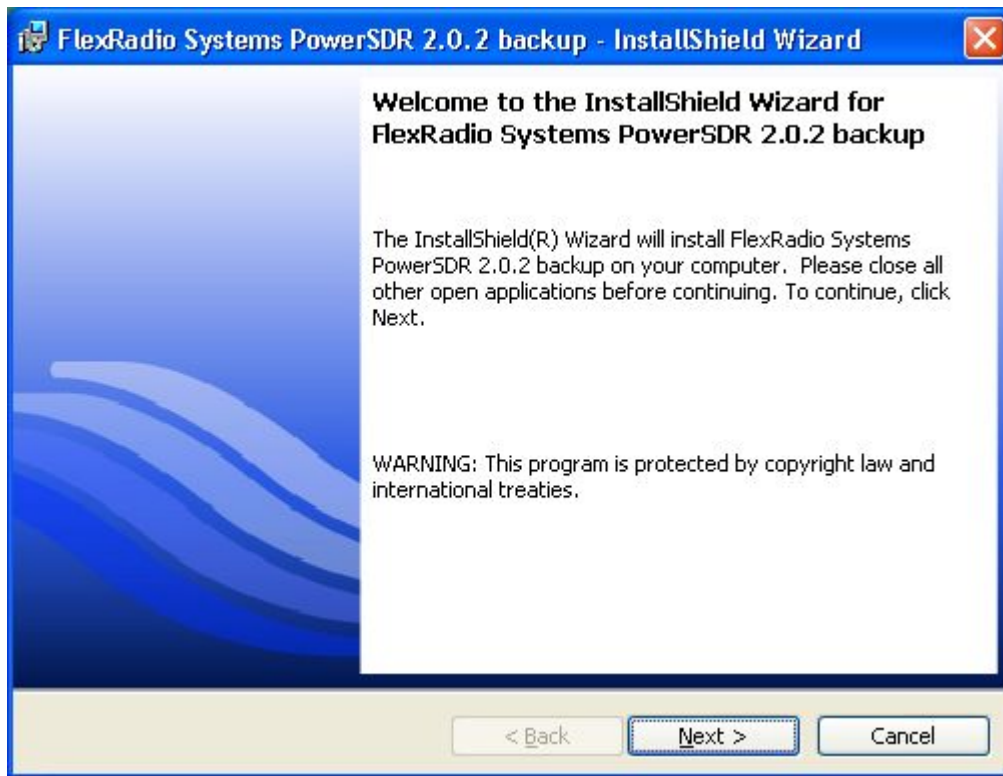


Figure 6: FlexRadio InstallShield Wizard - Welcome

Click **Next** to see the Proprietary Software License Agreement (Figure 7).

[The rest of this page has been left blank intentionally]

¹ All screenshots in this manual are as they would appear when using the Microsoft Windows XP operating system and may look slightly different when using Windows Vista or Windows 7, but the steps are the same.

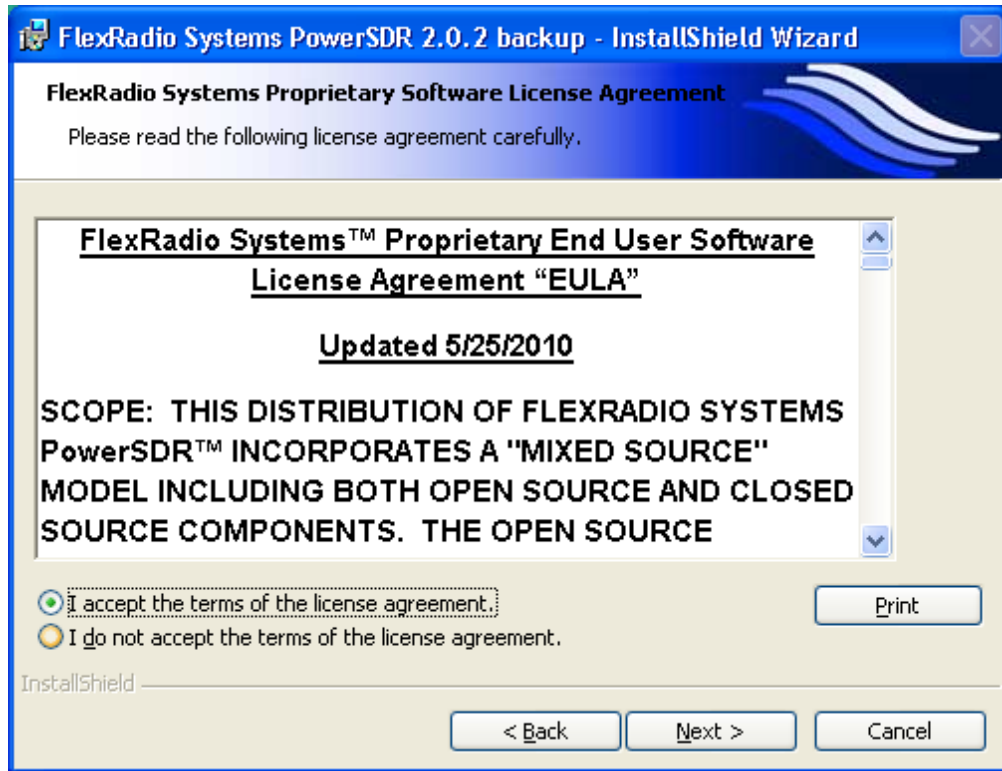


Figure 7: FlexRadio InstallShield Wizard – Proprietary Software License

There are two license agreements. The first is this End User License Agreement (EULA) for FlexRadio proprietary software, which covers those parts of the software that are proprietary to FlexRadio Systems. Read the agreement and select **I accept the terms of the license agreement to continue**. Click **Next** to see the GNU Public License (Figure 8).

[The rest of this page has been left blank intentionally]

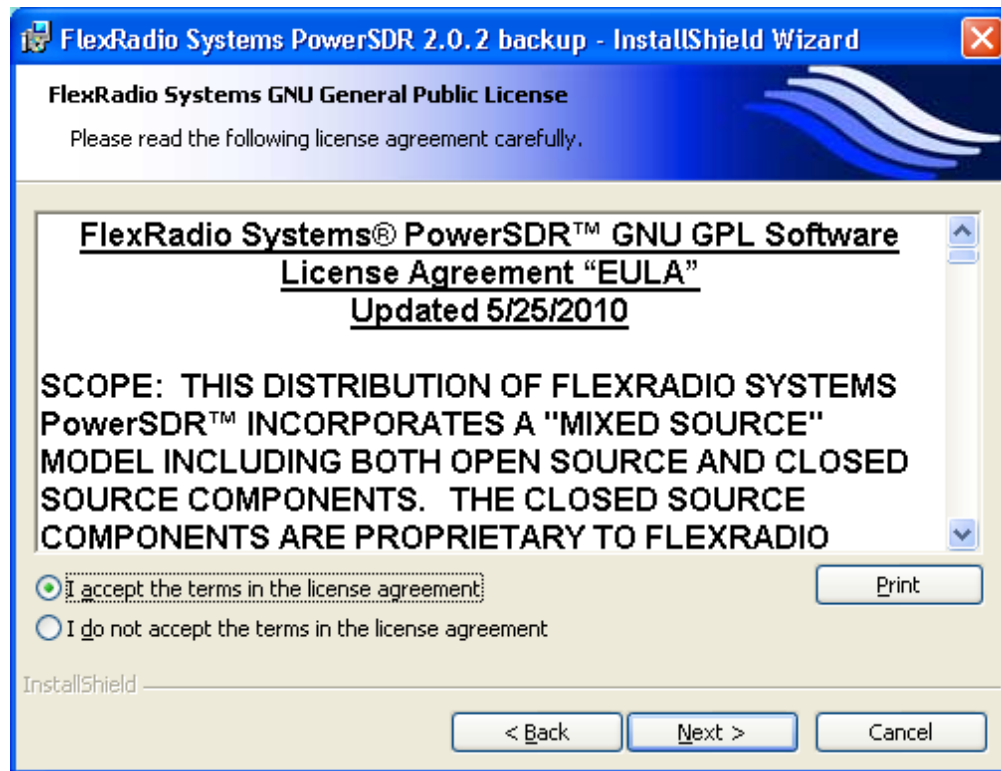


Figure 8: FlexRadio InstallShield Wizard – GNU Public Software License

The second EULA refers to those parts of the software which are covered by the GNU Public License. Read the EULA and select **I accept the terms of the license agreement** to continue. Click **Next** to enter your information (Figure 9).

[The rest of this page has been left blank intentionally]

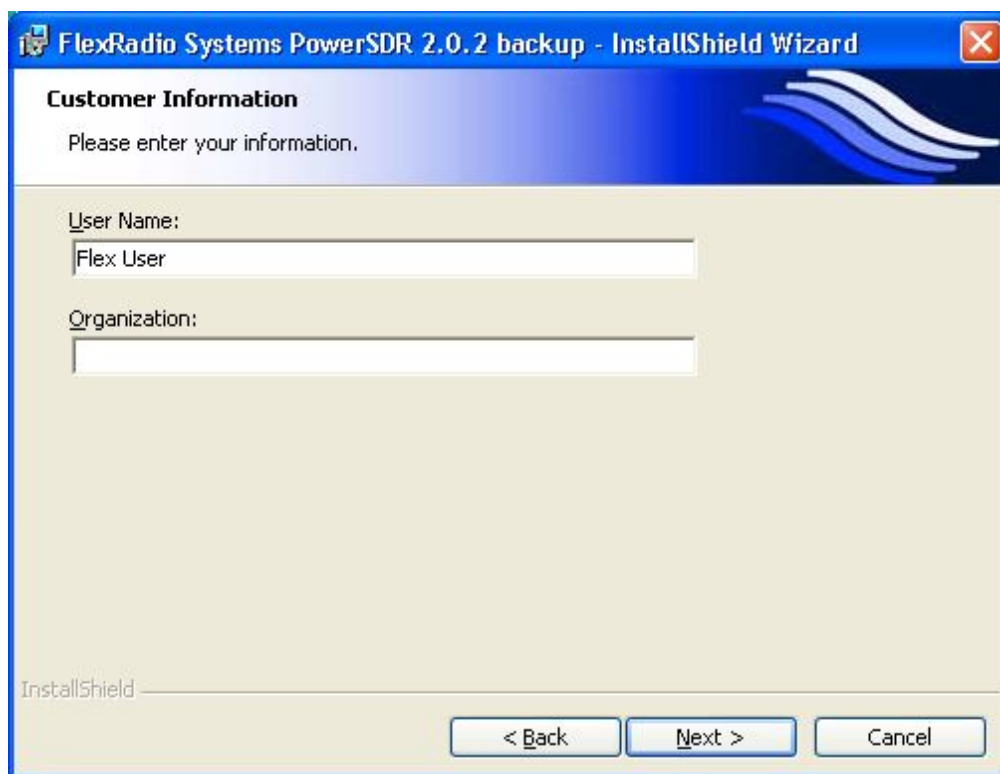


Figure 9: FlexRadio InstallShield Wizard – Customer Information

Enter your information and click **Next** to select the setup type (Figure 10).

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Figure 10: FlexRadio InstallShield Wizard – Setup Type

Select **Complete** to install all the software¹. Click **Next** to select the radio(s) (Figure 11).

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¹ Only rarely will you need to select **Custom** and then select those parts of the software you wish to install.

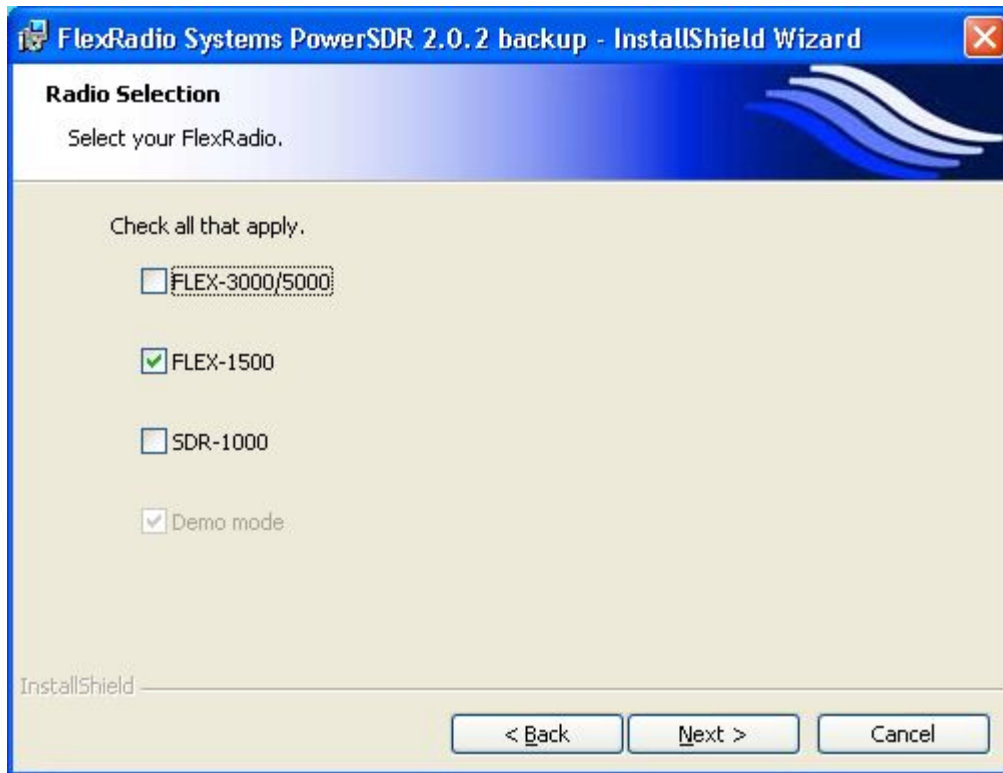


Figure 11: FlexRadio InstallShield Wizard – Radio Selection

Select **FLEX-1500** to install the software it requires. You may also elect to install at the same time the software for any other FlexRadio Systems radio(s) you own. Click **Next** and the InstallShield Wizard will indicate that it is ready to install (Figure 12).

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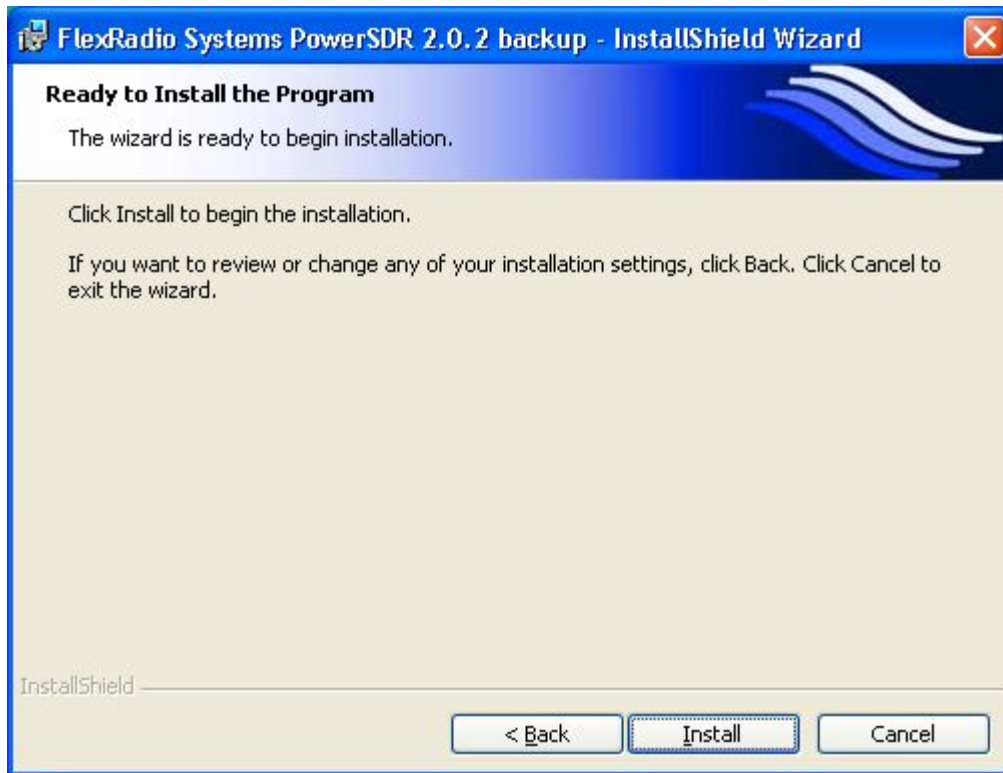


Figure 12: FlexRadio InstallShield Wizard – Ready to Install

To review and/or change your installation settings, click **Back**. Otherwise, click **Install** and the InstallShield Wizard will proceed to install all the required software (Figure 13).

[The rest of this page has been left blank intentionally]

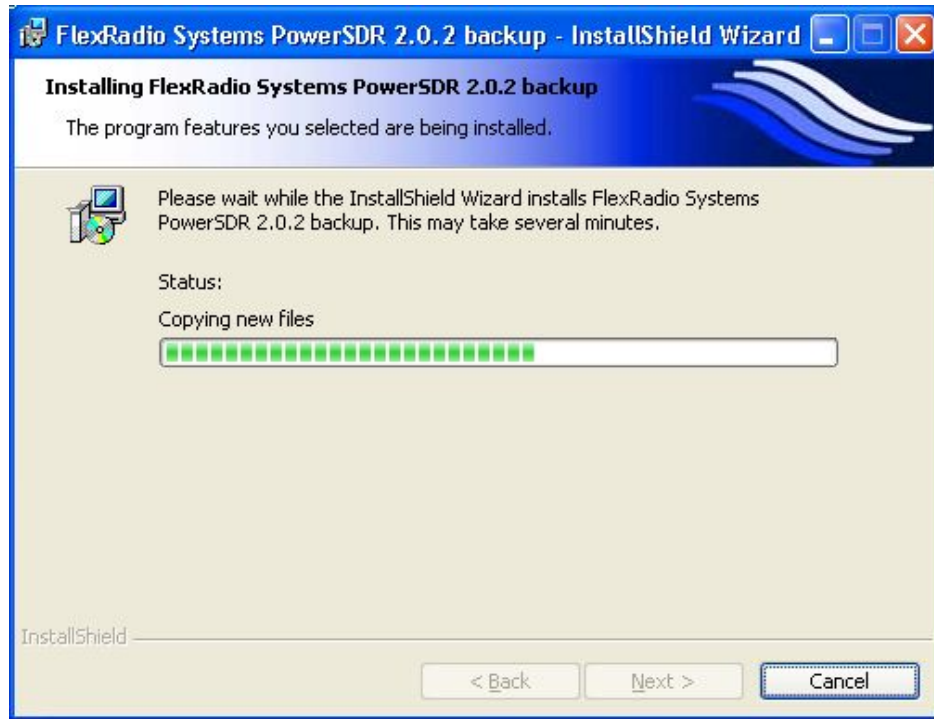


Figure 13: FlexRadio InstallShield Wizard – Installing

While the software is installing, which may take several minutes, the InstallShield will display a progress bar. When completed, the InstallShield Wizard will indicate that it has successfully installed the software (Figure 14).

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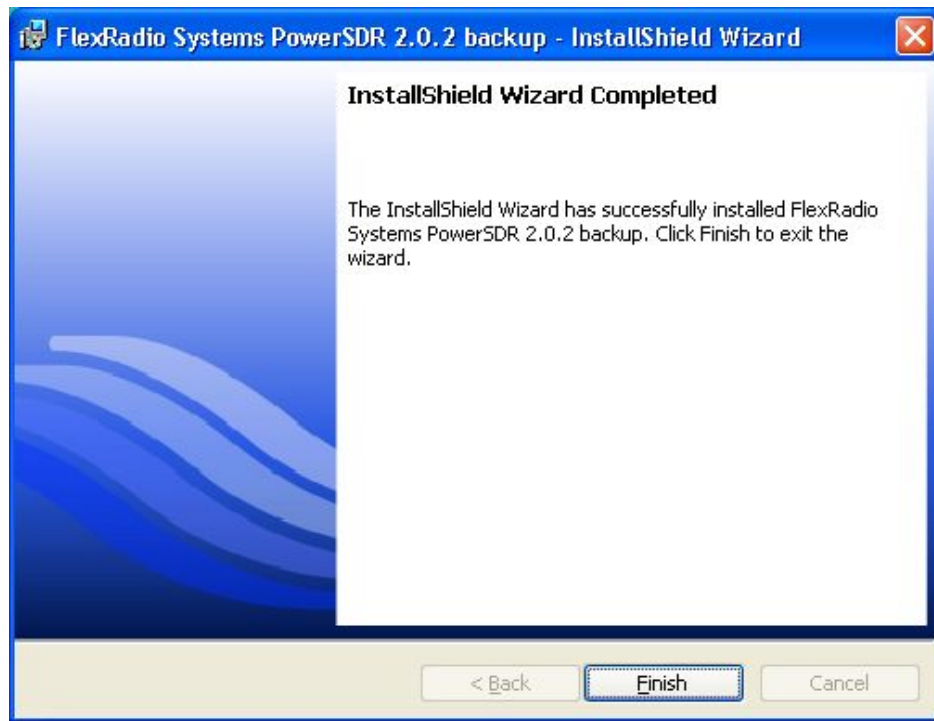


Figure 14: FlexRadio InstallShield Wizard – Installation Complete

Click **Finish** to exit the FlexRadio InstallShield Wizard.

[The rest of this page has been left blank intentionally]

Power Up the FLEX-1500 to Complete the Installation

Press and release the power button on the FLEX-1500 to power it up. The LED will illuminate the power button to indicate that it is on. What happens next depends on your operating system.

Windows® Vista® and Windows® 7® ¹

Windows will indicate that it recognizes the FLEX-1500 and will load the drivers in the background. When completed, a notification will appear on the task bar indicating successful installation (Figure 15).

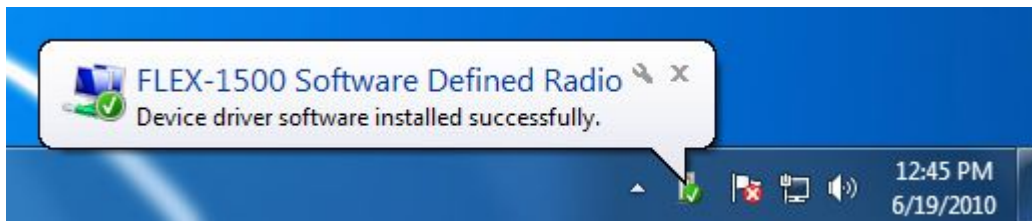


Figure 15: Indication of Successful Installation

Ignore the rest of this chapter and proceed to Chapter 3 PowerSDR Setup & Configuration.

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¹Windows, XP, Vista and 7 are all registered trademarks of Microsoft Corporation

Windows® XP®

Your computer will detect the FLEX-1500 and display the Found New Hardware Wizard Welcome screen (Figure 16).



Figure 16: Found New Hardware Wizard - Welcome Screen

Select the option **No, not at this time** and click **Next** to choose how to install the driver (Figure 17).

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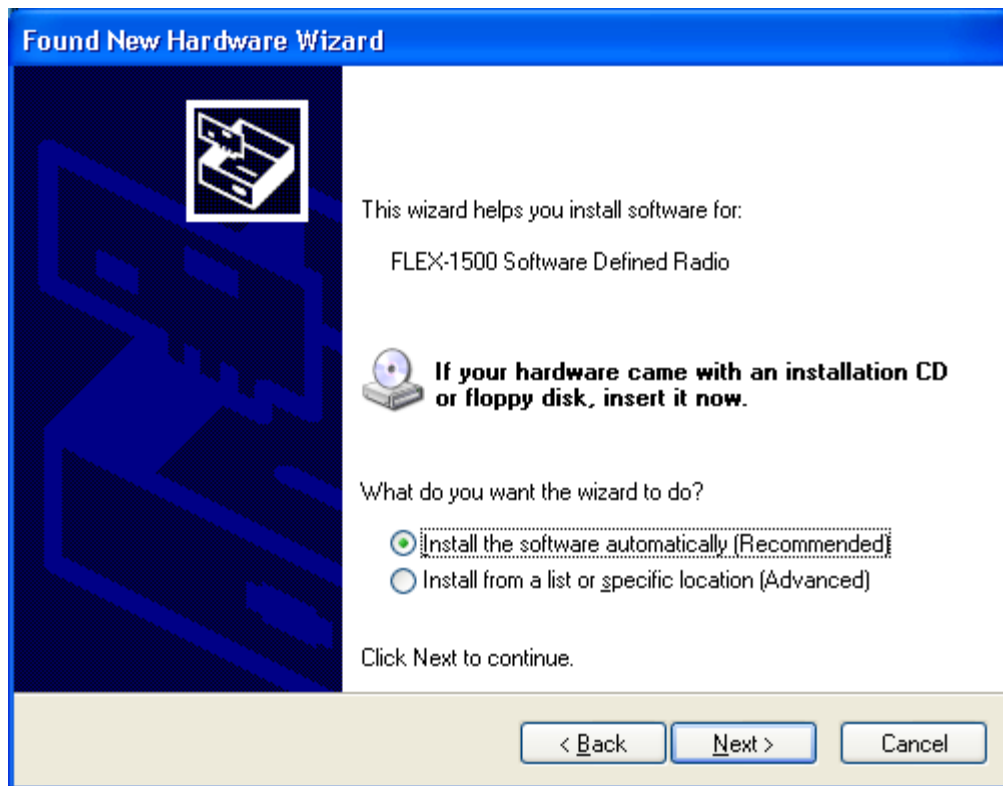


Figure 17: Found New Hardware Wizard - Installation Method

The Found New Hardware Wizard will show that you are trying to install a **FLEX-1500 Software Defined Radio**. Select the option **Install the software automatically (Recommended)**. Click **Next** to continue.

The Found New Hardware Wizard will request you to please wait while it installs the software. If a Hardware Installation warning appears, click the **Continue Anyway** button to proceed.

When the driver is loaded, the Found New Hardware Wizard will indicate that Installation is Complete (Figure 18).

[The rest of this page has been left blank intentionally]

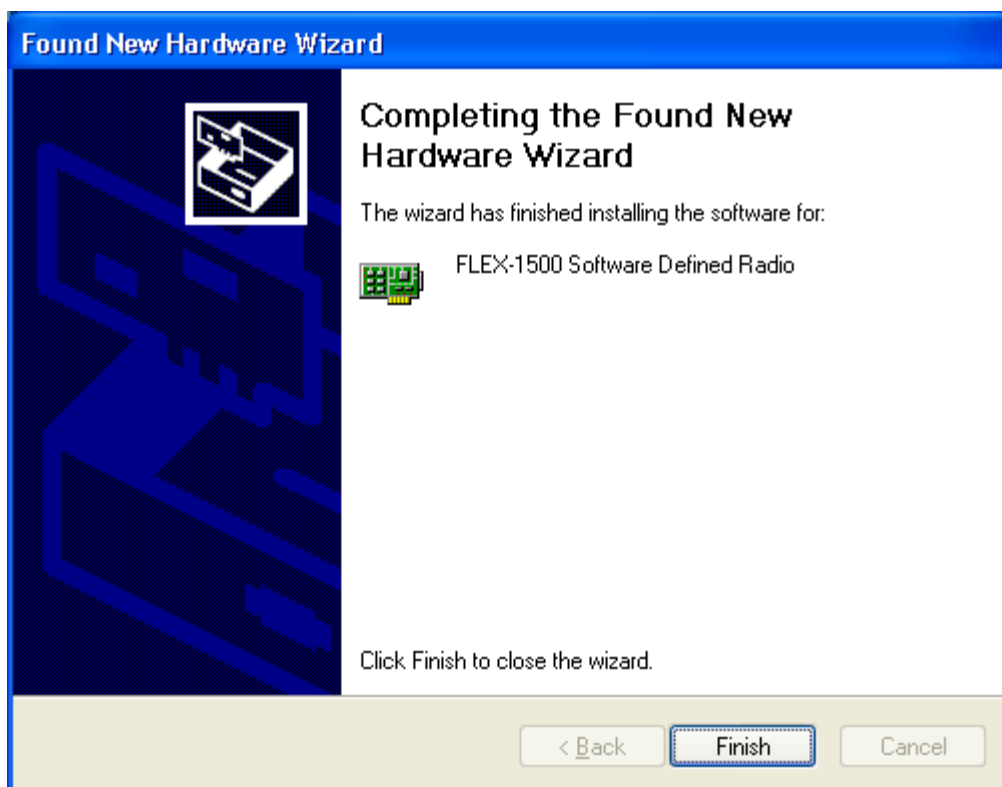


Figure 18: Found New Hardware Wizard - Installation Complete

Click **Finish** to exit the Wizard.

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PowerSDR Setup & Configuration

Setup Wizard

Power up the FLEX-1500 and start up the PowerSDR application using the shortcut that was created on your Desktop (or click on Start → All Programs → FlexRadio Systems → FlexRadio Systems Software 2.n → PowerSDR v2.n.n). When you run a new release of PowerSDR for the first time an optimization routine will run and the screens shown in Figure 19 will appear.

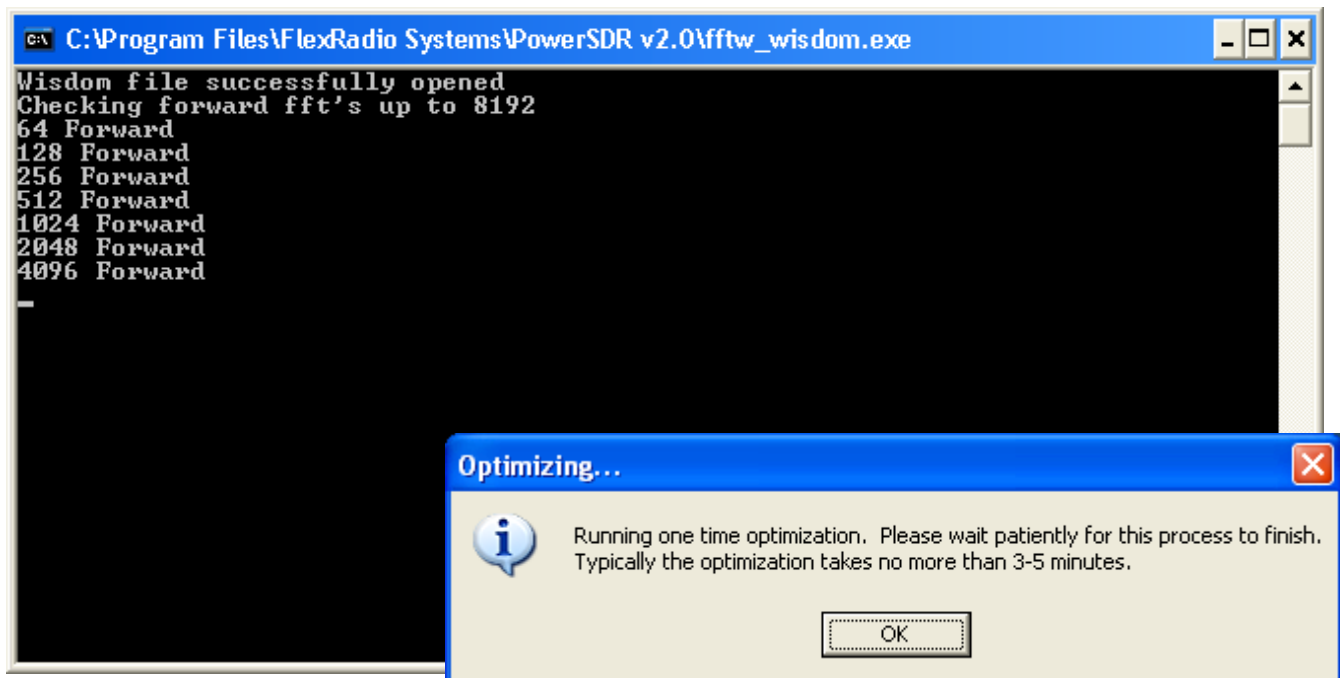


Figure 19: Optimization Routine

Click **OK** and let the routine run.

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Note: This routine aims to optimize the FFT (Fast Fourier Transform) calculations for the environment (hardware and software) in which the calculations will be performed. For optimal performance, you should therefore close all applications you will normally not be running simultaneously with PowerSDR. The results are saved in a file called **wisdom** in the %appdata%\FlexRadio Systems\PowerSDR v2.n.n¹ directory. If you wish to run FFTW again, delete this file from that directory and start up PowerSDR.

Next a brief startup sequence will follow, after which a warning regarding mobile operation appears, as shown in Figure 20.

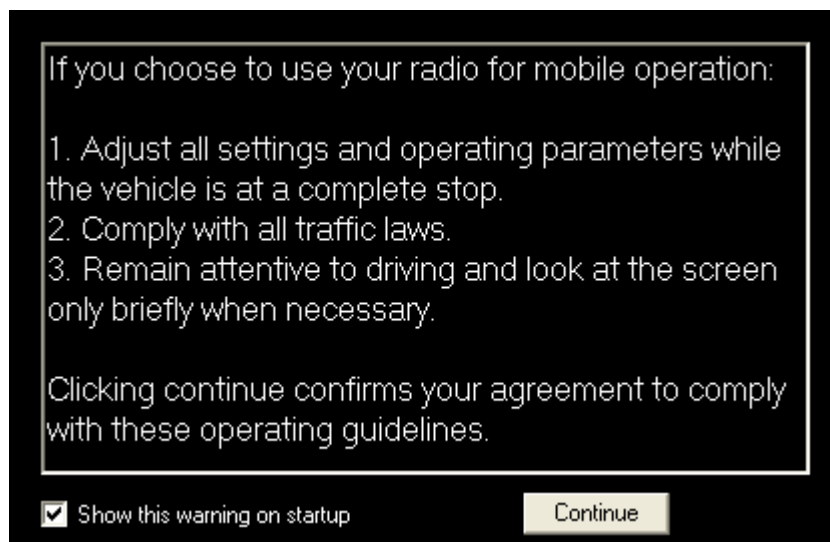


Figure 20: PowerSDR Setup Wizard Mobile Warning

Read the warning and then click the **Continue** button. The PowerSDR Setup Wizard will then ask you to choose your Radio Model (Figure 21).

[The rest of this page has been left blank intentionally]

¹ You can find your *Application Data* (%appdata%) directory by clicking Start→Run in Windows and entering %appdata%



Figure 21: PowerSDR Setup Wizard - Radio Model

Select the FLEX-1500 radio model as shown in Figure 21. Click the **Next** button to continue to Figure 22.

Note: If you are running without a radio, e.g. for demonstration purposes, select Demo/None.

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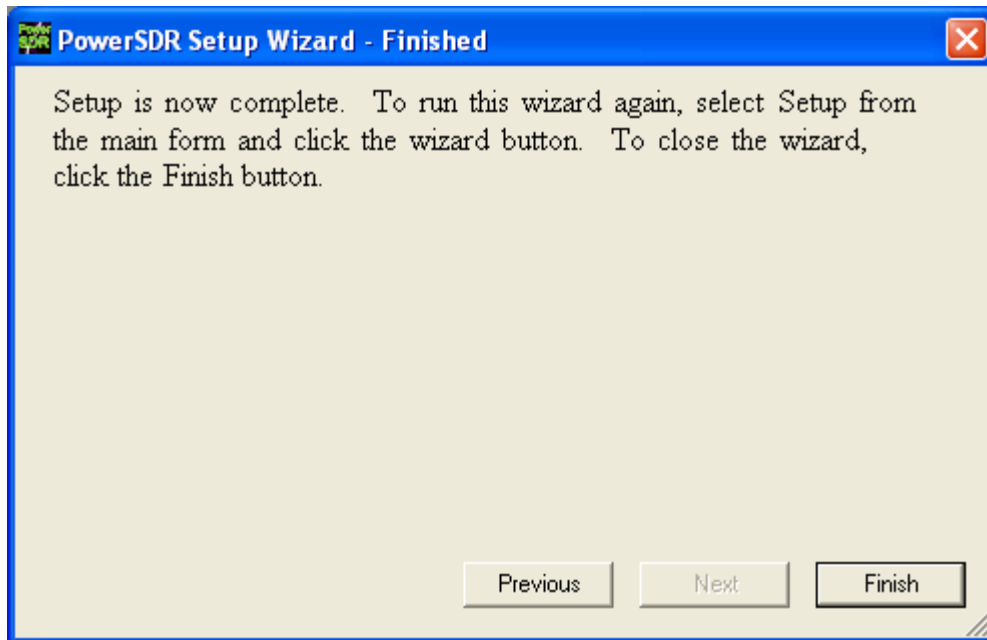


Figure 22: PowerSDR Setup Wizard – Finished

The Setup Wizard is now complete. Click the **Finish** button to exit the wizard.

Note:

If you forgot to power up the FLEX-1500 before starting PowerSDR, a communication error message will be displayed and PowerSDR will offer the ability to start in demo mode. Click **No** to close PowerSDR, power up the FLEX-1500 and restart PowerSDR.

Configuration

Before operating the FLEX-1500 you will need to configure Mixer and Antenna settings. If you have not yet done so, start up PowerSDR to open the Front Console, but do **not** yet click on the **Start** button.

Transfer of Calibration Data

When started for the first time, PowerSDR transfers your radio's calibration data from its EEPROM to your computer. You will see the progress indicator shown in Figure 23. When the transfer is complete, PowerSDR will complete starting up.

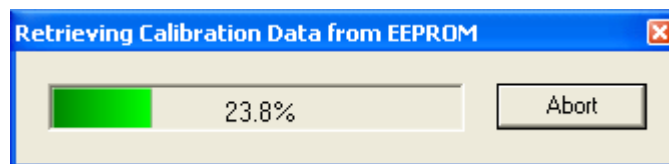


Figure 23: Calibration Retrieval Progress Indicator

Note: The FLEX-1500 comes to you completely factory calibrated. If due to some unlikely event you suspect your radio needs to be recalibrated, please contact [FlexRadio Support](#), (on our Website, select About FlexRadio and then Contact Us) who will guide you through the process.

Audio Mixer

The FLEX-1500 input and output audio channels are managed with an audio mixer, much the same as for your Windows sound card(s). To configure the audio mixer, click on **Mixer** on the Front Console menu (Figure 24).

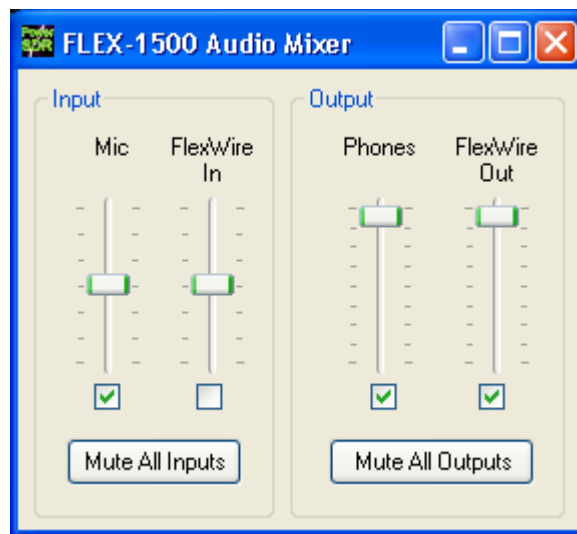


Figure 24: Audio Mixer

Select the desired **Input** and **Output** channels. Only one Input channel can be selected, but both Output channels can be selected. Close the Form when done.

- ❑ **Mic** selects the front panel MIC jack.
- ❑ **FlexWire In** selects pin#2 of the rear panel FlexWire I/O port (see Table 4 on page 7).
- ❑ **Phones** selects the front panel Phones jack.
- ❑ **FlexWire Out** selects pin# 9 of the rear panel FlexWire I/O port (see Table 4 on page 7).

For more detailed information see page 94.

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Antenna/Transverter Port and FlexWire PTT Out

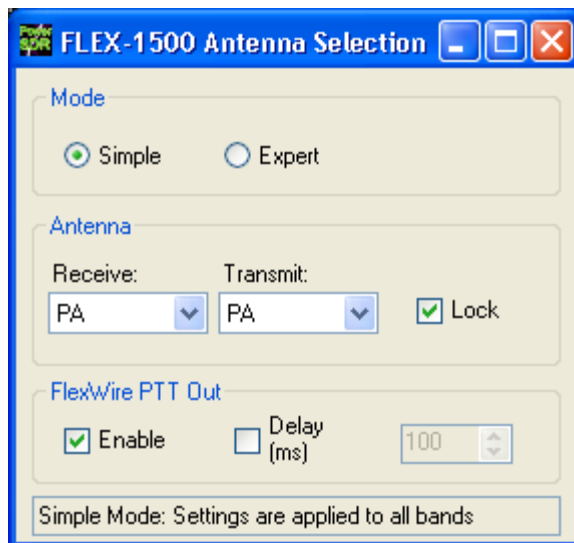


Figure 25: Antenna Form - Simple

You will next need to select the antenna and/or transverter ports you are using and possibly enable the **FlexWire PTT Out** connection. To do so, click on **Antenna** in the menu of the Front Console (Figure 25). We will only describe the controls for the **Simple** mode. For more detailed information, including **Expert** mode, see page 95.

- ❑ **Mode: Simple** uses the same antenna port for all bands, whereas **Expert** allows you to select different ports for each band. If you use only one antenna or transverter, choose **Simple**.
- ❑ **Receive:** the available selections are **PA** (to use the Antenna port), **XVTX/COM** or **XVRX**
- ❑ **Transmit:** the available selections are **PA** (to use the Antenna Port) and **XVTX/COM**

WARNING! Make sure you connect a 50 Ohm load to the transmit antenna port you selected. Failing to do so may damage your radio and void your warranty.

WARNING! Do not switch the transmit antenna while transmitting (hot switching). You could damage your radio and void your warranty.

- ❑ **FlexWire PTT Out:** Check **Enable** to enable the FlexWire PTT Out (pin# 3 – see Table 4 on page 7). You can also set a **Delay** in ms, to sequence the switching.

Close the Antenna Form when you are done.

Ready to Start Operating

You are now ready to use your FLEX-1500. Click on **Start** on the Front Console and you should hear receive audio. If you do not, double check all your connections and settings (especially for the Mixer and Antenna forms).

Note: If you hear audio popping or clicking, click on **Setup** at the left of the menu at the top of the Front Console to open the Setup Form. Select the Audio tab and then the Primary sub-tab. And increase your Buffer Size.

We urge you to read the remainder of this manual to help you fully understand the FLEX-1500 and PowerSDR. This will enable you to optimize your radio for your personal operating style and environment. You may also want to visit our extensive and ever expanding [Knowledge Center](http://kc.flex-radio.com/search.aspx) (<http://kc.flex-radio.com/search.aspx>) for more detailed and more up-to-date information on many topics.

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Operation

This chapter is intended to provide the user with a clear understanding of how the FLEX-1500 should be used when performing basic operations such as Powering Up or making a voice, CW or digital transmission.

Note 1: For consistency we will use the same control identifiers as used in Figure 35 on page 55. For clarity we will leave out any identifiers of controls not referenced in the relevant section.

Note 2: We assume you have familiarized yourself with the FLEX-1500 hardware and its various connections, have installed the software and have configured PowerSDR. If not, please see the previous chapters.

Note 3: If you have any questions, issues or problems operating PowerSDR and/or the FLEX-1500, you may be able to find the solution on the [Support Pages](http://support.flex-radio.com/) (<http://support.flex-radio.com/>) of our website, in our [Knowledge Center](http://kc.flex-radio.com/search.aspx) (<http://kc.flex-radio.com/search.aspx>), or through our highly active [Reflectors](#). (search for *reflector* on our Knowledge Center at <http://kc.flex-radio.com/search.aspx>). If none of these sources provide you the assistance required, please contact FlexRadio Systems using the information provided on the [Contact page](#) of our website (on our website www.flex-radio.com click *About FlexRadio* and then *Contact Us*).

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Power-Up Procedure

To power up the FLEX-1500

1. Connect (at a minimum) the FLEX-1500 to the computer and the power supply. Check the connections to ensure good contact.
2. Boot up the computer and make sure PowerSDR is ready to be launched (no hour glass cursor), but do not start it yet.
3. Turn on the power supply for the radio and press the FLEX-1500 power switch to latch it in the on position and the LED will illuminate.
4. Start up PowerSDR. It will automatically recognize the FLEX-1500. You are now ready to operate.

Power-Down Procedure

The power-down sequence is almost the reverse of the power-up procedure.

1. Stop PowerSDR by clicking on the Start/Stop button.
2. Close PowerSDR by clicking on the "X" in the upper right hand corner of the Front Console.
3. Press the FLEX-1500 illuminated Power switch to unlatch it and turn off the transceiver.

CAUTION: Make sure PowerSDR is shut-down before turning off the radio. Failing to do so may result in instability of your computer system, leading to a *Blue Screen*.

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Tuning Methods

Spectrum Drag and Click

The easiest way to tune signals on the display when set to Panadapter or Waterfall is simply to click on the signal and drag it into the filter area. You can also drag the displayed filter edges to adjust the filter width as well.

Mouse Wheel

A mouse wheel is another easy way to tune the radio. While the PowerSDR window is active, tune **VFO A** using the mouse wheel, with the mouse cursor anywhere on the screen. The frequency will change in steps equal to the selected **Tune Step (2)**¹ for each click of the mouse wheel. Adjust the **Tune Step** using the controls (**+** and **-** buttons), clicking the mouse wheel or pressing Ctrl + Left or Right Arrow key.

Note: When the **Tune Step** equals 1 kHz, each click of the mouse wheel will first step **VFO A** up or down to the nearest 1 kHz and then tune in 1 kHz steps.

Hint: Holding down the Shift key while turning the mouse wheel will step **VFO A** at the next lower **Tune Rate**.

Mouse Wheel Hover

Hover with the mouse over a digit in either **VFO A** or **VFO B** and increase or decrease its value using the mouse wheel. The digit to be tuned will be underlined.

Spectrum Click Tuning

With the display set to Spectrum, Panadapter, Waterfall, PanaScope, PanaFall or Histogram, hover with the mouse over the display and right click to cycle through yellow cross-hairs to tune **VFO A**, red cross-hairs to tune **VFO B** (only if **VFO B** is active, e.g. when **SPLT (12)** and/or **MultIRX (10)** are activated), or no cross-hairs (click tuning off). With the cross-hairs visible, hover over the desired signal in the display and click the left mouse button. The corresponding VFO will immediately tune to the frequency marked by the cursor.

When in CW, AM, SAM, DSB, FM, or DRM the VFO will tune the cursor frequency to the center of the filter pass band. In SSB the VFO will tune to the carrier frequency for the sideband selected.

¹ Chapter 5 on page 55 explains all the Front Console controls in detail. The identifiers between parentheses refer to the control identifiers used there.

Hint 1: You can very quickly center a CW, (S)AM, DSB or FM signal after click tuning it by clicking the **0 Beat (12)** button on the Front Console (make sure the display **AVG (9)** button is on to enable **0 Beat**).

Hint 2: If you have checked **Snap Click Tune** (Setup Form, General tab - Options sub-tab; see page 104) then spectrum click tuning will tune the VFO to the nearest discrete multiple of the Tune Step.

Keyboard Keys

Use the following keys on your keyboard to tune the VFO.

- ❑ **Numeric Keypad:** Key any frequency in MHz (e.g. 7.250) into the numeric keypad and hit enter to immediately tune **VFO A** to that frequency.
- ❑ **Mapped Keys:** You can map keys on your keyboard to tune each of the digits in **VFO A** using the Keyboard Tab on the Setup Form (page 142).
- ❑ **Ctrl +Arrow Keys:** Hold the Control key and press the
 - Up or Down Arrow key to tune **VFO A** up or down by the **Tune Step (2)**.
 - Right or Left Arrow key to increase or decrease the **Tune Step (2)**.

USB Tuning Knob

Both the Griffin PowerMate and the Contour Designs Shuttle Pro v2 can be used to tune the radio. You can download the [Griffin PowerMate Quick Start Guide](#) and the [Contour ShuttlePro v2 Quick Start Guide](#) from the downloads page of our website to learn how to setup and use these controllers. Also available is the [Contour ShuttlePro Default Preferences](#) file, which can be imported as a good starting point when using this controller. (All these documents and more can be found by searching for either *PowerMate* or *ShuttlePro* on our Knowledge Center at <http://kc.flex-radio.com/search.aspx>)

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Voice Operation

The following procedure outlines how to setup quickly for voice transmission operation (SSB, AM, or FMN). If something in this procedure is unclear, please contact us, as we would like this to be as simple as possible.



Figure 26 Front Panel Controls Used for Basic Voice Operation.

Please use Figure 26¹ to identify the controls referenced in the following step-by-step instruction. For consistency we have used the same control identifiers as in Figure 35 on page 55 and for clarity we have left out any identifiers of controls not referenced.

Note: In this chapter, we will only describe basic operation

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¹ All screenshots of the Front Console are displayed with the Default skin. Your Front Console may look differently if you have selected a different skin (see page 135 for more information on how to select skins).

1. Follow the Power Up Procedure, described on page 36. Then click the **Start/Stop** button **(14)**. Set the following controls as specified in Table 6 below.

Table 6: Initial Control Values for Voice Operation

Ctrl	Value	Reference to Figure 26
VFO A	14.3 MHz	(1)
RX Meter	Signal	(4)
TX Meter	MIC	(4)
BAND	20 m	(5)
Mode	USB	(6)
Filter	2.7 kHz	(7)
Mic Gain	35	(8)
DX	Off	(8)
CPDR	Off	(8)
DEXP	Off	(8)
RX EQ	Off	(8)
TX EQ	Off	(8)
VAC	Off	(8)
Display Mode	Panadapter	(9)
AVG	On	(9)
PEAK	Off	(9)
MultiRX	Off	(10)
SPLT	Off	(12)
XIT	Off	(12)
RIT	Off	(12)
MUT	Off	(17)
AF	50	(20)
AGC-T	90	(21)
Drive	50	(22)
AGC	Med	(23)
Preamp	20	(24)
SQL	Off	(25)

2. In the **Antenna Form (35)** choose **Simple** mode and set **Receive** and **Transmit** both to **PA** (see page 95 for more on the Antenna Form). Connect a 50 ohm dummy load to the Antenna jack, or tune **VFO A (1)** to a quiet frequency on the selected band. Use the **TUN (19)** button to verify power output on the **TX Meter (4)** (Set to **Fwd Pwr**).

WARNING! Connect a 50 ohm dummy load, or ensure that the selected antenna presents a 50 ohm load with a low SWR. Failing to do so may damage the FLEX-1500.

3. Press the Push-to-talk button on the microphone or click the **MOX (16)** button and speak into the microphone to transmit your voice. Release the Push-to-talk button or click the **MOX (16)** button to switch the transceiver back to receive.

If you do not see modulation on the spectrum, please check that the correct input for your microphone is selected in the **Mixer Form (34)** (see page 94) and that your microphone is connected correctly (see page 5 for pin-outs of the MIC connector). If you are using any external audio processing equipment, make sure it is turned on and hooked up correctly. Finally, if your audio level seems very low, you might try checking **Mic Boost On** on the Setup form – Audio tab, Primary sub-tab (see page 109).

4. Now that you can see the modulation on the spectrum, it is time to adjust the input. While transmitting, monitor the values with the **TX Meter (4)** set to **Mic**. Modify the **MIC gain (8)** setting until the **TX Meter** shows 0 dB on peaks while talking in a normal voice at a normal distance from the microphone (above 0 dB the signal will be compressed).
5. You are now ready to begin a QSO. If a 50 ohm dummy load was connected, connect a 50 ohm antenna in its place. Tune to the desired frequency using one of the methods outlined in the Tuning Methods section above.

Use the **Mode Specific Controls – Phone (8)** including **DX**, **CPDR**, and **DEXP** (Downward Expander). Generally, use either **DX** or **CPDR** to increase average power without adjusting the peaks. Check **Show TX Filter on Display** to visualize the band edges of the transmit filter. This filter can be adjusted on the Transmit Tab of the Setup Form (see page 130).

Hint: For information on how to optimize your audio further, please refer to the **Knowledge Center** (<http://kc.flex-radio.com/search.aspx>) on our website.

6. In order to monitor voice transmissions, enable the **MON (15)** button. You may notice a delay due to buffering in the audio/DSP system. This processing delay is largest when using large buffer sizes. If you find this delay objectionable, try decreasing it by reducing the **Buffer Size** setting on the Audio tab, Primary sub-tab (page 109). You will want to keep this buffer as small as possible on your computer system without introducing audio artifacts such as pops and clicks.
7. The **Fwd Pwr** setting on the **TX Meter (4)** will read out average power in Watts, measured at the output of the internal Power Amplifier. While the average has a short time constant, it is still an average and will not approach peak power in voice modes if calibrated properly even when the **Drive** control (**22**) is set to 100. This is also true when monitoring voice transmissions on an external watt meter.

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Note: The typical male voice has a peak to average power ratio of 14 dB. Therefore a typical male voice transmission that is peaking at 5W will only average less than 0.5W. To raise the average power, use the **DX (8)** control and the associated slider to increase the compression in 1 dB steps. This must be done carefully and incrementally as adding too much compression can result in high levels of distortion.

CW Operation

The following procedure outlines how to setup quickly for CW transmissions using the Internal Keyer and paddles, an external keyer, the CWX-form or a third party program.



Figure 27: Front Panel Controls Used for CW Operation

Please use Figure 27 to identify the controls referenced in the following step-by-step instruction. For consistency we have used the same control identifiers as in Figure 35 on page 55 and for clarity we have left out any identifiers of controls not referenced.

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Initial Settings

1. Follow the Power Up Procedure, described on page 36. Then click the **Start** button **(14)**. Set the following controls as specified in Table 7.

Table 7: Initial Control Values for CW Transmission

Ctrl	Value	Reference to Figure 27
VFO A	14.05 MHz	(1)
RX Meter	Signal	(4)
TX Meter	Fwd Pwr	(4)
Band	20 m	(5)
Mode	CWU	(6)
Filter	500 Hz	(7)
VAC	Off	(8)
Display Mode	Panadapter	(9)
AVG	On	(9)
PEAK	Off	(9)
MultiRX	Off	(10)
SPLT	Off	(12)
XIT	Off	(12)
RIT	Off	(12)
MON	On	(15)
MUT	Off	(17)
AF	50	(20)
AGC-T	90	(21)
Drive	50	(22)
AGC	Med	(23)
Preamp	+20	(24)
SQL	Off	(25)

2. In the **Antenna Form (35)** choose **Simple** mode and set **Receive** and **Transmit** both to **PA** (see page 95 for more on the Antenna Form). Connect a 50 ohm dummy load to the Antenna jack, or tune **VFO A (1)** to a quiet frequency on the selected band. Use the **TUN (19)** button to verify power output on the **TX Meter (4)** (Set to **Fwd Pwr**).

WARNING! Connect a 50 ohm dummy load, or ensure that the selected antenna presents a 50 ohm load with a low SWR. Failing to do so may damage the FLEX-1500.

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Hint: There is a trade-off to be made of minimum latency versus sharpest (narrowest) filters. Both are driven by the Buffer Size (DSP and Audio) settings. Set your audio buffer as low as your computer system will tolerate. The DSP Buffer Size - RX setting should then be set as high as possible, without introducing disturbing latency.

Note: **CW VFO Frequency Offset**
The VFO in PowerSDR is designed to show the zero beat of the CW tone relative to the selected CW Pitch. This allows click-tuning of CW signals as well as the traditional CW VFO readout. This also enables the VFO to remain constant when switching from CWL to CWU mode. Every effort is made to preserve a CW signal when switching between any SSB and CW modes.

Internal Keyer

If using PowerSDR's internal keyer, open the Setup Form – DSP Tab, Keyer Sub-Tab shown in Figure 28 below. Several of the controls in this form are also available in the **Mode Specific Controls – CW (8)** section on the Front Console.

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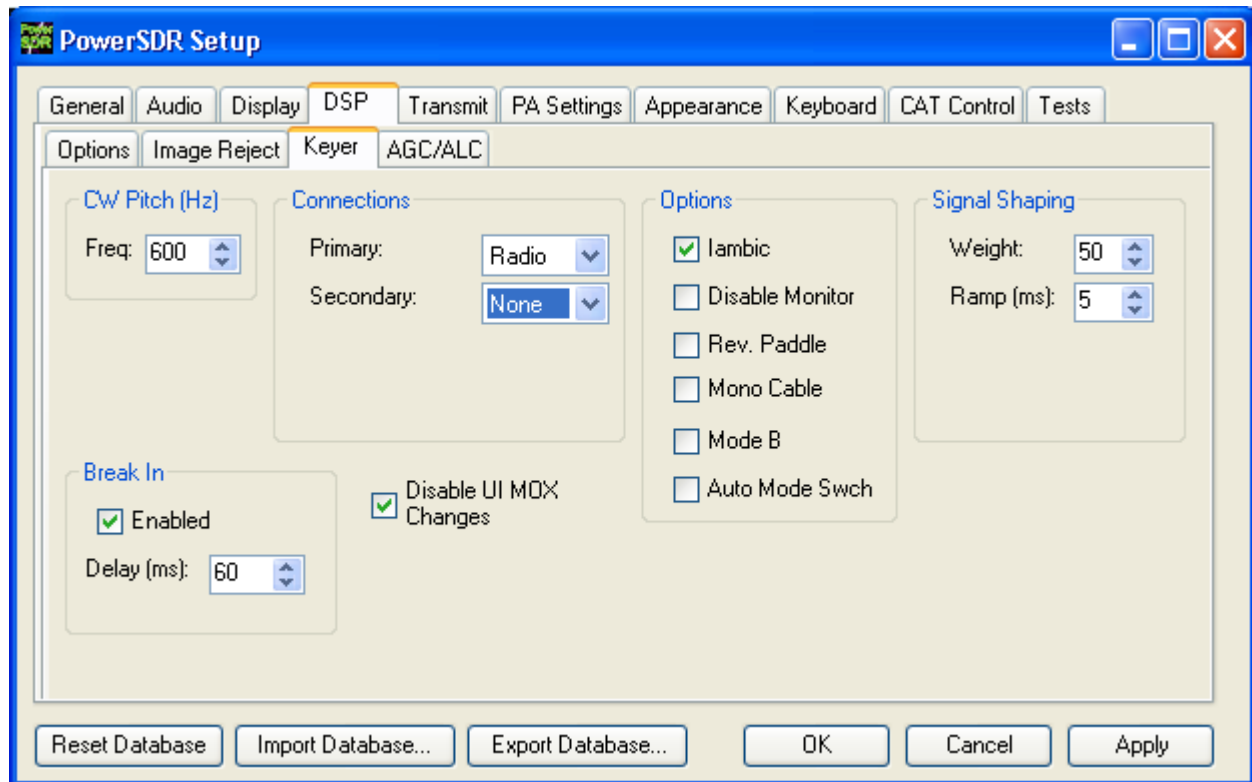


Figure 28: Setup Form – DSP Tab, Keyer Sub-Tab

1. Connect your paddles or keyer to the Key jack on the back panel (see page 5) and on the Keyer Sub-Tab in the **Connections** section, set **Primary** to **Radio** (see Figure 28).
2. In the **Options** section, check **Iambic** for Iambic mode, otherwise leave unchecked (e.g. for a straight key). If the paddles seem reversed, check **Rev. Paddle**. If your key connector only has a tip and shield (i.e. the cable is a mono cable), check **Mono Cable**; leave unchecked if the connector has a tip, ring and shield. Check **Disable UI MOX Changes** to avoid delays due to changes in the Front Console when switching between transmit and receive. (refer to the Keyer Sub-Tab section on page 125 for more detail).
3. The **Break In** option allows the radio to start transmitting simply with detection of keyer input. Set **Delay** to the amount of time between key up and when the radio will switch back to receive.
4. Select the settings for **CW Pitch**, **Weight** and **Ramp** as desired (refer to the Keyer Sub-Tab section on page 125 for more detail).
4. If not using **Break In**, click **MOX (16)** on the Front Console and begin transmitting using your paddles. If using **Break In (8)**, simply begin transmitting to key the radio. If using Iambic mode, adjust the speed with **CW Speed (8)** on the Front Console. If **Disable Monitor** is unchecked, you should hear the side tone. Verify with the **TX Meter (4)** set to **Fwd Pwr** that there is forward power.

5. You are now ready to begin a QSO. If a 50 ohm dummy load was connected, connect a 50 ohm antenna in its place. Tune to the desired frequency using one of the methods outlined in the Tuning Methods section above. Select either **CWL** or **CWU (6)** and proceed with the QSO.

External Keyer

1. Connect your keyer to the Key jack on the front panel (see page 3) and set the **Primary Connection** to **Radio** (see Figure 28 on page 45)
2. In the **Options** section, leave **Iambic** unchecked. If your external keyer does not seem to be keying, try checking **Rev. Paddle**. If using an external keyer with a side tone, check the **Disable Monitor** check box to avoid hearing the side tone from the internal keyer. The **Break In** option allows the radio to start transmitting simply with detection of keyer input. Set **Delay** to the amount of time between key up and when the radio will switch back to receive.
3. If using the side tone from the internal keyer, select the settings for **CW Pitch**. Select the settings for **Weight** and **Ramp** as desired (refer to the Keyer Sub-Tab section on page 125 for more detail).
4. If not using **Break In**, click **MOX (16)** on the Front Console and begin transmitting using your external keyer. If using **Break In**, simply begin transmitting to key the radio. If **Disable Monitor** is unchecked, you should hear the side tone. Verify with the **TX Meter (4)** set to **Fwd Pwr** that there is forward power.
5. You are now ready to begin a QSO. If a 50 ohm dummy load was connected, connect a 50 ohm antenna in its place. Tune to the desired frequency using one of the methods outlined in the Tuning Methods section above. Select either **CWL** or **CWU (6)** and proceed with the QSO.

CWX Form

If you wish to send CW automatically or with the keyboard, click on **CWX (33)** on the Front Console menu to open the CWX Form shown in Figure 29 below. (Refer to the CWX Form section on page 89 for more detail on how to use this form).

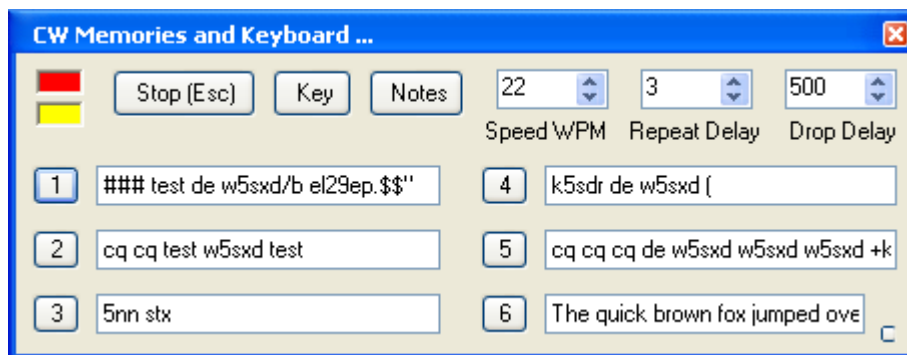


Figure 29: CWX Form

1. Click on one of the numbered buttons to start transmitting the corresponding CW sequence. Verify with the **TX Meter (4)** set to **Fwd Pwr** that there is forward power.

2. You are now ready to begin a QSO. If a 50 ohm dummy load was connected, connect a 50 ohm antenna in its place. Tune to the desired frequency using one of the methods outlined in the Tuning Methods section above. Select either **CWL** or **CWU (6)** and proceed with the QSO.

Third Party CW Program

To operate CW with a third party program, traditionally the computer is connected to the radio through a serial port. Although PowerSDR can also connect to a serial port, using third party CW software would then require two serial ports interconnected through a null modem cable¹. If the third party software and PowerSDR are running on the same computer, this is not only somewhat cumbersome, it also requires the computer to have two serial ports.

Alternatively, a virtual null-modem serial port pair can be created, as shown in Figure 30. There are various programs that can be used to create such a virtual serial port pair, such as VSP Manager (see http://k5fr.com/ddutilwiki/index.php?title=VSP_Manager) or Com0Com (search for com0com in our Knowledge Center at <http://kc.flex-radio.com/search.aspx>). The key to understand is that virtual serial ports present themselves to programs just like physical ports. Also, the pair consists of two virtually interconnected ports (shown below as COM-A and COM-B). One of these ports is selected as the CAT control port in PowerSDR, the other as the port to connect to in the CW program.

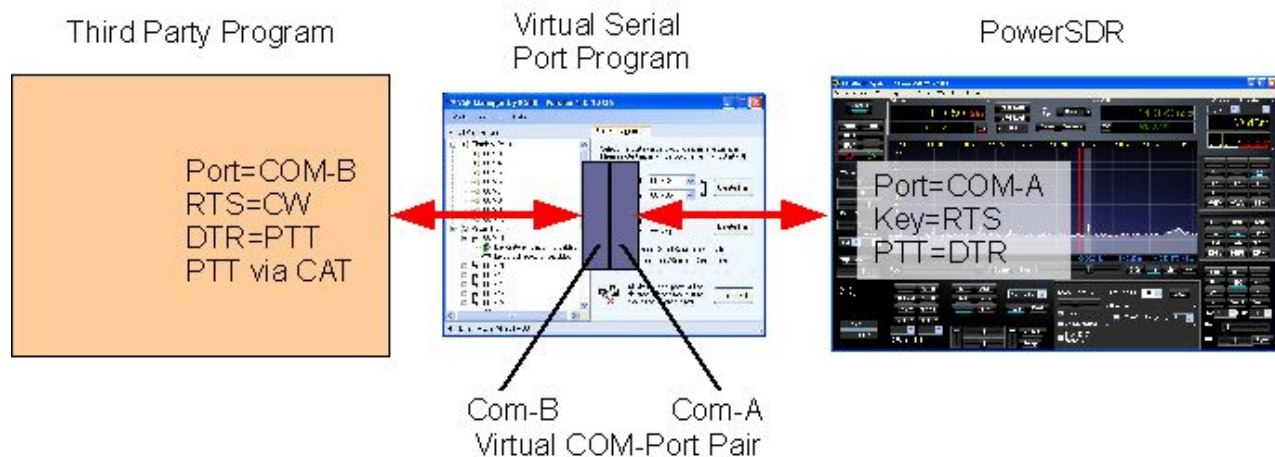


Figure 30: Diagram Illustrating Connections Between PowerSDR and Third Party Program

In the following we will assume that a virtual serial port pair *COM26/COM6* has been created. (In other words *COM-A = COM26* and *COM-B = COM6*).

1. In PowerSDR open first the **Setup Form**, **CAT Control** tab, select *COM26* as the **Cat Control** port for PowerSDR to connect to and check **Enable CAT** (see page 143).
2. Next, in PowerSDR open the **Setup Form – DSP Tab, Keyer Sub-Tab** shown in Figure 31 below to access the Internal Keyer controls.

¹ If the CW program runs on one computer and PowerSDR on another, two physical serial ports are indeed required (one on each computer). The ports are interconnected as described.

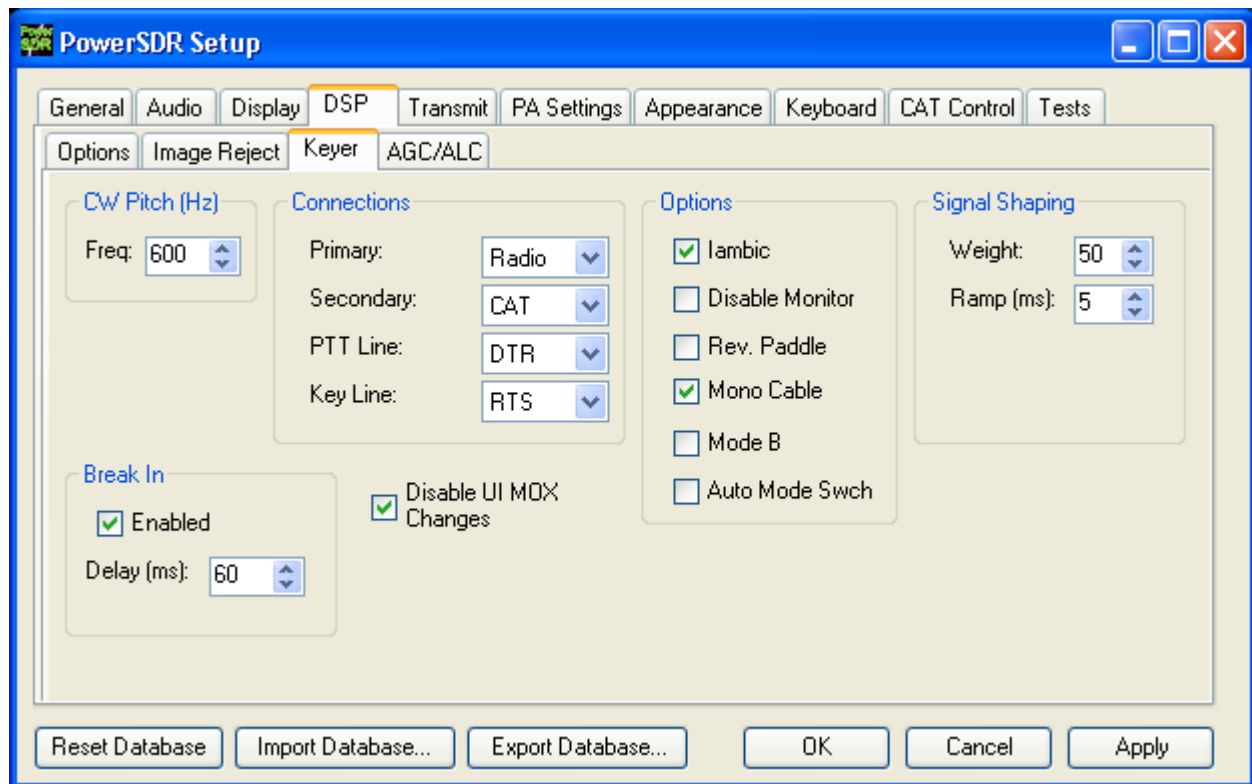


Figure 31: Setup Form – DSP Tab, Keyer Sub-Tab

3. On the Keyer Sub-Tab in the **Connections** section, set **Secondary** to **CAT** (to use the virtual COM port *COM26*), as selected on the **CAT Control Tab**. This will open up two additional selection boxes. Set **PTT Line** to **DTR** and **Key Line** to **RTS** as shown above.
3. Finally, configure your CW program to use *COM6* as its port, set PTT to operate via CAT and connect CW to RTS and PTT to DTR. Set the transceiver type as a Kenwood¹ TS2000 (The CAT control commands of PowerSDR are based on those of the Kenwood TS2000 and have been extended to cover PowerSDR's many unique features; search for cat in our Knowledge Center at <http://kc.flex-radio.com/search.aspx> for more information on the PowerSDR's CAT commands)
4. You are now ready to begin a QSO. If a 50 ohm dummy load was connected, connect a 50 ohm antenna in its place. Tune to the desired frequency using one of the methods outlined in the Tuning Methods section above. Select either **CWL** or **CWU (6)** and proceed with the QSO.

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¹ Kenwood is a registered trademark of Kenwood Corporation

Digital Operation

Operating digital modes traditionally requires a sound card connection between the computer and your transceiver for your digital mode software to decode and encode signals. Additionally, a serial port connection can be used so that your digital mode program can control the transceiver.

Although PowerSDR can connect to a sound card, connecting to digital mode software would require a second sound card, with both sound cards interconnected such that the output of one connects to the input of the other and vice versa¹. If the digital mode software and PowerSDR are running on the same computer, this is not only somewhat cumbersome (two sound cards on one computer), the signals are also converted from digital to analog and back to digital leading to loss of signal quality.

Instead, we can use a program called Virtual Audio Cable (VAC) to create virtual digital audio connections, that present themselves to programs just like a sound card. For more information, search for VAC in our Knowledge Center at <http://kc.flex-radio.com/search.aspx>. Likewise, for the serial port interconnection, there are several programs that can be used to create a virtual null-modem serial port pair. This is described in the previous section (see Third Party CW Program on page 47). Figure 32 below illustrates these virtual connections.

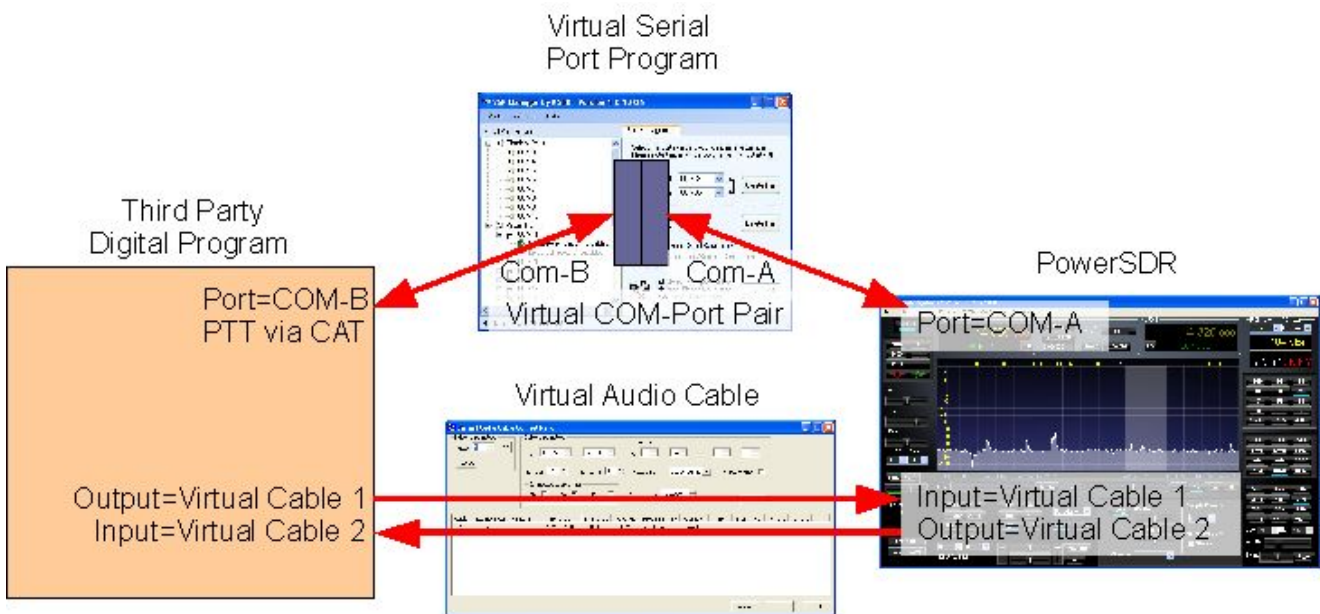


Figure 32: Virtual Audio and Serial Port Connections Between PowerSDR and Digital Program

In the following we will assume that two virtual audio cables (*Virtual Cable 1* and *Virtual Cable 2*) have been created as well as a virtual serial port pair *COM26/COM6*. (In other words *COM-A = COM26* and *COM-B = COM6*).

¹ If the digital mode software and PowerSDR run on separate computers, two sound cards (one on each computer) are indeed required and they are interconnected as described.



Figure 33: Front Panel Controls Used for Basic Digital Mode Operation

Please use Figure 33 to identify the controls referenced in the following step-by-step instruction. For consistency we have used the same control identifiers as in Figure 35 on page 55 and for clarity we have left out any identifiers of controls not referenced.

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1. Follow the Power Up Procedure, described on page 36. Then click the **Start** button **(14)**. Set the following controls as specified in Table 8.

Table 8: Initial Control Values for Digital Mode Operation

Ctrl	Value	Reference to Figure 33
VFO A	14.09 MHz	(1)
RX Meter	Signal	(4)
TX Meter	Fwd Pwr	(4)
BAND	20 m	(5)
Mode	DIGU	(6)
Filter	2.7 kHz	(7)
VAC	On	(8)
Display Mode	Panadapter	(9)
AVG	On	(9)
PEAK	Off	(9)
MultiRX	Off	(10)
SPLT	Off	(12)
XIT	Off	(12)
RIT	Off	(12)
MUT	Off	(17)
AF	50	(20)
AGC-T	90	(21)
Drive	50	(22)
AGC	Med	(23)
Preamp	+20	(24)
SQL	Off	(25)

2. In PowerSDR open the **Setup** Form, **Audio** tab and then the **VAC** sub-tab (see Figure 34 below). Check **Enable VAC**, Select *Virtual Cable 1* as the **Input** and *Virtual Cable 2* as the **Output**. If your digital mode software requires a stereo connection, check **Stereo**. To automatically enable VAC for **DIGU**, **DIGL** and **DRM (6)** modes, check **Auto Enable**. When operating these modes, the Front Console also shows several controls relating to **VAC (8)**, as shown in Figure 33 above).
3. If you want your digital mode software to control PowerSDR, then in the **Setup Form - CAT Control** tab, select *COM26* as the **Cat Control** port for PowerSDR to connect to and check **Enable CAT** (see page 143).

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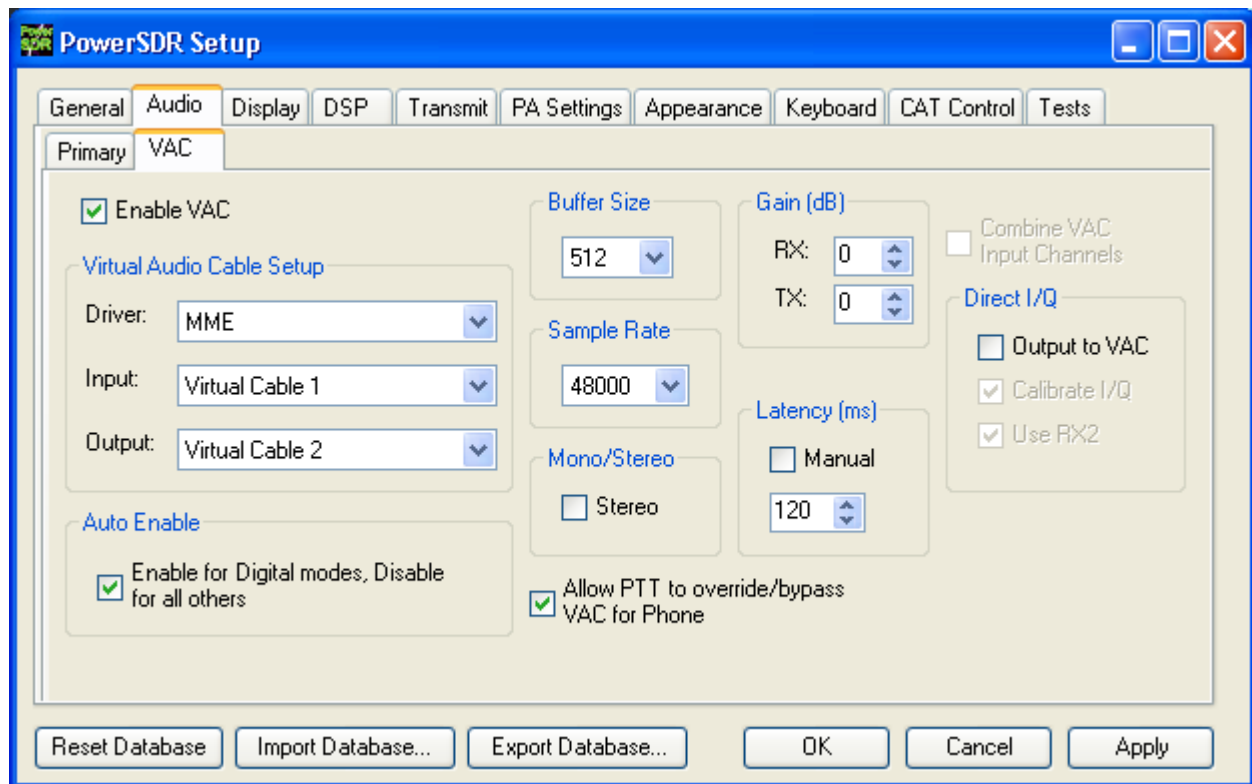


Figure 34: Setup Form - Audio Tab ,VAC Sub-Tab

4. Start up your digital mode program, select *Virtual Cable 1* for its sound card output and *Virtual Cable 2* for its input. Use the **RX Gain (8)** control to adjust the audio level going to your digital mode program (instead of the **AF (20)**) and **TX Gain (8)** to adjust the level going to PowerSDR.
5. If you are controlling PowerSDR with your digital mode software, set its CAT port to *COM6*.
6. In the **Antenna Form (35)** choose **Simple** mode and set **Receive** and **Transmit** both to **PA** (see page 95 for more on the Antenna Form). Connect a 50 ohm dummy load to the antenna jack, or tune **VFO A (1)** to a quiet frequency on the selected band. Use the **TUN (19)** button to verify power output on the **TX Meter (4)** (Set to *Fwd Pwr*).

WARNING! Connect a 50 ohm dummy load, or ensure that the selected antenna presents a 50 ohm load with a low SWR. Failing to do so may damage the FLEX-1500.

7. If using CAT control, click on the Transmit button of your digital mode program. It should switch PowerSDR to transmit. Transmit a test signal (e.g. several CQ calls) in the mode you plan to operate and use the **TX Gain (8)** control to adjust the volume of audio coming from your digital mode program. Set the **TX Meter (4)** to **ALC** and adjust for 0 dB to calibrate transmit. Click on Receive on your digital mode program and PowerSDR should switch back to receive.

8. You are now ready to begin a QSO. If a 50 ohm dummy load was connected, connect a 50 ohm antenna in its place. Tune to the desired frequency using one of the methods outlined in the Tuning Methods section above. Select either **DIGL** or **DIGU (6)** for lower or upper side band digital mode operation respectively. Select **DRM (6)** for DRM mode operation.

Note 1: The **DIGL**, **DIGU** and **DRM (6)** mode buttons bypass all signal processing in PowerSDR, except for AGC and Filtering. With **DIGL** and **DIGU** you have control over the filter width using the filter buttons **(7)**. **DRM** mode invokes a fixed 10 kHz wide double side band filter.

Note 2: **DIGL** and **DIGU (6)** apply an offset when using Spectrum Click Tuning (see page 104). By default, the offsets are set to 1200 Hz (SSTV) in **DIGU** mode and 2210 Hz (RTTY) in **DIGL** mode respectively. These offsets can be modified on the **Setup Form - General Tab, Options Sub-Tab**.

Separately, so called **RTTY Offsets** (for **DIGU** and **DIGL** mode) can be applied to the **VFO A** (and/or **VFO B**) frequency, before CAT reports it to a third party program (see page 143). These offsets can be modified on the **Setup Form - CAT Control Tab**.

Hint 1: When operating digital modes you have two options with regard to using filters. On the one hand you can use a wide band-pass filter in PowerSDR and use the filters within your digital mode program for selectivity.

On the other hand you can home in on a specific signal with PowerSDR's filters and ignore the filters in your digital mode program. Although circumstances and operator preference will dictate which to use, many operators have found the second option to be especially valuable to them.

Hint 2: Please check our Knowledge Center (<http://kc.flex-radio.com/search.aspx>) for more articles on how to use PowerSDR with various digital mode programs.

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Front Console

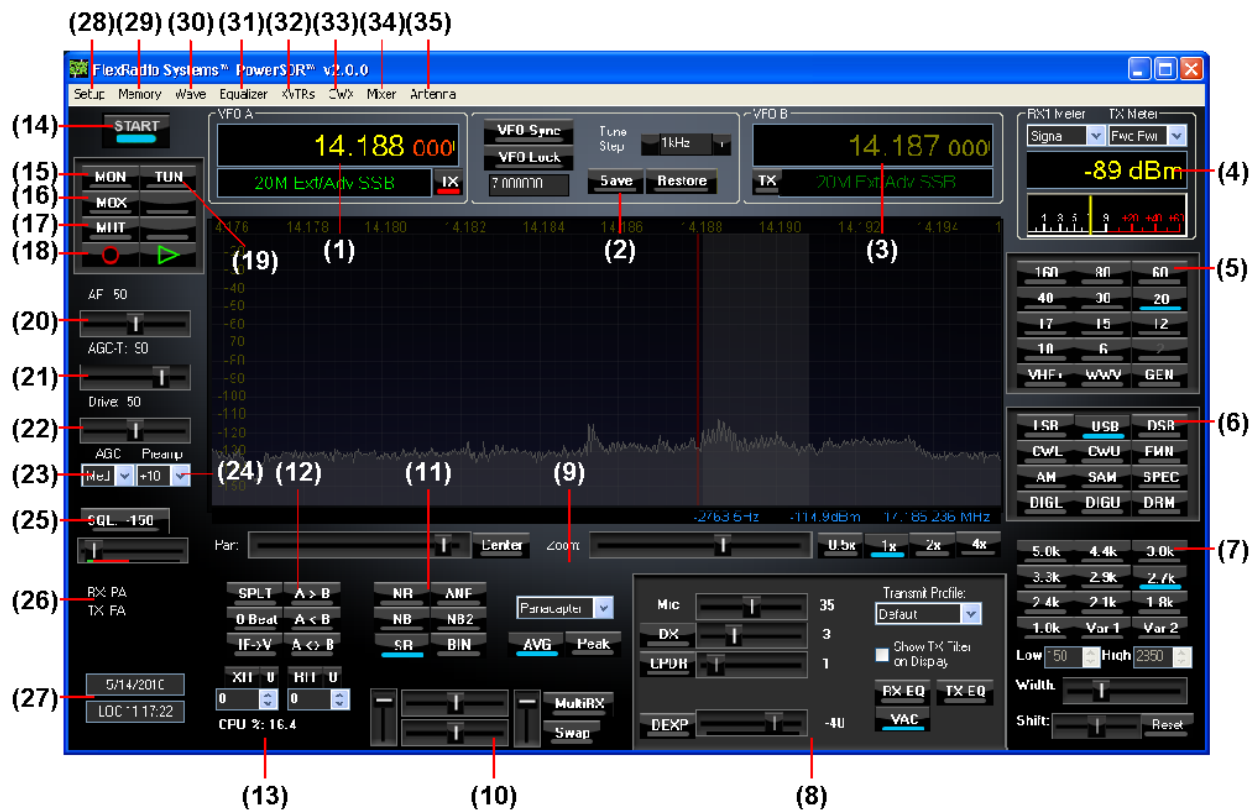


Figure 35: FLEX-1500 PowerSDR Front Console

Note:

The front console controls the basic functions of the radio: frequency, mode, filters, and display. In addition to these basic features, there are many other controls that are described in detail below. The exact behavior of many of these controls can be configured with the Setup Form.

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- Hint 1:** Hovering with your mouse over any control will show a brief description of that control's function.
- Hint 2:** Clicking just to the left or right of a slider will respectively decrease or increase its value by 1.

(1) VFO A



Figure 36: VFO A

VFO A is the main tuning VFO. It consists of a frequency and a band description (related to the selected frequency). The upper frequency area of the VFO is a Text Box and may be edited as such (click and drag highlighting, etc). The frequency may also be changed by entering a numeric character (without any mouse interaction). An underline will indicate the digit that will be tuned when hovering over the frequency display. See the Tuning Methods on page 37 for more details on how to tune. Note that when using the keyboard to enter a frequency, you can return to the previous frequency at any time by pressing the 'Escape' (Esc) key before you press the Enter key.

The red **TX** indicator identifies which VFO is displaying the transmit frequency:

- ❑ With Split off, the transmit frequency is displayed in VFO A (VFO A **TX** indicator is red)
- ❑ With Split on, the transmit frequency is displayed in VFO B (VFO B **TX** indicator is red).

The band text information below the frequency gives general information about the FCC Amateur bands as well as the Short Wave Radio bands and WWV. If not on a recognized frequency, the text will display "Out Of Band". If not in an amateur band, the text background will change from black to gray. Note that this information has no bearing on the current operating mode.

(2) Tuning Controls



Figure 37: Tuning Controls

VFO Sync keeps VFO B synchronized to VFO A.

VFO Lock keeps the frequency from being changed inadvertently. This is a handy feature to use while in a QSO to keep from accidentally losing the frequency due to clicking in the wrong area or hitting the wrong key on the keyboard.

The **Tune Step** displays the current tuning rate when using the mouse wheel (or Ctrl + Up/Down Arrow) to tune the radio. Rotating the mouse wheel away from you will increase the frequency at the rate of 1 tune step per click, while rotating the wheel toward you will decrease the frequency. You can change the Tune Step by clicking either of the **−** or **+** buttons, clicking the mouse wheel button, or using Ctrl + Left/Right Arrow.

The **Save** button quickly saves the frequency, mode and filter. The saved frequency is shown in the box to its left. The **Restore** button restores the most recently saved frequency (displayed), mode and filter.

(3) VFO B

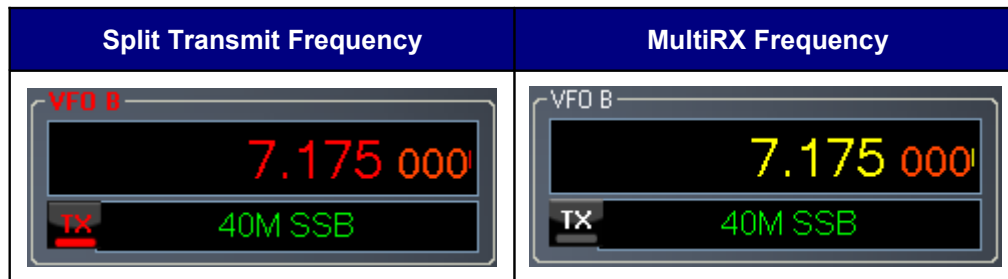


Figure 38: VFO B

The operation of VFO B is similar to that of VFO A. However, VFO B is used only in specific instances:

- ❑ When operating split (**SPLT** button), VFO B displays in red the transmit frequency (and **TX** indicator is red).
- ❑ When activating the multi receive function (**MultiRX** button), VFO B displays in yellow the second receive channel's frequency.
- ❑ Otherwise, it can be used as a storage container to copy VFO A data to (see the VFO Controls section on page 74).

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(4) Multimeter

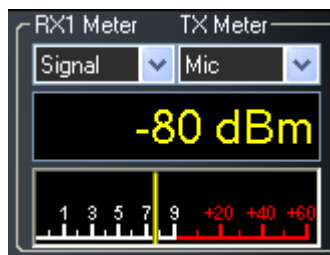


Figure 39: Multimeter

The multimeter displays both digitally and graphically various RX and TX signal parameters as determined by the selection from the two drop down boxes at the top.

The text display below the meter selections shows the digital data for either the receiver or the transmitter (Signal strength in Figure 39 above). The lower display at the bottom of this section shows the data graphically as an edge meter. Alternatively a bar graph display can be selected (see the description of the Setup Form - Appearance Tab, Meter Sub-Tab on page 140).

RX Meters

- ❑ **Signal (Signal Level):** Calculates the true RMS power in dBm of the current signal within the passband, as measured at the FLEX-1500 antenna port.
- ❑ **Sig Avg (Signal Average):** Calculates the true RMS power in dBm of a time-averaged signal within the passband, as measured at the FLEX-1500 antenna port.
- ❑ **ADC L (Analog To Digital Left):** Calculates the level in dBFS (decibel full scale) of the Left input from the internal I/Q ADC.
- ❑ **ADC R (Analog To Digital Right):** Calculates the level in dBFS (decibel full scale) of the Right input from the internal I/Q ADC.
- ❑ **Off:** Used for debugging purposes or to save CPU cycles on slower machines.

TX Meters

- ❑ **Fwd Pwr (Forward Power):** Reads out forward power in Watts as measured by the internal ADC on the PA. The meter shows average power. (See also the **Note** on page 42 regarding average versus peak power of a typical voice.)
- ❑ **Mic:** Reads modulation power from -20 dB to 3 dB. Ideal operation will peak around 0 dB and will rarely if ever hit 3 dB. If it is hitting 3 dB, the ALC is cutting back the power. Adjust the MIC control on the front console to give more or less modulation.
- ❑ **EQ:** Reads the power in dB following the equalizer, where 0 dB is ideal. If the equalizer is not enabled, the equalizer power is equal to the Mic power.

- ❑ **Leveler:** Reads the power in dB following the leveler, where 0 dB is ideal. The leveler attempts to level the voice coming from the microphone as the head and mouth change position relative to the microphone element. If the leveler is not enabled, this power is identical to EQ.
- ❑ **Lev Gain:** Reads the gain in dB currently being applied by the leveler.
- ❑ **ALC:** Reads the power in dB after the ALC, where 0 dB is ideal.
- ❑ **ALC Comp:** Reads the gain in dB applied by the ALC algorithm. The gain is always ≤ 0 in dB. The minus sign is implicit.
- ❑ **CPDR:** Reads the power in dB after the compander, where 0 dB is ideal. If the compander is not enabled, it reads the same as ALC Comp.
- ❑ **Off:** Used for debugging purposes or to save CPU cycles on slower machines.

The **TX** meters **Mic**, **EQ**, **Leveler**, **CPDR** and **ALC** show either peak or true RMS values, depending on whether TX meter is set to use peak readings for DSP Values (see Setup Form – DSP Tab, Options Sub-Tab on page 117).

(5) Band Selection & Band Stacking Memories



Figure 40: Band Selection

The Band Selection controls perform multiple roles in PowerSDR. First, when tuning the VFO to a specific frequency the band indicator will move to the appropriate band (GEN if not in one of the specific bands listed). This is used to quickly identify which band you are in, or when you are stepping over a band edge boundary (see Figure 40).

Secondly, clicking on one of the Band Selection buttons will change the frequency, mode and filter to the one last used on that band.

The third role is a feature called Band Stacking Memories. A single memory is defined as a frequency, mode, and filter combination. Each band has several memories associated with it. Clicking on a band button repeatedly will cycle through the available memories. This is useful to quickly tune to various frequencies within a band. To replace one of the memories with the frequency, mode, and filter of your choice, first click the band button for the band memory you would like to modify. Then change the frequency, mode, and filter to the desired settings (the frequency must be in the band selected). Finally click the band button again to save the values.

The modified memories will be saved to the database upon graceful exit of PowerSDR. If for some reason PowerSDR crashes the changed memories will not be saved in order to keep faulty data from making it into the database.

Note : Some band memory frequencies (such as 60m and WWV) are fixed in software and cannot be changed.

The **VHF+** button will swap between the typical HF bands and any configured transverter bands (see the description of the XVTRs Form on page 87). The VHF band buttons work in the same way, but for the frequencies within the transverter frequency range.

(6) Operating Mode Selection



Figure 41: Operating Mode Selection

These controls allow you to change the selected (de)modulation routine. Changing operating modes will select the last frequency and filter used for that mode. Additionally, it will display the (configurable) filter settings available for that mode (see Figure 43 below) and the appropriate mode specific controls on the front console (see page 63). Following is a list of the available operating modes:

- ❑ **LSB:** Lower Side Band
- ❑ **USB:** Upper Side Band
- ❑ **DSB:** Double Side Band
- ❑ **CWL:** CW Lower Side Band
- ❑ **CWU:** CW Upper Side Band
- ❑ **FMN:** Frequency Modulation (FM) Narrow
- ❑ **AM:** Amplitude Modulation
- ❑ **SAM:** Synchronous (PLL) Amplitude Modulation
- ❑ **SPEC:** Spectrum mode (DC IF, full receiver bandwidth)
- ❑ **DIGL:** Digital Lower Side Band (Enables VAC if VAC Auto Enable is engaged, see page 111)
- ❑ **DIGU:** Digital Upper Side Band (Enables VAC if VAC Auto Enable is engaged, see page 111)

- ❑ **DRM:** Digital Radio Mondiale (requires licensed external demodulator software not available from FlexRadio Systems; Enables VAC if VAC Auto Enable is engaged, see page 111)

Hotkeys are available in the Setup-Form, Keyboard Tab to cycle through the various operating modes using the keyboard (see page 142).

(7) Filter Controls



Figure 42: Filter Controls

The filter controls consist of ten customizable, mode-specific, labeled filter buttons and two variable filter buttons.

Labeled Filter Buttons

Clicking on any of the labeled buttons in the top half of the filter controls section sets the filter bandwidth. The available filters depend on the selected modulation mode. The 3 groups of default filter selections for CW (CWL, CWU), SSB (LSB, USB, DIGL, DIGU) and DSB (DSB, FMN, AM, SAM) are shown below. The SPEC mode has no filters associated with it and the DRM filter is fixed at 12 kHz.

CW Default Filters	SSB Default Filters	DSB Default Filters
1.0k, 800, 750	5.0k, 4.4k, 3.8k	16k, 12k, 10k
600, 500, 400	3.3k, 2.9k, 2.7k	8.0k, 6.6k, 5.2k
250, 100, 50	2.4k, 2.1k, 1.8k	4.0k, 3.1k, 2.9k
25, Var 1, Var 2	1.0k, Var 1, Var 2	2.4k, Var 1, Var 2

Figure 43: Default Mode Dependent Filters

Each of the 10 labeled filter buttons can be customized for any of the modes. To do so, right click on a filter button and select **Configure...** to bring up the screen shown in Figure 44.

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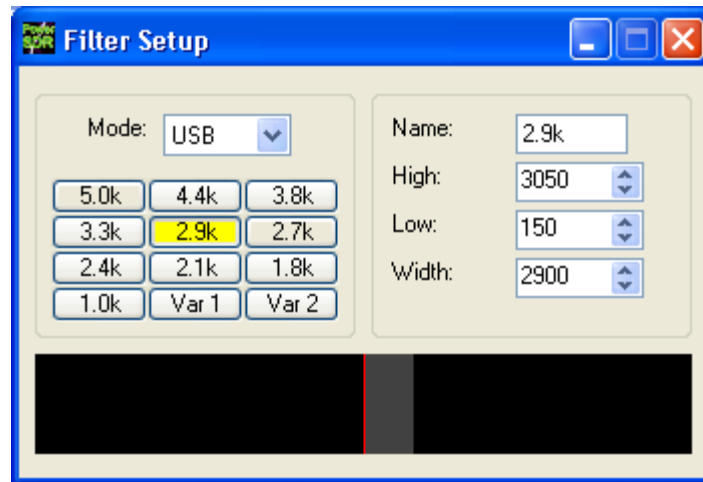


Figure 44: Filter Setup Screen

On the left, select the Operating **Mode** and the filter button to configure. A preview of the filter is displayed in the lower section of this screen. On the right, adjust its settings. Alternatively, in the preview screen, drag the filter as a whole, or drag the edges to adjust. When done, you can select another button and/or mode to change that filter. When finished, just close the Filter Setup Screen. To revert back to the default settings, right click on a filter button, select **Reset to Defaults** and click **Yes**.

Note: Although there are 3 groups of mode-dependent default filter settings, you can customize the labeled filter for each operating mode independently. E.g. you can have different filters for LSB and USB, for FMN and AM, etc.

Variable Filter Buttons

The variable filter buttons **Var 1** and **Var 2** offer two separate filters, each of which can be adjusted with the **Low**, **High**, **Width**, **Shift** and **Reset** controls described below. The Panadapter display setting is good for visualizing changes to variable filter controls.

- ❑ **Low:** Selects the low cutoff frequency for the filter. The value is the plus or minus offset from the center frequency as shown in the VFO display. Note that in lower side band modes (LSB, CWL and DIGL) this value can be negative.
- ❑ **High:** Selects the high cutoff frequency for the filter. Note that in lower side band modes (LSB, CWL and DIGL) this value can be negative.
- ❑ **Width:** Widens the filter as the slider is moved right, and narrows the filter as it is moved left. The behavior of this control is set in the **Setup Form – General Tab, Filter Sub-Tab** (page 107).

- ❑ **Shift:** Shifts the selected filter passband up or down from its normal center frequency. This can help to eliminate interference caused by signals in close proximity of the received signal. The behavior of this control is set in the **Setup Form – General Tab, Filter Sub-Tab** (page 107). After a variable filter (**Var 1, Var 2**) has been shifted you can use the **IF→V** button to translate a filter shift to a new VFO frequency (see the VFO Controls section on page 74)
- ❑ **Reset:** Returns the **Shift** control to the default middle position and restores the filter to its original position (i.e. before the **Shift** was used).
- ❑ When the display is set to Panadapter, the mouse can be used to directly adjust the selected variable filter (**Var 1** or **Var 2**). To do so right click with the mouse on the Panadapter display until no cross-hairs are showing. Then click on the filter and drag it to shift the filter as a whole or click on a filter edge and drag it to adjust the filter bandwidth.

The **Var 1** and **Var 2** filters are saved just like the labeled filters and are mode-dependent (i.e. you can save a different **Var 1** filter for **LSB** than for **AM**). Hotkeys are available in the **Setup Form-Keyboard Tab** (described on page 142) to change the filters using the keyboard.

(8) Operating Mode Specific Controls

This section of the front console displays key controls specific to the selected mode. There are three sets of controls: Phone, CW and Digital.

Phone Controls

The phone controls, shown below, are available for all phone modes (LSB, USB, DSB, FMN, AM and SAM). Most of these controls can also be found on the Setup Form-Transmit Tab (see page 130, for a more detailed description).

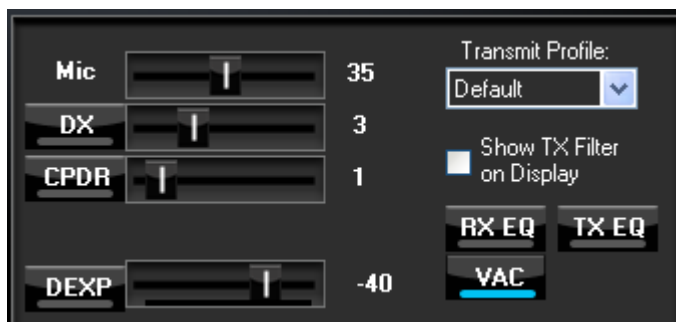


Figure 45: Mode Specific Controls - Phone

- ❑ **Mic:** adjusts the (software) microphone gain. This is a simple multiplier applied to the input samples when transmitting. Note that increasing the **MIC** control will also raise the amount of noise in the signal. A hardware preamp will give the best performance for amplifying microphone signals. Having said that, the software gain works very well in many setups. The setting is optimal when the peak reading on the TX Mic Meter reads just below 0 dB (see page 58).
- ❑ **DX:** click to enable the DX compander (a form of compression), which has been optimized to give your voice an extra punch, especially useful in DX situations. Adjust its level with the slider.

- ❑ **CPDR:** click to enable the compander and adjust its level with the slider.
- ❑ **DEXP:** click to enable the Downward Expander and adjust its threshold with the slider. When transmitting, a bar graph will show just below the slider control. The green part of this bar graph shows the portion of the sound level that will be attenuated; the red part the portion that will not. See page Error: Reference source not found for a detailed description on how to set this threshold control as well as the DEXP attenuation percentage, both of which can be found on the Setup Form-Transmit Tab.

Hint: The Downward Expander can (and should) be enabled in all situations where ambient noise will render your transmissions less clear.

- ❑ **Transmit Profile:** select the transmit profile to use for phone transmissions. The default profiles are **Default** and **Default DX**. See also the Setup Form-Transmit Tab (page 130)
- ❑ **Show TX Filter on Display:** when checked, the band edges of the transmit filter, set on the Setup Form-Transmit Tab (page 131) will be shown as two yellow lines on the Panadapter display. It can be an especially useful visual aid when operating split to position your transmit frequency where desired (in a pile-up) using VFO B. Additionally, it will give you a quick visual impression of whether your transmit filter needs to be adjusted or not.
- ❑ **RX EQ:** activates either the receive three-band or ten-band equalizer. See also the Equalizer form described on page 85.
- ❑ **TX EQ:** activates either the transmit three-band or ten-band equalizer. See also the Equalizer form described on page 85.
- ❑ **VAC:** activates *Virtual Audio Cable* (<http://software.muzychenko.net/eng/>), a third party program (written by Eugene Muzychenko) to enable digital audio transfer between PowerSDR and other third party (digital) programs. See also the Setup Form – Audio Tab, VAC Sub-Tab described on page 110. VAC is not automatically enabled for phone modes, even if **Auto Enable** has been checked on the VAC Sub-Tab.

CW Controls

The CW controls, shown in Figure 46 below are available when either CWL or CWU is selected. Most of these controls can be found on the Setup Form-DSP Tab, Keyer Sub-Tab (see page 125, where you can also find a more detailed description).

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Figure 46: Mode Specific Controls - CW

- ❑ **Speed:** sets the CW speed when using the internal keyer in Iambic mode. Adjust the speed with the slider.
- ❑ **Iambic:** check to set the internal keyer to Iambic mode (see also page 126)
- ❑ **Disable Monitor:** check to disable the monitor (this can be useful when using an external keyer).
- ❑ **Show TX CW Frequency:** check to show the CW transmit frequency as a single yellow line when the display is set to Panadapter. It can be an especially useful visual aid when operating split to position your transmit frequency where desired (in a pile-up) using VFO B.
- ❑ **Pitch Freq (Hz):** sets the desired audio frequency for CW listening at the center of the CW filters. This will determine the offset that is applied to the carrier in receive and transmit. The display will continue to read the actual carrier frequency, but the software will provide for an offset to get the desired CW tone. This pitch will determine the automated tuning frequency using the display and mouse ClickTune™ functions.
- ❑ **VAC:** click to enable *Virtual Audio Cable* (<http://software.muzychenko.net/eng/>), a third party program (written by Eugene Muzychenko) to enable digital audio transfer between PowerSDR and other third party (digital) programs. See also the Setup Form – Audio Tab, VAC Sub-Tab described on page 110. VAC is not automatically enabled for CW modes, even if **Auto Enable** has been checked on the VAC Sub-Tab.
- ❑ **Break In:** check the **Enabled** box to activate Break In for the internal keyer. Set the delay in the **Delay** text box. See also page 127.

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Digital Controls

The digital controls, shown below are available when either DIGL, DIGU or DRM is selected. These controls can mostly be found on the Setup Form- Audio Tab, VAC Sub-Tab (see page 110, where you can also find a more detailed description).

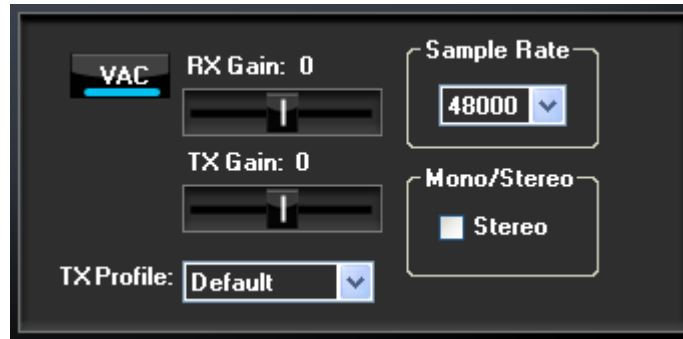


Figure 47: Mode Specific Controls - Digital

- ❑ **VAC:** click to enable *Virtual Audio Cable* (<http://software.muzychenko.net/eng/>), a third party program (written by Eugene Muzychenko) to enable digital audio transfer between PowerSDR and other third party (digital) programs. See also the Setup Form – Audio Tab, VAC Sub-Tab described on page 110. If **Auto Enable** (page 111) has been checked on VAC Sub-Tab, then VAC will automatically be enabled when either DIGL, DIGU or DRM is selected.
- ❑ **RX & TX Gain:** Adjust the gain for signals coming in and out of the VAC interface. Use the RX Gain control to adjust the audio level going to third party programs. (Note that for third party applications this control supersedes the front panel AF control). Similarly, use the TX control to adjust the volume of audio coming from third party applications (adjust for 0 dB on the ALC meter).
- ❑ **Sample Rate:** sets the sample rate of the VAC interface. This needs to be matched to your third party software sample rate.
- ❑ **Mono/Stereo:** sets the VAC interface to operate either mono or stereo. This can be of importance, depending on your third party software. (E.g. MixW requires the mono setting, whereas DREAM requires stereo).

(9) Display Controls

The main display controls, shown in Figure 48 below, consist of two sections: screen adjustment controls and display selection controls. The former act on the screen as a whole, whereas the latter determine the display type to be used.

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Figure 48: Display Controls

Screen Controls

The screen controls adjust the view of the Panadapter, Waterfall or Panafall display (see Figure 50 and Figure 51 below), they are not functional for any of the other display types.

- ❑ **Pan:** adjust the slider to pan the Panadapter or Waterfall display from left to right. Click on **Center** to quickly return the display to its original position.
- ❑ **Zoom:** adjust the slider to zoom in on or out of the display. Additionally click on either on of the 4 buttons to the right to quickly zoom to the labeled setting.

Display Selection Controls

The main display is able to visualize received (and transmitted) signals in various ways (display types), which can be selected from the list box. These various display types are detailed below with a snapshot of each type. The refresh rate (in Frames Per Second, FPS) of the main display can be modified on the Setup Form-Display Tab (see page 114).

- ❑ **AVG (Average):** click to view time-averaged signals. This will smooth fast-changing signals and is a good way to separate real from stochastic (noise) signals. The averaging time can be set on the Setup Form-Display Tab (see page 113). **AVG** must be enabled for the **0 Beat** VFO Control to be available.
- ❑ **Peak:** click to hold the peak value for each frequency in the display.

Display Type Descriptions

Note: The actual display in PowerSDR is crisper than the compressed images shown below.

There are six frequency domain display types (Spectrum, Panadapter, Waterfall, Histogram, Panafall™ and Panoscope™) and three time domain display types (Scope, Phase and Phase2). Various colors used in the display (text, data line, etc) are customizable using the Setup Form-Appearance Tab, Display Sub-Tab (page 137).

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Spectrum

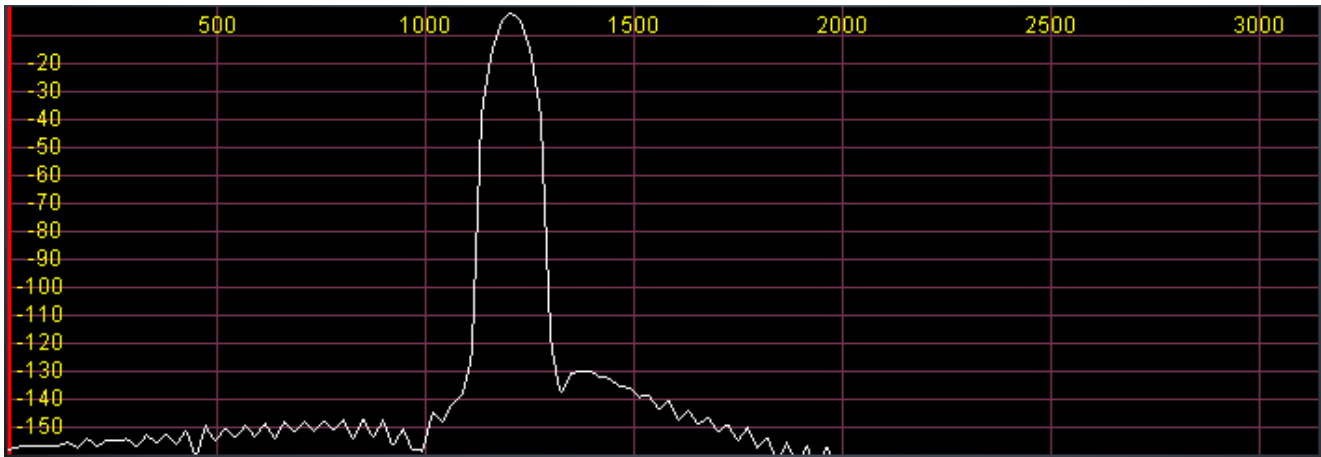


Figure 49: Spectrum Display

The Spectrum Display shows a classical spectral view of the frequency with the ends of the display determined by the bandwidth of the filter. The scale across the top shows the frequency offset in Hz from the VFO A frequency. Rather than only using half the display window when in lower or upper sideband, we expand the display moving the 0 Hz line to the left or right margin (1.2 kHz tone in USB mode with a 2.7 kHz filter shown).

Panadapter (Panoramic Adapter)

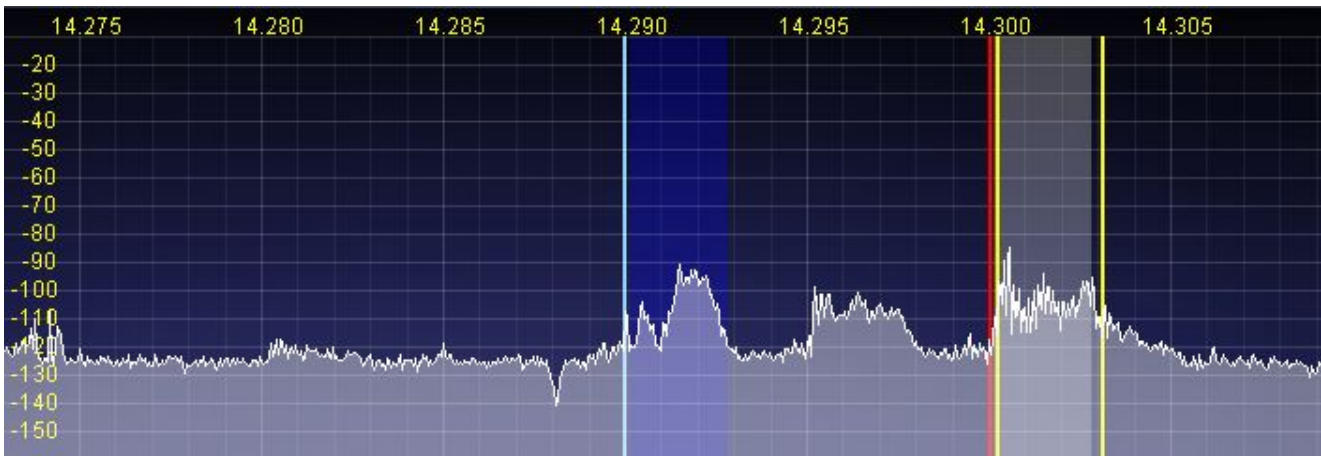


Figure 50 Panadapter Display

The Panadapter Display is similar to the Spectrum Display with several differences.

- ❑ The maximum display width is fixed at approximately 44 kHz, no matter what filter bandwidth is selected.
- ❑ The selected filter is displayed as an overlay to help the user visualize the filter. Shown are the main RX filter (gray, VFO-A), the MultiRX filter (blue, VFO-B) and the TX filter edges (yellow vertical lines). The color of all the filter overlays can be changed independently using the Setup Form-Appearance Tab, Display Sub-Tab (page 137).

- ❑ The frequency scale shows the actual frequency (in MHz).
- ❑ The edges of the amateur bands are marked as red vertical lines and the corresponding frequencies are displayed in red
- ❑ With the mouse, filters and filter edges can be varied by dragging and dropping
- ❑ Point click tuning is available with mouse and cross-hairs showing.

The Panadapter is useful because although you hear only the signals within the audio passband, you can see in real time all signals within the receiver's passband. This gives a much more complete picture of the surrounding area in the band, especially when there is abundant signal activity (e.g. contest and DX situations).

Waterfall

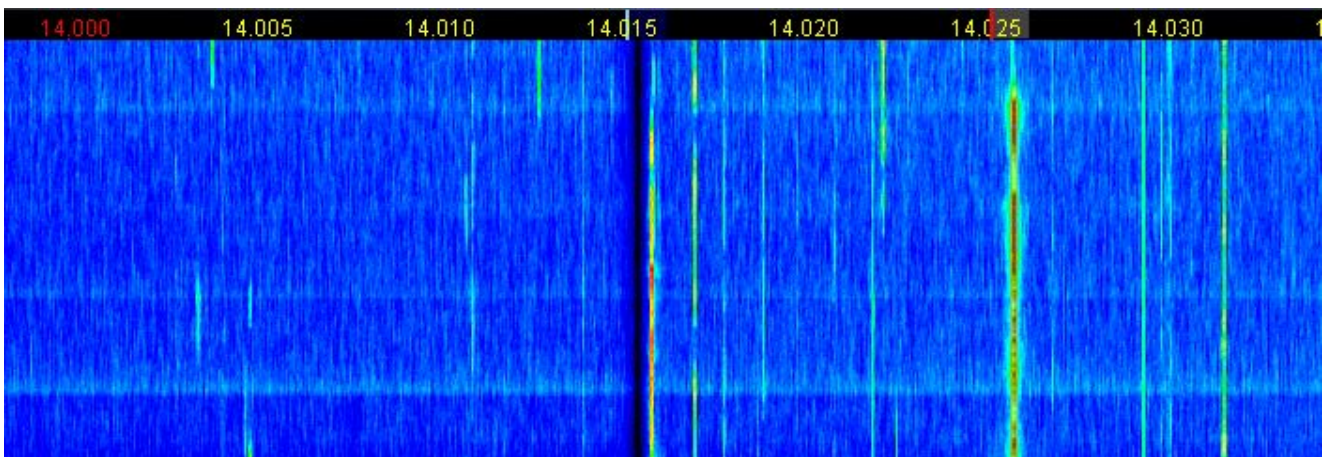


Figure 51: Waterfall Display

The Waterfall Display shows a scrolling view of activity within the receiver's passband. This makes tracking narrow band signals much easier and can even allow visualization of CW signals at slower speeds (longer line is a dash, short line is a dot, no line is a pause).

- ❑ Across the top the audio passband filters are displayed, similar to the panadapter.
- ❑ The filter widths and positions can be adjusted with the mouse, similar to the panadapter.
- ❑ All mouse tuning methods available in the panadapter are also available in the waterfall.
- ❑ The frequencies corresponding to the Amateur band edges are displayed in red.

The Waterfall Display can be customized on the Setup Form- Display Tab This allows custom setting of the dynamic range and coloring for the display. (See the Setup Form-Display Tab on page 115 for more details.)

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Histogram

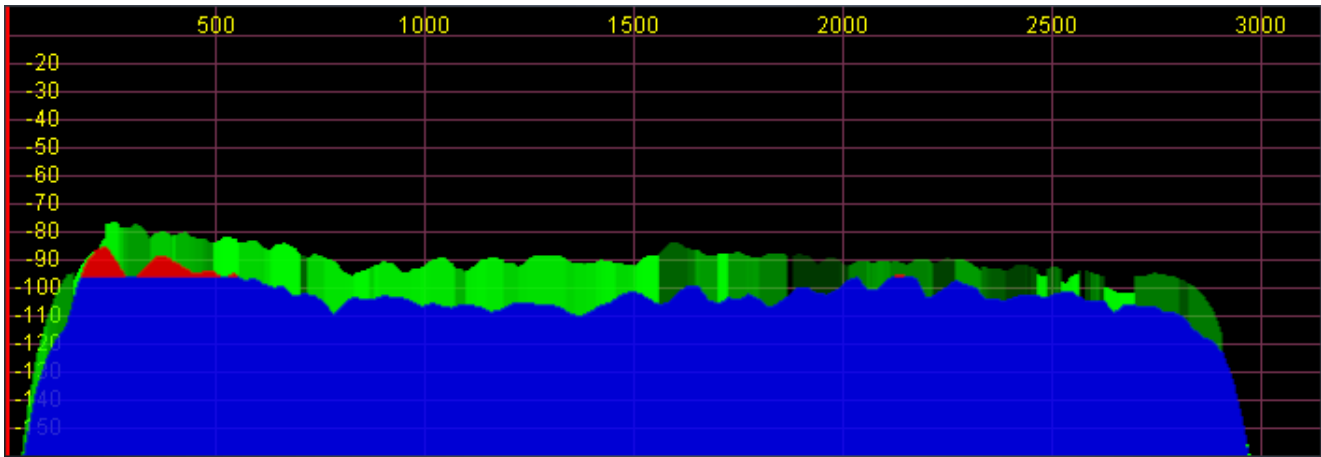


Figure 52: Histogram Display Mode

The Histogram Display is similar to the Spectrum Display, but instead of a single color data line, additional colored data is used. Blue signals are real-time (current) signals that are below a signal threshold (roughly below the average plus a small margin). The red signals are real-time (current) signals that are above that same threshold. The green signals are previous peaks on that same frequency that will fade as time goes by (a type of history, hence the name).

Scope

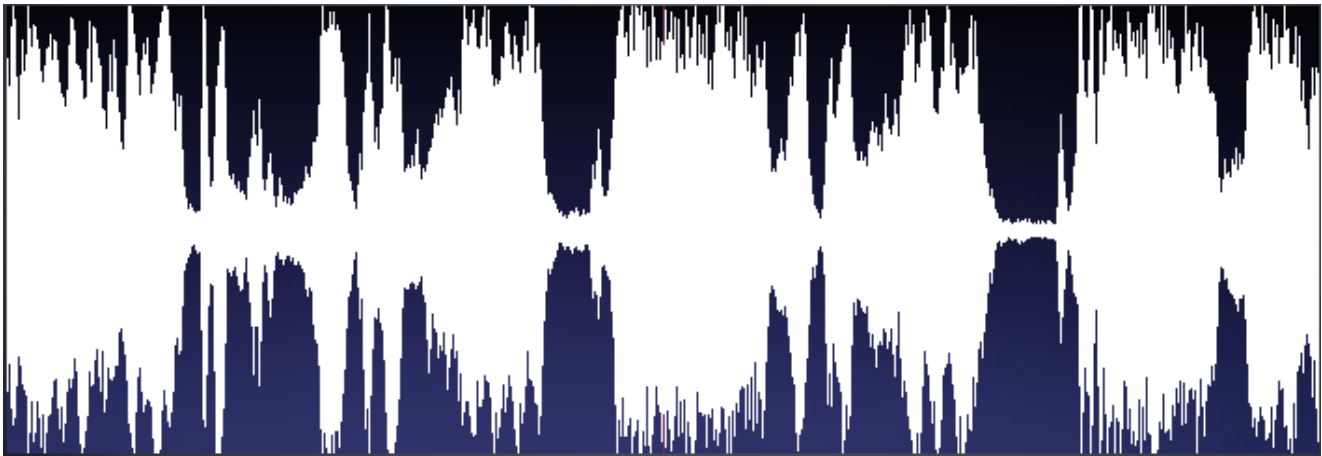


Figure 53: Scope Display

The Scope Display shows the received or transmitted audio signal in the time domain. Shown is an SSB signal. The Scope Display is particularly useful when transmitting to monitor your audio waveform, e.g. to see the effects of DX (page 63) or equalization (page 85). The time base can be adjusted on the Setup Form- Display Tab (see page 116).

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Phase

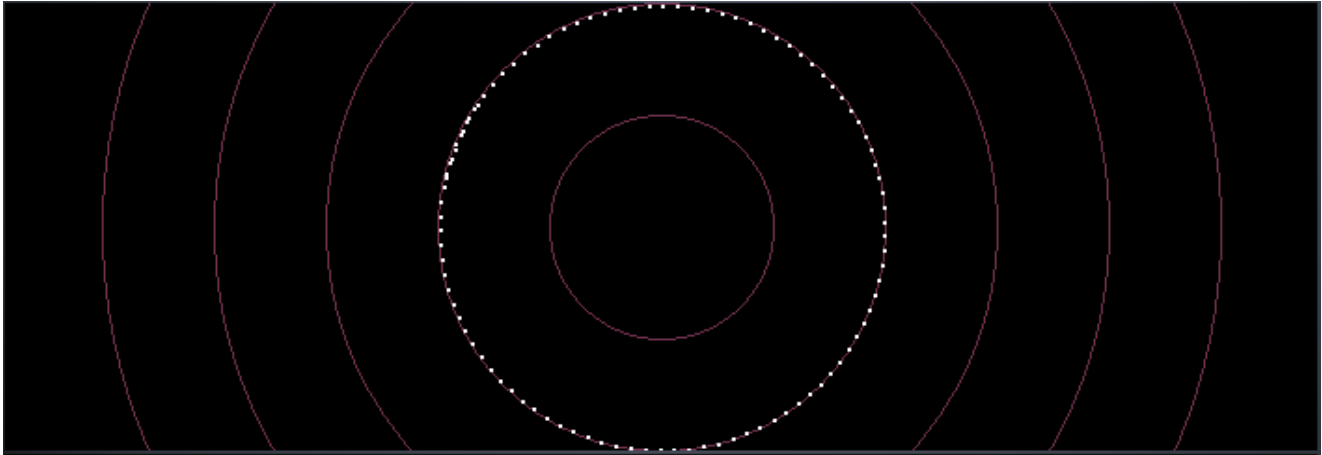


Figure 54: Phase Display

The Phase Display maps the *filtered* I and Q (Left and Right) channels to the X and Y coordinate planes. This is useful for making sure the two channels are 90 degrees out of phase as they should be. There is also a **Phase2** Display that maps the *unfiltered* data directly from the ADC. When a continuous carrier signal is received, the unfiltered data in the Phase2 Display should produce as near to a perfect circle as possible. If the circle distorts into an oval or a straight line, the input phase is off balance which would indicate a connection or hardware problem.

Panafall

This display is a combination of the Panadapter and the Waterfall displays described above.

Panascope

This display is a combination of the Panadapter and the Scope displays described above.

Off

In this setting the display is turned off. It is mainly used for debugging purposes, but can also be used with slower systems to decrease the CPU load to more reasonable levels.

Cursor and Peak Position

There are two sets of data side by side just below the graphical display that are used to communicate cursor (left) and peak signal (right) information to the user. For each the data shown equals Offset from VFO, Signal Level and Frequency. For example, in Figure 55 below¹, the peak signal is offset – 28742.6 Hz from the VFO frequency (14.255 MHz). The peak signal level is –92.5 dBm, and the peak signal is at 14.226257 MHz. Note that these values are fairly low resolution due to the discrete nature of the pixel display.

¹ This figure is created using a FLEX-5000, which can have a wider receiver bandwidth than the FLEX-1500.



Figure 55: Cursor and Peak Position Information

- ❑ In the frequency domain displays (Spectrum, Panadapter, Histogram, Waterfall), right clicking the mouse cycles through yellow crosshairs, red crosshairs (only if **SPLT** or **MultiRX** is enabled), or no crosshairs. The crosshairs span the width and height of the display (yellow cross hairs are shown in Figure 55 above).
- ❑ Together with the **AVG** control they allow easy measurement of signals on the display. For example, in Figure 55 the cursor position is offset -10219.9 Hz from the VFO frequency and is at 14.244780 MHz. The horizontal line of the crosshairs is at -96.0 dBm.
- ❑ Another feature of the crosshairs is ClickTuning. Clicking the left mouse button with the yellow crosshairs visible tunes VFO A to the frequency indicated by the cursor position data (or if Snap ClickTune is on (see page 104), to the nearest multiple of the Tune Step). The red crosshairs tune VFO B when **SPLT** or **MultiRX** is enabled. This is an excellent way to tune CW signals as it will zero beat the tone to the set CW pitch.

(10) MultiRX Controls

The MultiRX controls, shown below, allow you to enable a second receive channel within the receiver's passband as determined by the audio sample rate setting. Both the primary and the secondary receive channel can be positioned independently in the audio spectrum to facilitate separating the two signals in your head.



Figure 56: MultiRX Controls

Click **MultiRX** to enable the second receive channel. The second receive channel will be tuned to the frequency shown in VFO B. In the Panadapter and Waterfall Displays, its passband is shown in blue, but only if it is within the range of the Panadapter/Waterfall. Use the upper and lower horizontal sliders to position the primary and secondary channel respectively anywhere in the left-right audio spectrum. Use the left and right vertical sliders to adjust their respective volumes. Click **Swap** to swap the audio between the left and right speakers.

Hint: In split operation you can use the secondary receive channel to listen to the pile-up, while using the primary receive channel to listen to the DX.

(11) DSP Controls



Figure 57: DSP Controls

These controls enable the digital signal processing (DSP) functions. The first four are described in detail in the Setup Form-DSP Tab, Options Sub-Tab (see page 117); **SR** (Spur Reduction) is described in the Setup Form-General Tab, Options Sub-Tab (page 103).

- ❑ **NR (DSP Noise Reduction):** Activates the DSP Noise Reduction algorithm (see page 117).
- ❑ **ANF (Automatic Notch Filter):** Activates the Automatic Notch Filter algorithm (see page 118).
- ❑ **NB (Impulse Noise Blanker):** Activates the Noise Blanker algorithm (see page 120).
- ❑ **NB2 (Mean Rank Noise Blanker):** Activates the Mean Rank Noise Blanker algorithm (see page 120).
- ❑ **SR (Spur Reduction):** Activates the Spur Reduction algorithm (see page 103).
- ❑ **BIN (Binaural Audio):** Activates the Binaural algorithm. Binaural audio is a special feature of PowerSDR. It generates a pleasing effect as the two phased channels (I and Q) are mapped to the left and right audio channels. The phasing of the demodulated and filtered audio signal within the passband gives a stereo-like, spatial effect to the received signal. When tuning across CW signals, they will seem to move in “space” as you tune the radio. Many experienced operators feel that binaural audio gives them a competitive advantage under contest conditions where the effect allows them to more easily pick signals out of a pile up. Wearing headphones increases the effect of the spatial separation.

Note: **BIN** is not available when operating **FMN**, **AM** or **SAM**.

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(12) VFO Controls



Figure 58: VFO Controls

- ❑ **SPLIT (Split):** Enables Split operation using VFO B for the transmit frequency. The frequency text and TX indicator in VFO B will turn red to indicate that it is the transmit frequency.
- ❑ **0 Beat:** Centers the signal peak within the RX filter passband. An exception is made in CW mode if the CW Pitch is within the passband. In this case, the signal is tuned to the CW Pitch.

Note: **0 Beat** is only available if **AVG** is enabled for the Display.

- ❑ **IF→V:** Translates any offset created by Filter **Shift** back to baseband by retuning the VFO. Useful when chasing a signal with the Filter **Shift** control (see also page 62).
- ❑ **A >B:** Transfers the contents of VFO **A** to VFO **B** (frequency, mode, and filter).
- ❑ **A <B:** Transfers the contents of VFO **B** to VFO **A** (frequency, mode, and filter).
- ❑ **A <>B:** Swaps the contents of VFO **A** and **B** (frequency, mode, and filter).
- ❑ **XIT (Transmit Incremental Tuning):** Click to enable XIT. XIT may be used as a quick way to operate split at a specific offset. When enabled, the transmit frequency is increased from the VFO A frequency by the amount shown in Hz while leaving the receive frequency intact. With **SPLIT** activated, XIT modifies the VFO B frequency. Click the **0** button next to the XIT button to clear the XIT control to 0.
- ❑ **RIT (Receive Incremental Tuning):** Click to enable RIT. When enabled, the receive frequency is increased from the VFO A frequency by the amount shown in Hz while leaving the transmit frequency intact. Click the **0** button next to the RIT button to clear the RIT control to 0.

(13) CPU %

This displays your computer's total CPU load as seen in the *Windows Task Manager* under the Performance Tab. Note that running other applications will cause the CPU load to increase. If your CPU load is peaking at close to 100%, audio and possibly video artifacts will become noticeable. In this case closing ancillary applications (e.g. email, web browser, etc.) and/or deactivating some of PowerSDR's functions (e.g. NR, ANF, BIN, etc.) may improve the performance.

(14) Start/Stop Button

Click **Start** to activate PowerSDR, click **Stop** to deactivate it (see Figure 59).



Figure 59: Power Button States

Note: Please see also the Power-Up/Down procedures described on page 36 for information on best practices.

(15) MON (Monitor)

When enabled, the transmitted audio is monitored through the receiver's speakers. The MON function is not available in AM, SAM, or FM modes as those modes are transmitted at the Intermediate Frequency (IF, usually 9 kHz). In voice operation the **MON** feature will allow you to hear the effects of MIC gain, TX equalization, compression and compansion and to adjust them in real time. The **AF** control can be used to adjust the monitor volume.

(16) MOX (Manually Operated Transmit)

When enabled MOX activates the transmitter. It is used primarily for voice operation. MOX will not generate a CW carrier. To generate a carrier for tuning, refer to the tune (**TUN**) button description on page 76.

Note 1: If the radio ever seems like it is stuck transmitting, try disabling the Push-To-Talk (PTT) function by selecting **Disable PTT** on the Setup Form-General Tab, Options Sub-Tab.

Note 2: To use PowerSDR without any hardware attached to the PC you must disable PTT. On the Setup Form-General Tab, select either **Disable PTT** on the Options Sub-Tab, or **Demo/None** on the Hardware Config Sub-Tab

(17) MUT (Mute)

This button Mutes the speaker audio.

(18) Record (○) and Play (▶)

The **Record** and **Play** buttons offer a quick and easy way to record and play back a signal. Click **Record** to record a signal and click **Record** again to stop recording. Once recorded, the signal can be played back by clicking **Play**. Subsequently clicking **Record** will overwrite any audio file previously recorded in this way. The **Record** and **Play** buttons are the same as the **QuickRec** and **QuickPlay** buttons on the **Wave Form** (see page 83)

- Note 1:** The audio file is saved as SDRQuickAudio.wav in the %appdata%\FlexRadio Systems\PowerSDR v2.n.n\ directory. The saved file contains post-processed audio, and can be played back with any wav file player.
- Note 2:** The location of your *Application Data* (%appdata%) directory depends on your version of Windows. To open your *Application Data* directory, click **Start** on the Windows task bar and then click **Run**. Type %appdata% and click **OK**.

(19) TUN (Tune)

TUN transmits a continuous (CW) carrier at the level set with the **Tune Power** control (default 10) on the Setup Form-Transmit Tab (page 130) and outputs a tone at the CW Pitch. The **Drive** control shows the Tune Power setting while **TUN** is activated. Any changes to the **Drive** control while **TUN** is active are saved when the **TUN** button is turned off.

(20) AF (Audio Frequency Gain)

This control sets the audio gain. It may also be adjusted by pressing the + (plus) and - (minus) keys on the numeric keypad. For best performance set the external speaker volume control to the high end of the scale so that the AF control can be set to a lower value.

(21) AGC-T (AGC Maximum Gain)

This control sets the *maximum gain* of the AGC. It is the same control as can be found on the Setup Form-DSP Tab, AGC/ALC Sub-Tab (page 128). The operational use of the AGC control is essentially the same as that of an RF gain control found in more traditional receivers. There are several articles on configuring and optimizing the AGC in our Knowledge Center which may also be of use. (Search for AGC in our Knowledge Center at <http://kc.flex-radio.com/search.aspx>).

- Hint:** For optimal use, set the **AGC-T** control such that the band noise level is comfortable, yet weak signals still jump out of the noise. Then adjust the **AF** control to comfortably hear the received signal.

(22) Drive (Transmitter Power Output/Tune Power)

This control adjusts the percentage of maximum power that will be available when transmitting. The **Drive** control may be adjusted while either receiving or transmitting.

Note: The control doubles in function as the power level setting for the **TUN** (Tune) button described above. The Tune power may be adjusted while the **TUN** button is activated or by using the control on the Setup Form-Transmit Tab.

While great care is taken to ensure that this value is accurate and that selecting a **Drive** value will give approximately that amount when using the 5W PA, there are variances in the filter components and transmitter characteristics that make it difficult for this to be exactly right over the whole range (1-100).

(23) AGC (Automatic Gain Control)

This control sets the Automatic Gain to one of the following settings: Fixd (Fixed or off), Long, Slow, Med (Medium), Fast, or Custom. The Custom setting uses the controls on the Setup Form-DSP Tab, AGC/ALC Sub-Tab (page 128), where also a more expansive explanation of the AGC can be found.

(24) Preamp

The five preamp gain settings range from -10 dB to +30 dB in 10 dB increments. These gain settings are created through the combination of a 20 dB preamp and an adjustable IF gain, as shown in Table 9. This table also lists for each gain setting the signal level at which the receiver becomes overloaded, as well as the bands on which it would be typically used.

Table 9: Preamp Details

Preamp Setting	Preamp (20 dB)	IF Gain (dB)	RX Overload (dBm)	Typical Usage
-10	Off	-10	0	(see Note 1 below)
0	Off	0	-10	160 thru 20 meters
+10	On	-10	-20	17 and 15 meters
+20	On	0	-30	12 and 10 meters
+30	On	+10	-40	6 meters

Note 1: The -10 setting should only be necessary if in the presence of extremely strong signals. In this position, receiver overload will not occur until S-9 plus 73 dB.

Note 2: In an unusually noisy or high signal location, you may want to reduce the preamp setting by one step. In an unusually quiet location, you may want to increase the preamp setting by one step.

(25) SQL (Squelch)



Figure 60: Squelch Controls

The **SQL** button enables the Squelch function. The threshold can be set with the slider and its value (in dBm) is displayed numerically. The bar graph displays in green the signal level below the threshold (squelch closed) and in red above the threshold (squelch open: only the red level is audible with **SQL** enabled). Squelch can be very useful to remove all noise from CW signals, especially in narrow filter settings.

(26) Antenna Selection Display

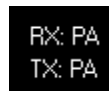


Figure 61: Antenna Selection Display

The antenna selection display can be a helpful reminder of which antenna/transceiver ports are selected for the receiver and the transmitter. These ports are selected using the Antenna Form, described on page 95.

(27) Date/Time Display

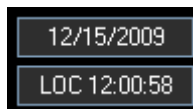


Figure 62: Date/Time Display

The date and time display can be especially helpful when taking screenshots, but can also be a quick reference to UTC time for those of us who are "time zone challenged." Click inside the Date or Time area to cycle between *LOC* (Local Time), *UTC* (UTC Time), and *Off* .

(28) Setup Form

The Setup Form contains numerous controls for everything from the hardware configuration to transmit settings. Please refer to the Setup Form chapter on page 99 for more detailed information.

(29) – (35) Operating Forms

Each of these items opens a form, which is used while operating. Please refer to page 79 for more detailed information on each one.

Operating Forms

This chapter describes each of the so-called operating forms. You can access each form individually by clicking on the relevant menu item to the right of **Setup** at the top left of the Front Console (see Figure 63). For ease of reference, the numerical identifiers from the previous chapter on the Front Console are repeated in this chapter. Additionally, the key combination Ctrl-Shift-I activates the voltage and temperature form (see page Error: Reference source not found).

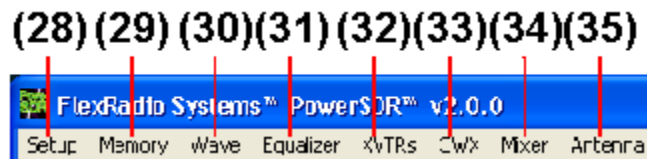


Figure 63: Operating Form Identifiers

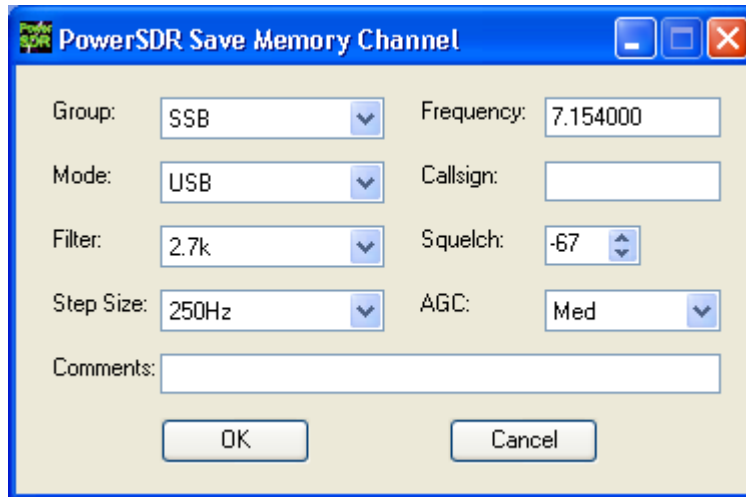
[The rest of this page has been left blank intentionally]

(29) Memory Form

Click the **Memory** menu to save and recall information such as frequency, mode, filter and various other settings.

Save...

Opens the Save Memory Channel form as shown in the figure below.



Group:	SSB	Frequency:	7.154000
Mode:	USB	Callsign:	
Filter:	2.7k	Squelch:	-67
Step Size:	250Hz	AGC:	Med
Comments:			

Figure 64: Save Memory Channel Form

The current **Mode**, **Filter**, **Step Size**, **Frequency**, **Squelch** and **AGC** settings are automatically transferred from the console. The **Group** Drop Down Box allows a further level of characterization of the type of entry. In the future this Group list will be customizable. The **Callsign** and **Comments** details can be entered by the user as desired. Clicking the **OK** button will save the information shown above into the memory database before closing the form. Clicking **Cancel** simply closes the form (the data is not saved).

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Recall...

Presents the user with a Memory form with data from all previously stored memory locations (shown in the figure below).

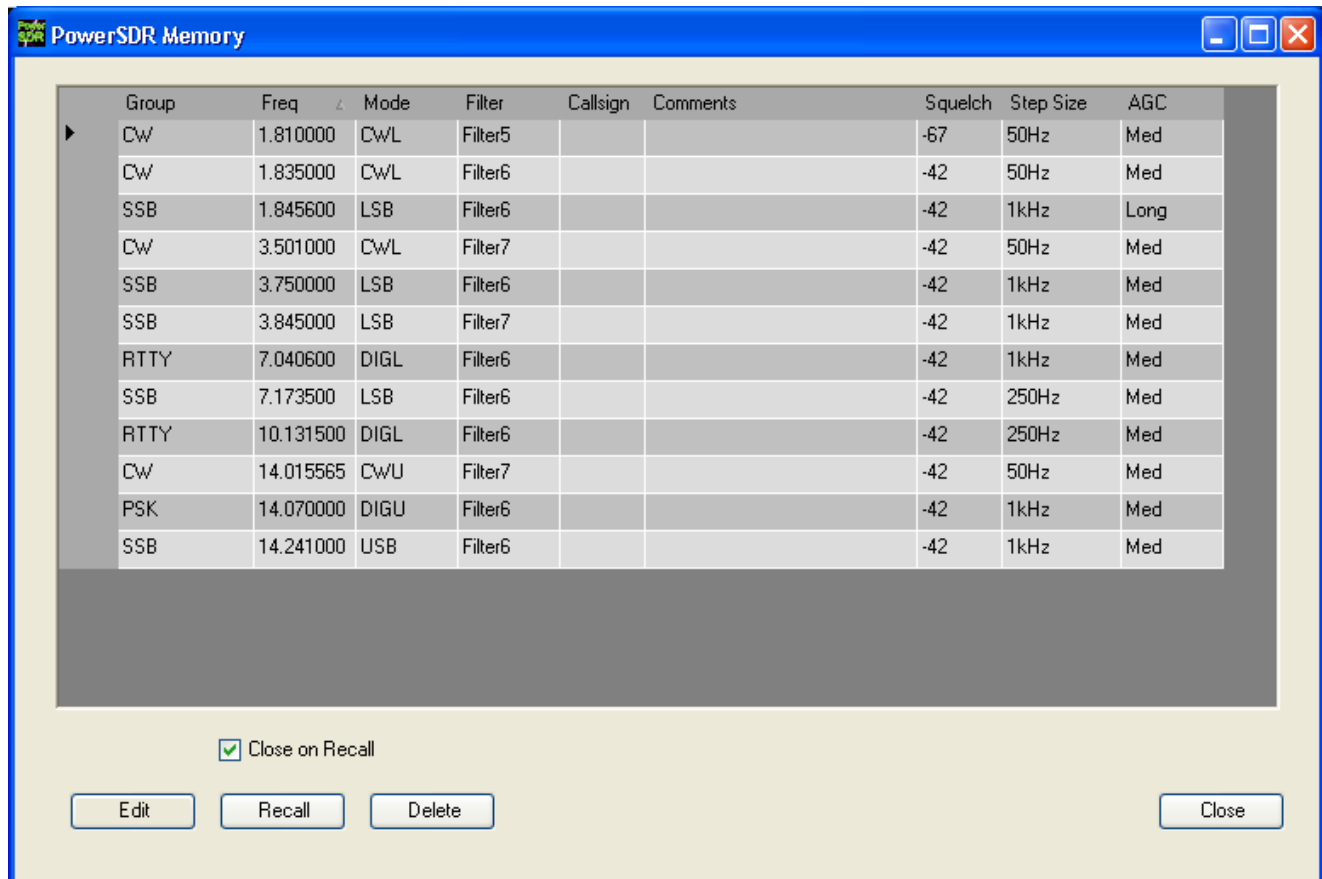


Figure 65: Memory Form

The data grid displays each memory that has been saved to the database. Clicking in the left hand margin will allow a particular memory to be selected. Clicking on the column titles will sort the data using the information in that column. Repeatedly clicking will alternate between ascending and descending order as indicated by the small arrowhead in the column title.

- ❑ **Edit:** Clicking **Edit** causes all fields in all records to become editable. Thus to change Group, e.g., in two different entries you would click **Edit**, then click on the Group field of the first entry to be changed, alter the contents and then click on the Group field of the second entry and alter it. When done, click the **Edit** button again to stop the editing process. When you click the **Close** button your work will be saved.
- ❑ **Recall:** Click the Recall button to send the data in the memory to the Front Console (i.e., restore a memory). You can also double-click on a row to accomplish this. Select **Close on Recall** to close the Memory Form when clicking **Recall**.
- ❑ **Delete:** Click the Delete button to remove a memory from the database. A prompt will be shown to prevent unintended loss of memories.

(30) Wave Form

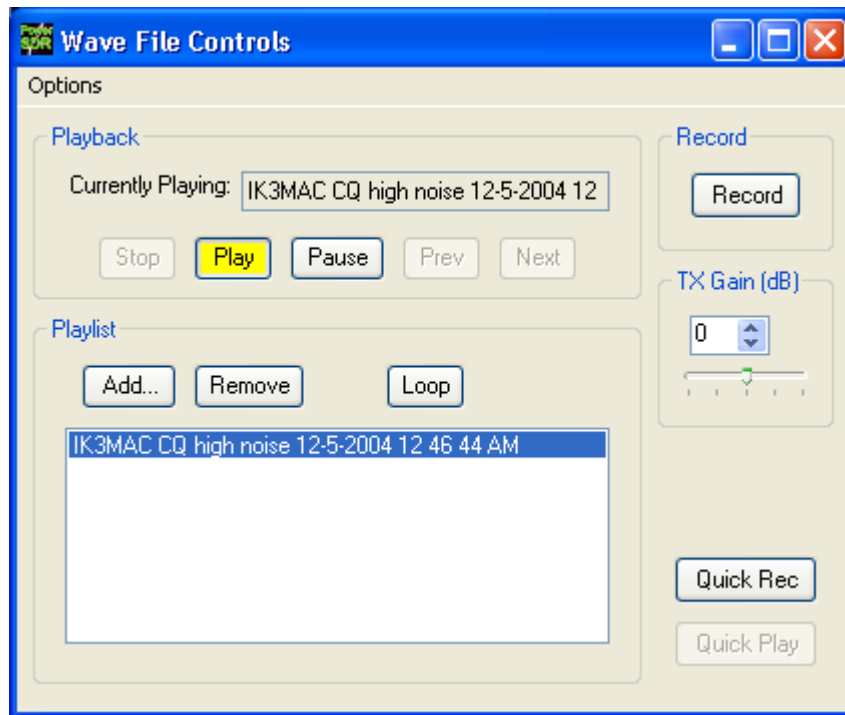


Figure 66: Wave Form

The Wave form allows the user to Record and Playback either the post-processed audio (see page 84) of the current station, or the complete (36 kHz) receiver bandwidth of pre-processed IF (I and Q) "audio" (see page 84) from the FLEX-1500.

Note:

The recorded audio is always played back through PowerSDR. So if you record pre-processed audio and play it back with PowerSDR set to *Receive* you will see all the signals within the 36 kHz bandwidth and be able to tune them, filter them etc, as if you were actually receiving those signals. If on the other hand you record post-processed audio and play it back with PowerSDR set to *Transmit* you will be transmitting the audio you received and recorded.

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Playback

- ❑ **Currently Playing:** Displays the filename of the currently playing wave file.
- ❑ **Play:** Click this button to start or stop playback of the current wave file. Note that clicking this button twice while a file is playing will restart the file.
- ❑ **Pause:** Pauses the wave file playback. Click once to pause and again to resume playback.
- ❑ **Prev (Previous):** When there is more than one file in the playlist, clicking this button will cause the previous file in the list to begin playing.
- ❑ **Next:** When there is more than one file in the playlist, clicking this button will cause the next file in the list to begin playing.

Playlist

- ❑ **Add...:** Click this button to open a file menu to select wave file(s) to add to the playlist. Note that incompatible wave files will be removed from the list when they are played for the first time.
- ❑ **Remove:** Removes the currently selected file in the playlist. If the file is currently being played, then you will be prompted if you would like to stop playing the file and remove it from the list.
- ❑ **Loop:** When there is more than one file in the playlist, enabling this option allows playback to continue after finishing the last wave file in the list. At this point it will start playing the file at the top of the list.

Record

Click the **Record** button to begin recording a wave file. Click it again to complete the recording. The wave file will be date and time stamped automatically and saved in your %appdata%\FlexRadio Systems\PowerSDR v2.n.n\ folder. The exact location of your %APPDATA% folder depends on your operating system (Windows XP, Vista or 7, see the notes under **Record (○) and Play (▶)** on page 76).

TX Gain (dB)

Use this control to adjust the volume of audio being played back when transmitting. Use this control instead of the **MIC** control on the front console to calibrate transmit (adjust for 0 dB on the ALC meter).

Quick Rec and Quick Play

The **Quick Rec** and **Quick Play** buttons offer a quick and easy way to record and play back a signal audible on the receiver. Click **Quick Rec** to record a signal and click **Quick Rec** again to stop recording. Once recorded, the signal can be played back by clicking **Quick Play**. Subsequently clicking **Quick Rec** will overwrite any audio file previously recorded in this way. These two buttons perform the same function as the **Record (○) and Play (▶)** buttons on the Front Console (see page 76).

Record Options

Click **Options** at the top of the Wave Form (see Figure 66) to open the following form:



Figure 67: Wave Recording Options

The Wave Record Options can be used to modify what is recorded in either receive or transmit modes.

Receive

- ❑ **Pre-Processed Audio** will record the whole bandwidth of the receiver input. This is useful for playing back through PowerSDR at a later time (e.g. for demonstration purposes).
- ❑ **Post-Processed Audio** will record only the filtered, AGCed audio as you hear it coming out of the speaker. This is useful for playing back the received audio through a typical wav file player (not a part of PowerSDR).

Transmit

- ❑ **Pre-Processed Audio** will capture the audio as it is seen at the microphone input without any of the effects of filtering, compression, companding, equalization or any other audio processing features that may be turned on in the transmit chain.
- ❑ **Post-Processed Audio** allows the recording to capture the audio after it has been filtered, compressed, companded, equalized or modified by any other audio processing feature turned on in the transmit chain.

Sample Rate

Sets the sample rate at which the wave file will be recorded.

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(31) Equalizer Form

There are two equalizers available: a 3-band and a 10-band equalizer. These equalizers tailor the shape of the passband of an audio channel, much the same as the *treble* and *bass* controls do on an ordinary radio. The equalizers may be enabled either from the Equalizer Form or in the phone modes, from the Front Console (see page 63).

3-Band Equalizer

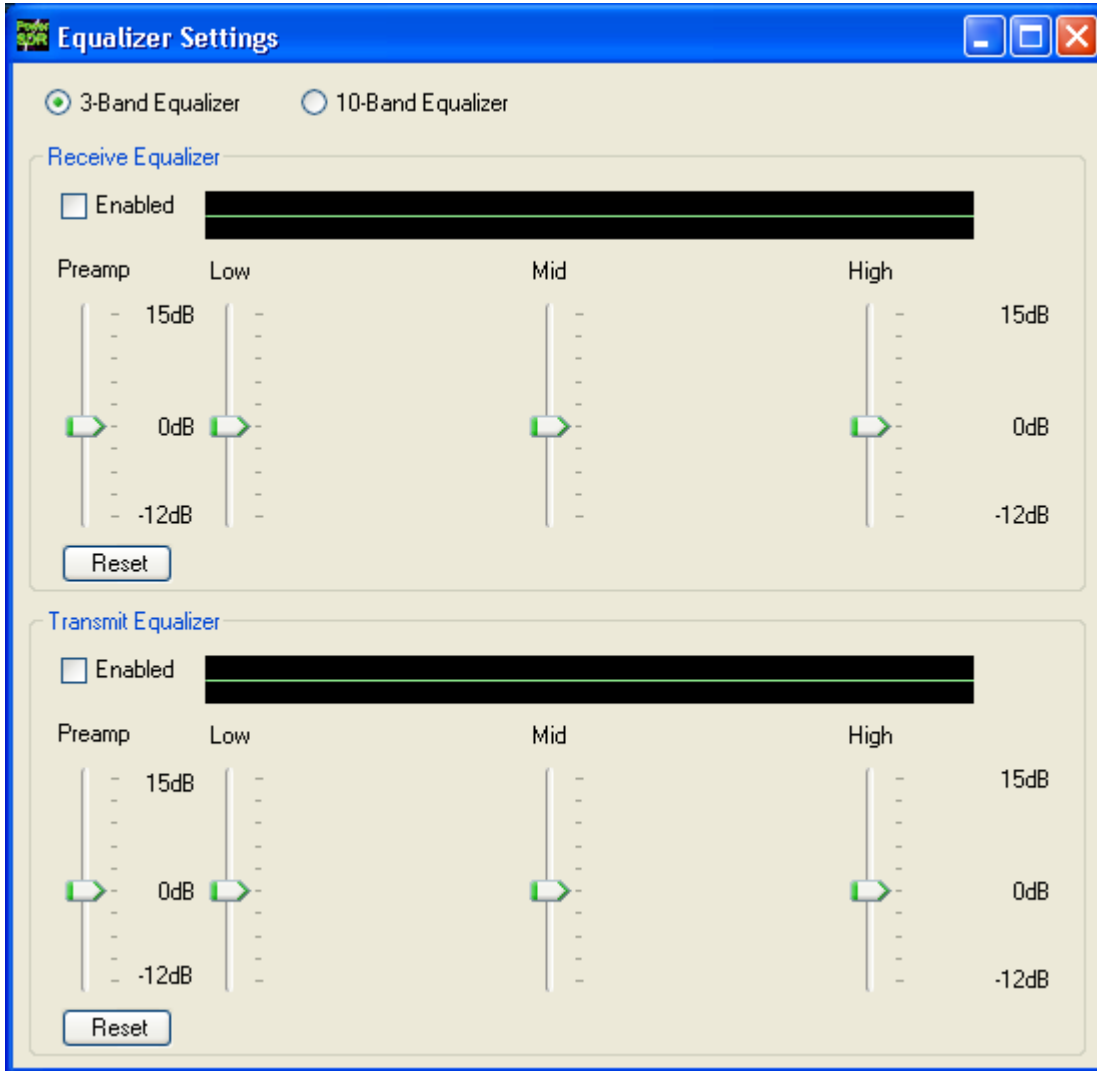


Figure 68: Three-Band Equalizer Form

In most situations the 3-Band Equalizer will suffice. The receive and/or transmit audio can be modified by adjusting the gain for the **Low**, **Mid** and **High** audio bands. The **Preamp** applies gain across the whole audio spectrum. Easily compare the audio with and without the equalizer using the **Enabled** check box. The **Reset** button will reset all of the sliders to the 0 dB position.

Hint: Hover with your mouse over a slider to see its frequency range of operation.

10-Band Equalizer

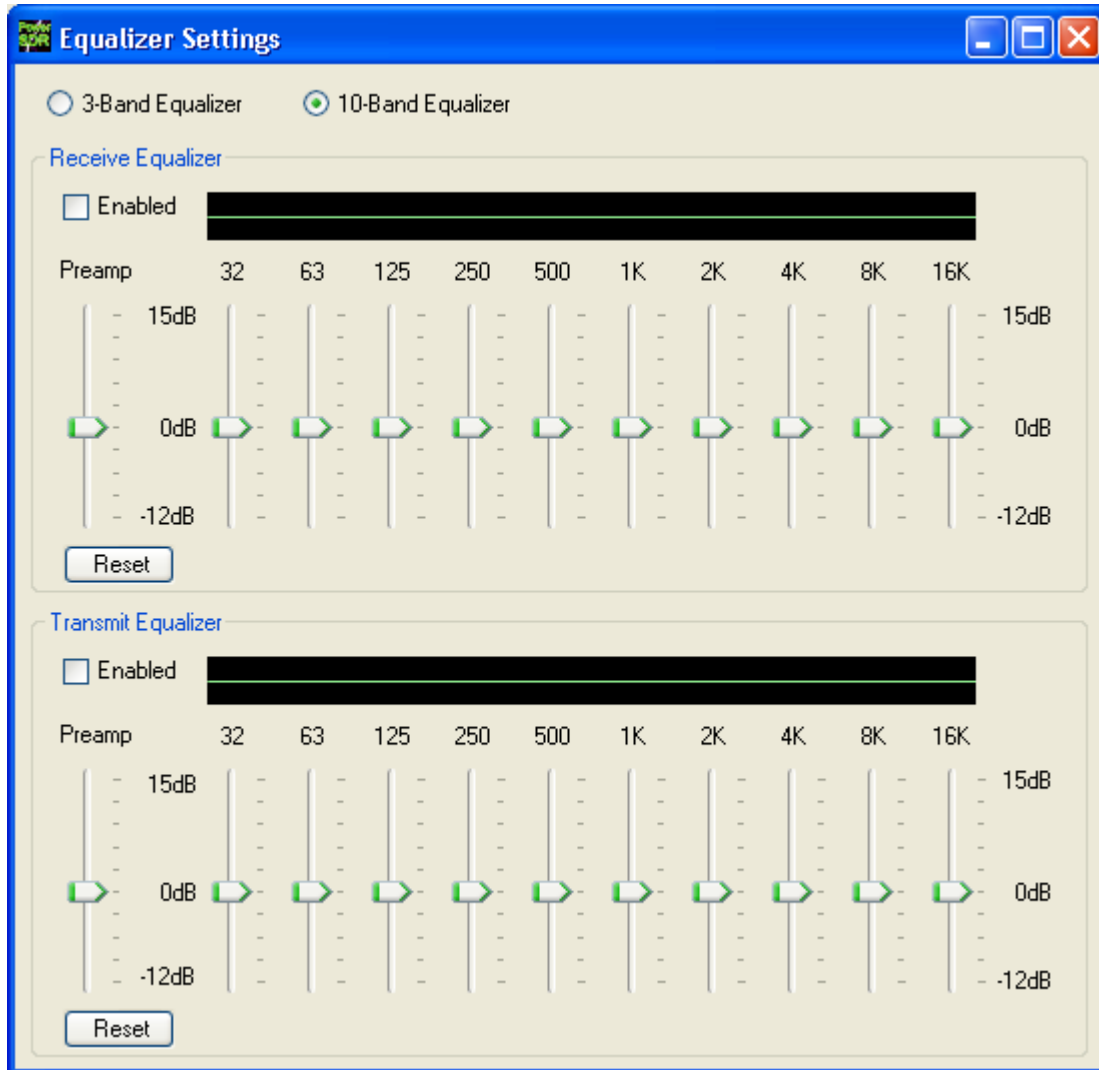


Figure 69: Ten-Band Equalizer Form

The 10-Band Equalizer offers a finer degree of audio frequency control than does the 3-band equalizer. You may want to use this equalizer if the 3-band equalizer does not give you the result you want.

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(32) XVTRs Form

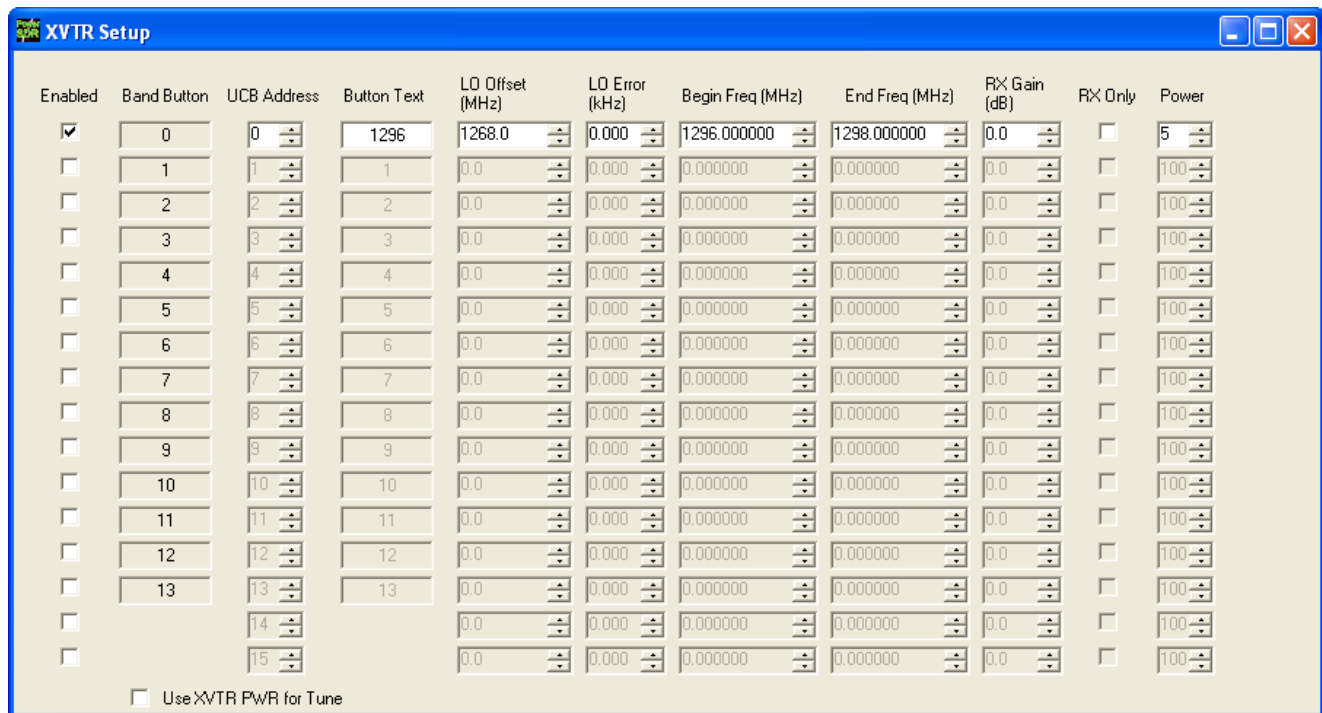


Figure 70: XVTR Setup Form

The XVTR (transverters) Setup Form allows the user to configure up to 16 external transverters for use with the PowerSDR software.

- Enabled:** Enables that particular Band Button on the front console with the options selected.
- Band Button:** Band button to use for the particular transverter that is being configured.
- UCB Address:** Used to set the FlexWire to switch the correct external device (or a relay that controls the external device).
- Button Text:** The text that will be shown on the Band Button.
- LO Offset (MHz):** The difference between the transverter low frequency and the IF frequency. For example, on 2m, you might use 144-28 MHz = 116.0.
- LO Error (kHz):** This setting allows the user to correct for any error in the transverter’s oscillator.
- Begin Frequency (MHz):** The lower frequency bound of the transverter.
- End Frequency (MHz):** The upper frequency bound of the transverter.
- RX Gain (dB):** Amount of gain to apply to the incoming signals to compensate for gain within the transverter. *Please note that this is still in development.*

- ❑ **RX Only:** If this box is checked, the radio will not transmit while in this configured band.
- ❑ **Power:** Sets the **Drive** control on the front console to this value whenever the VFO is within the configured band.
- ❑ **Use XVTR PWR for Tune:** When you click the **TUN** button on the Front Console the power will be set to the value you enter in the **Power** control on this form (see above). Otherwise, the Tune Power setting on the Setup Form – Transmit Tab (page 130) will be used.

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(33) CWX Form

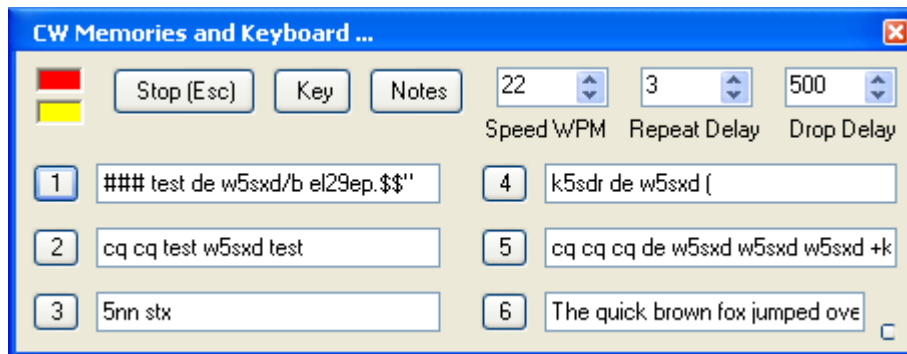


Figure 71: Standard CWX Form

The CWX form is designed to allow you to control automatic Morse code transmission and to send code from your computer keyboard. Pressing the **CWX** button on the main console menu opens this form. The radio must be in either **CWL** or **CWU** mode for transmission to take place.

Standard CWX Controls

- ❑ **Red Indicator:** The small red indicator shows when the radio is transmitting.
- ❑ **Yellow Indicator:** The yellow indicator shows when the key is being *pressed* by the program.
- ❑ **Key:** Clicking this button will cause the radio to start transmitting a steady carrier for up to one minute. Clicking **Key** again will stop the steady sending.
- ❑ **Stop (ESC):** Clicking this button or pressing the **Esc** key on your keyboard will terminate most functions and prepare the program to receive new orders or allow the iambic paddle to be used.
- ❑ **Notes:** Clicking this button will cause a small page of useful notes to be displayed. You can leave the notes up on the screen while you continue to work.
- ❑ **Speed WPM:** This control lets you set the speed of the Morse code being sent. The speed is computed using the standard PARIS method. The softness of the edges may be set by the **RAMP** control on the **Setup Form - DSP Tab, Keyer Sub-Tab**. The weighting is always 50% for the memory/keyboard keyer.

Note: This setting is separate from the control on the front console.

- ❑ **Repeat Delay:** This control specifies the amount of time that the keyer will wait when a special pause character is encountered.
- ❑ **Drop Delay:** This control specifies the amount of time that the semi-break in keying will wait before dropping the transmitter when there is no keying occurring.

CWX Memories

There are nine CWX memories, three of which are hidden on the extended form to the right (see Figure 72 below). Each memory can hold thousands of characters and is displayed in a standard single line text box. The numbered buttons to the left of each memory box may be clicked to start the message. A message may be stopped at any time by clicking the **Stop (Esc)** button or pressing the **Esc** key. Starting a message will seamlessly stop any current message or other automatically keyed transmissions from the radio, including the iambic paddle. The keyer will start the transmitter and send the Morse code for each character until the message ends, at which time the transmitter will stop. Messages may be edited at any time but the changes will not take place until the memory is started again.

Special Characters

There are several predefined characters that provide non-Morse code functionality or to send familiar combinations like AR and SK (see Table 10 below). For beacon transmissions, the character # will send a long 23 element time dash comparable to a zero, with the key down the whole time. Multiple # characters can be strung together for longer continuous dashes. The \$ character works in a similar manner but generates a long 23 element time space. The *or ditto* character may be placed at the end of a message. When encountered, the keyer will shut down for the delay time set in the **Repeat Delay** control and then restart the message. This allows you to program a CQ and then listen for a reply with the radio back in receive. If the delay is set to zero then the message will simply repeat without the radio switching to receive. Six special combinations are preprogrammed, as shown in Table 10.

Table 10: Overview of Special Characters

Special Character	Action
#	Beacon - transmits 23 element "zero" time dash
\$	Beacon - transmits 23 element time "space"
+	AR (. - . - .)
(KN (- . - - .)
*	SK (... - . -)
!	SN (... - .)
=	BT (- ... -)
\	BK (- ... - . -)
& `) : ; < > [] ^	User definable, up to any combination of 9 contiguous dots or dashes

The remaining special characters & `) : ; < > [] and ^ are undefined and may be user defined to produce any combination of nine contiguous dots and dashes (see **Morse Definition Editor** on page 92). Characters that are undefined have no dots and dashes and are simply sent as a space.

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Keyboard and Extended Controls

Click the little square button in the lower right corner of the form to expand it. When you do this, the remainder of the memories and controls will be visible including the keyboard window as shown below.

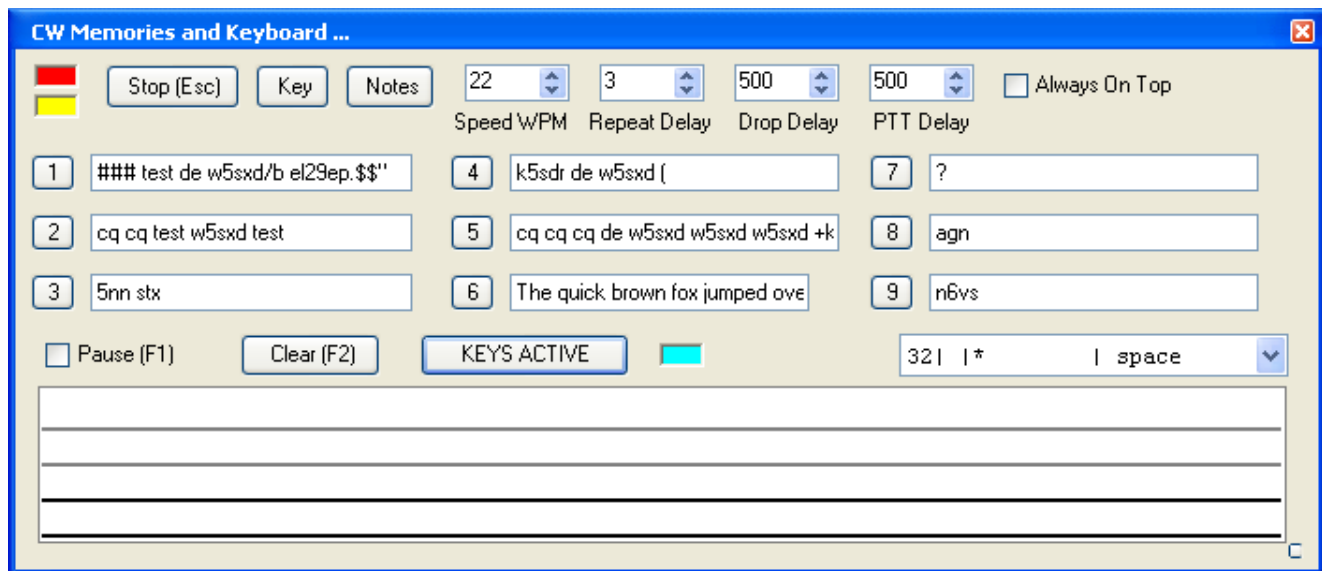


Figure 72: Extended CWX Form

Extended CWX Controls

- ❑ Keyboard area: the four-line text box at the bottom. Unsent characters are shown in black and sent characters in gray.
- ❑ **Keyboard/KEYS ACTIVE/KEYS OFF.** This button has three labels:
 - At first use, the button is labeled **Keyboard**, the indicator is grayed out and the keyboard cannot be used to enter characters.
 - When clicked it changes to **KEYS ACTIVE** and the indicator shows cyan. The keyboard can now be used to enter characters at the end of the unsent area. As soon as a character is typed it will be sent and then moved to the unsent area. If you type faster than the code is being sent, it will be buffered in the bottom area.
 - The **Backspace** key will work in the unsent area.
 - Other editing keys like cut and paste are not implemented.
 - Pressing **Alt 1** to **Alt 9** or right clicking the message number button will cause the numbered message memory to be copied into the unsent area just as if you had typed it.
 - The *or ditto* character is ignored in the keyboard mode.

- Clicking **Clear(F2)** (see below) deactivates the keyboard, changes the **KEYS ACTIVE** button to **KEYS OFF** and the indicator shows black. Clicking **KEYS OFF** reactivates the keyboard, changing the label to **KEYS ACTIVE** again and the indicator to cyan.
- **Pause (F1):** Clicking this button or pressing the **F1** key will cause keyboard buffer sending to pause.
- **Clear (F2):** Clicking this button or pressing the **F2** key will clear the keyboard area, stop it sending and deactivate the keyboard (**KEYS ACTIVE** button changes to **KEYS OFF** and indicator changes to black). Of course, the **Stop (Esc)** button or the **Esc** key will do the same.
- **PTT Delay:** This control allows you to set the time delay between switching the radio to transmit and the first key closure.
- **Always On Top:** Check to keep this form always on top of any other windows that may be open.

Morse Definition Editor

The Morse definition editor allows you to define and even redefine almost all of the characters in the sixty-four-character set. The drop-down box on the right lets you view and select any of the characters in the set. Each one is displayed as four fixed width fields separated by the | character. There are five special control characters that you may not change and they have an * in the element field.

Once you have selected the character that you wish to edit, left click to select and then right click to bring up the editor dialog.

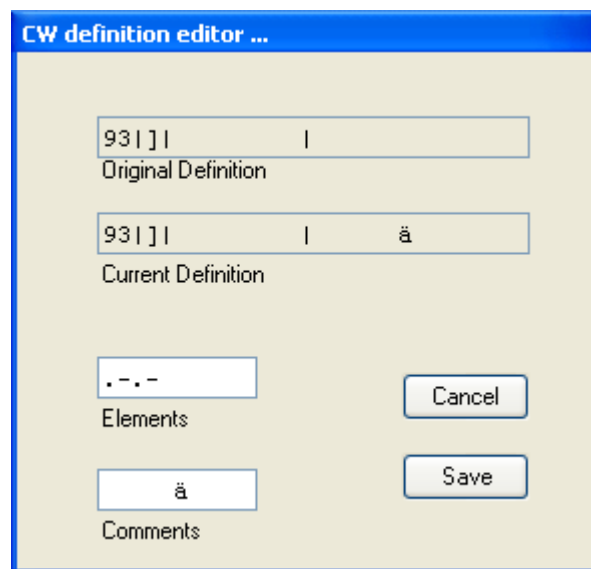


Figure 73: CW Definition Editor

The editor dialog example above shows the `|` character being changed to send didahdidah which is the German code for **ä** (umlaut a). When your definition appears to be correct, click the **Save** button and the definition file will be resaved to the disk.

- ❑ The definition file is called **morsedef.txt** and can be found in the `%APPDATA%` directory, which varies by operating system. To find this directory, see the notes under **Record (○) and Play (▶)** on page 76).
- ❑ The **morsedef.txt** file can be manually edited with a simple character editor like notepad (not Word), but the format must be followed *exactly*. Each line must be 26 characters long, not including the two end-of-line codes. It is not free-formatted. The line structure is: a two-digit number field (the decimal ASCII code) | a one-character code field | a nine character elements field | a ten-character comment field preceded by a space and followed by a carriage return and linefeed code. If you mess this file up too badly, simply close PowerSDR, delete **morsedef.txt**, and a clean, default copy will be created the next time you start PowerSDR and click **CWX**. The editor makes simple changes relatively easy to do.

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(34) Mixer

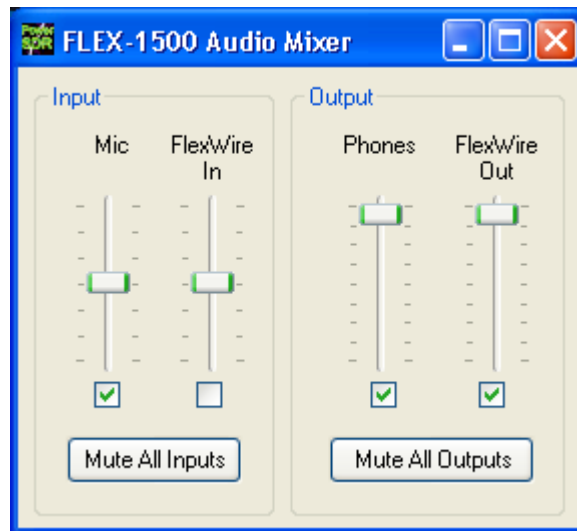


Figure 74: Audio Mixer Form

The Mixer controls the audio lines into and out of the FLEX-1500. In essence it is no different than the usual Windows sound card mixer.

Input

The FLEX-1500 has two possible sources of input audio. These are the **MIC** connector on the Front Panel and the **FlexWire In** (pin# 2 of the FlexWire connector) on the Back Panel. Check to select the desired input source (only one may be selected at a time) and adjust its signal level with the corresponding slider. Click **Mute All Inputs** to mute all the inputs.

Output

There are two possible audio outputs. These are the Front Panel **Phones** connector and on the Back Panel the **FlexWire Out** (pin# 9 of the FlexWire connector). More than one output can be selected at a time. Check to select the output and adjust its level with the slider. Click on **Mute All Outputs** to mute all the outputs.

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(35) Antenna

The Antenna Selection Form offers two selection modes:

- ❑ **Simple** uses the same antenna ports and FlexWire PTT Out setting for all bands. Antenna and transceiver ports can be selected for both the receiver and the transmitter, but they will remain the same for all bands. This is the recommended setting if you use only one antenna/transceiver.
- ❑ **Expert** allows you to customize antenna ports and FlexWire PTT Out setting for each band.

WARNING! Make sure you have a 50 ohm load connected to the Transmit antenna/transceiver port you selected. Failing to do so may damage your radio and void your warranty.

WARNING! Do not switch the transmit antenna while transmitting (hot switching). You could damage your radio and void your warranty.

Note: If you switch from the **Expert** to the **Simple** mode your Expert settings will be remembered should you decide to change back.

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Simple

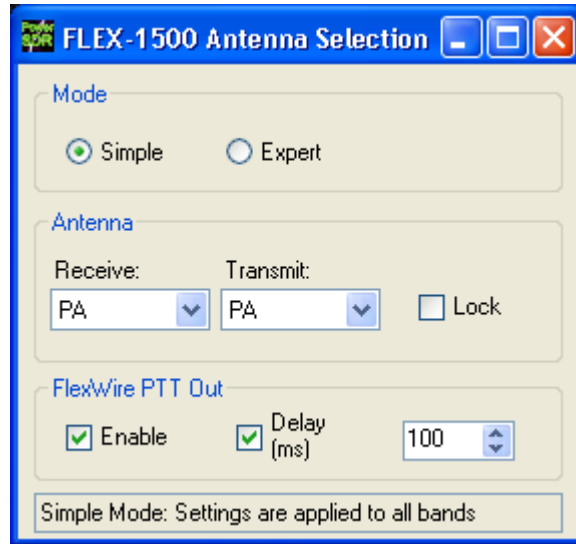


Figure 75: Antenna Selection Form - Simple

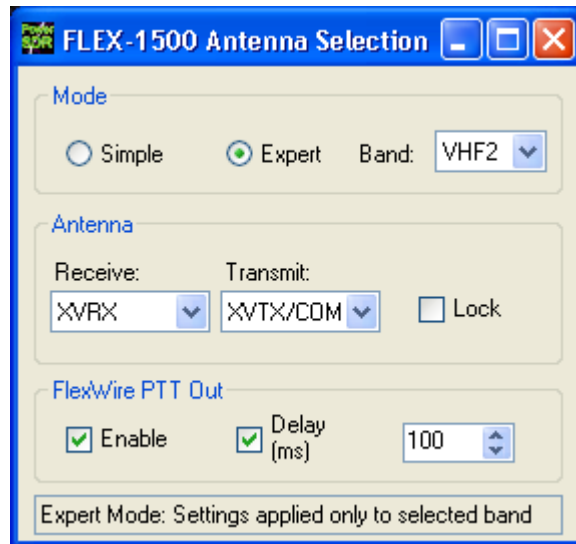
The following selections are possible:

- ❑ **Receive:** PA, XVTX/COM, XVRX
- ❑ **Transmit:** PA, XVTX/COM
- ❑ **Lock:** Check to lock the antenna selections for Receive to Transmit. Any change you make in one will be followed by the other.
- ❑ **FlexWire PTT Out:** Click **Enable** to activate and for sequenced switching, click **Delay** and set the delay in ms.

Close the Antenna Form when you are done.

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Expert



The screenshot shows the 'FLEX-1500 Antenna Selection' dialog box. It has a blue title bar with standard window controls. The 'Mode' section has two radio buttons: 'Simple' (unselected) and 'Expert' (selected). To the right is a 'Band:' dropdown menu set to 'VHF2'. The 'Antenna' section has 'Receive:' and 'Transmit:' dropdown menus, both set to 'XVRX' and 'XVTX/COM' respectively, and a 'Lock' checkbox which is unchecked. The 'FlexWire PTT Out' section has two checked checkboxes: 'Enable' and 'Delay (ms)', with a spinner box set to '100'. At the bottom, a text box reads 'Expert Mode: Settings applied only to selected band'.

Figure 76: Antenna Selection Form - Expert

In addition to the selections discussed for the **Simple** complexity level, the **Expert** level offers the **Band** control. For each band, set the various controls as desired and these settings will automatically be enabled when operating on that band. The Band selections available include all the HF bands as well as 14 VHF bands, which are configured with the XVTR Form (see page 87).

Hint:

To quickly set the various controls, make the selections first for the Simple complexity level. Then switch to Expert and adjust where necessary for those bands that need adjustment from the original settings.

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Setup Form

The Setup Form contains a vast assortment of controls and settings from hardware setup to detailed DSP options. These controls are available on Tabs of the Form. Due to space concerns, several of the Tabs (e.g. General, Audio and DSP) have been split into Sub-Tabs. Take care when changing the controls to pay attention which Tab (and Sub-Tab) you are on.

Along the bottom of the Setup Form are six global buttons. These are:

- ❑ **Reset Database:** This displays the warning shown in Figure 77. Click **No** to avoid resetting the database. Click **Yes** to reset the database, which entails closing PowerSDR, copying the database file `database.xml` to your desktop and deleting it from its current location. The next time you start-up PowerSDR it will automatically create a new, clean database and read the EEPROM data from your FLEX-1500 to the database. The copy of the database on your desktop is an xml-file named `PowerSDR_database_[date]_[time].xml`.

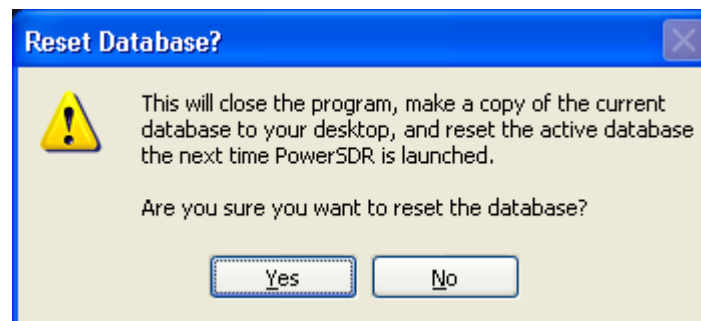


Figure 77: Reset Database Warning

- ❑ **Import Database:** To import a database, click this button and then browse to the directory of the database to import. Double click the xml database file to be imported and PowerSDR will attempt to import all the settings. A confirmation message will let you know if the import was successful.
- ❑ **Export Database:** This will export a copy of your database to a location of your choosing.
- ❑ **OK:** Saves the current values to the database and closes the form.
- ❑ **Cancel:** Reloads the values from the database into the Setup Form and closes the form. This button can be used to reverse unintended changes to the Setup controls.
- ❑ **Apply:** Immediately saves the current values to the database.

General Tab

Hardware Config Sub-Tab

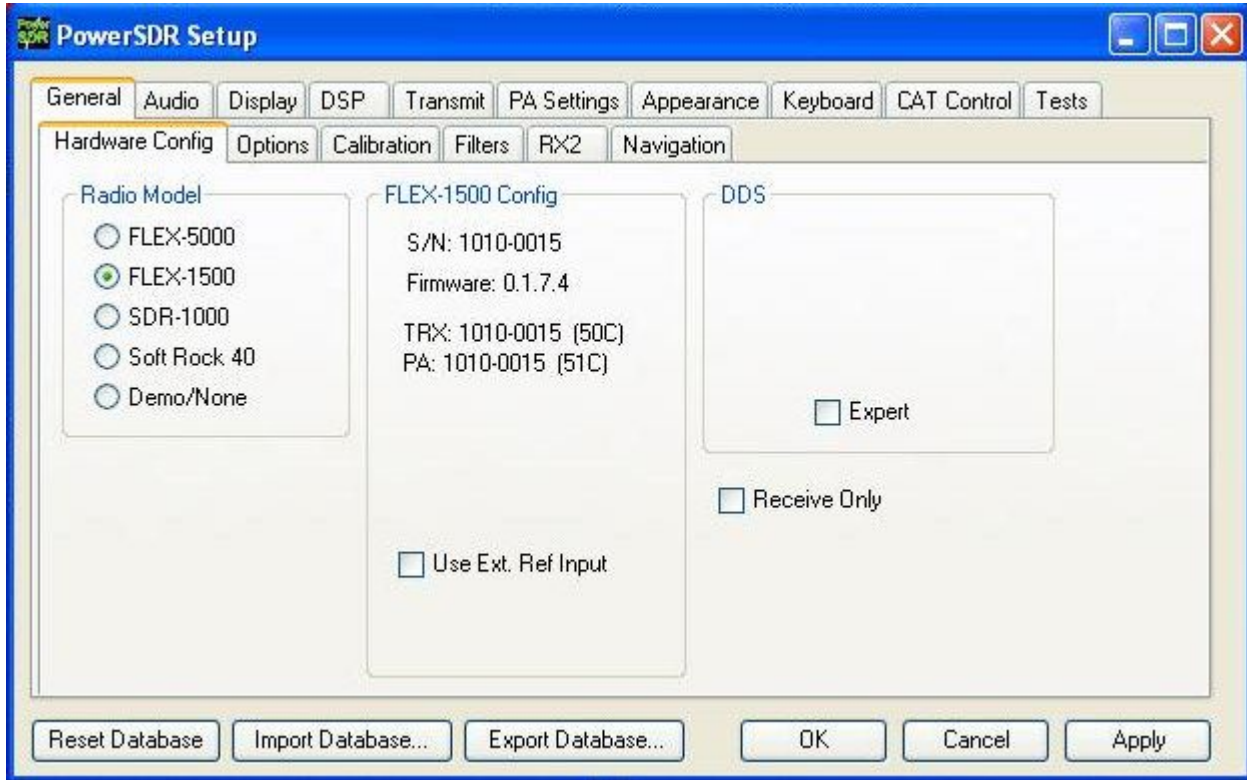


Figure 78: Setup Form - General Tab, Hardware Config Sub-Tab

Radio Model

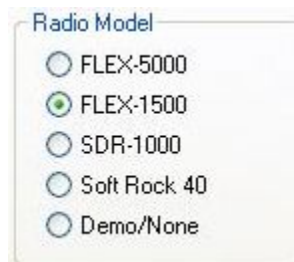


Figure 79: Radio Model Selection

Use this selection to choose the hardware (if any) that is connected to the computer running the PowerSDR software.

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FLEX-1500 Config

With the FLEX-1500 selected as the radio model, this section lists the serial numbers of your FLEX-1500, installed Firmware version and the installed hardware boards of your radio.

Use Ext. Ref Input: Check this box if you have an external reference oscillator connected to the 10 MHz Ref In port on the back panel (see (1) in Figure 4 on page 6).

Note: If you check **Use Ext. Ref Input**, but fail to physically connect an external reference to the radio's **Ref In** port, the radio will appear to be deaf.

Receive Only

Check this box to use only the receiver, while disabling the transmitter. When checked, MOX and TUN will become unavailable on the Front Console and PTT (either via the MIC connector or pin#4 of the back panel FlexWire I/O connector) will also not function.

DDS

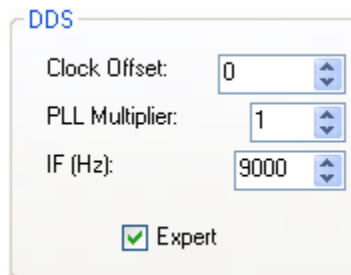


Figure 80: DDS

To reveal the **Clock Offset** and the **IF** controls (Figure 80), check **Expert**. This will show a warning; click **Yes** to proceed.

DDS Stands for Direct Digital Synthesis. The DDS chip in the FLEX-1500 produces an analog sine wave at up to micro Hertz resolution. The DDS is used as a local oscillator to tune the radio. Normally there will be no need to adjust the oscillator and the controls are hidden.

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- **Clock Offset:** Allows software corrections to be made manually if the DDS clock oscillator is not running at exactly 500 MHz. Changing the clock offset will change the frequency calibration of your radio. Typically there will be no need to do so as the radio has been completely factory calibrated. However, as the radio ages, the oscillator frequency may change slightly.
 - To adjust the frequency calibration of your radio, first use the automatic Frequency Calibration controls described on page 106.
 - The Clock Offset can also be calculated as follows. Divide the DDS frequency (384 MHz) by the known signal frequency (say, 10 MHz WWV) and then multiply by the difference between the known and the measured frequency. For example, say you tune the VFO to 10 MHz and the peak shows up at 9.999700 MHz (difference is $10.0 - 9.999700 = +300$ Hz). The Clock Offset would be $384/10 * 300 = 11520$. Plugging in 11520 into the Clock Offset control should zero beat the signal. Note that if the measured frequency were 10.000300 MHz, the offset would be -11520. Fine adjustments may be made directly on the **Clock Offset** control using the phase display as described above.

Note: Any adjustments you make are saved to your database only and not to the radio's EEPROM. Therefore, if you start PowerSDR with a clean database, you will lose these adjustments.

- **IF (Hz):** Controls the **I**ntermediate **F**requency used in the software to avoid low frequency noise. The default value is 5,000 Hz and can be varied between 0 and 20,000 Hz. Normally there will be no need to adjust this. However, if you are experiencing low frequency noise, such as spurs that cannot be eliminated with the Spur Reduction (**SR**) enabled, you might try adjusting the IF.

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Options Sub-Tab

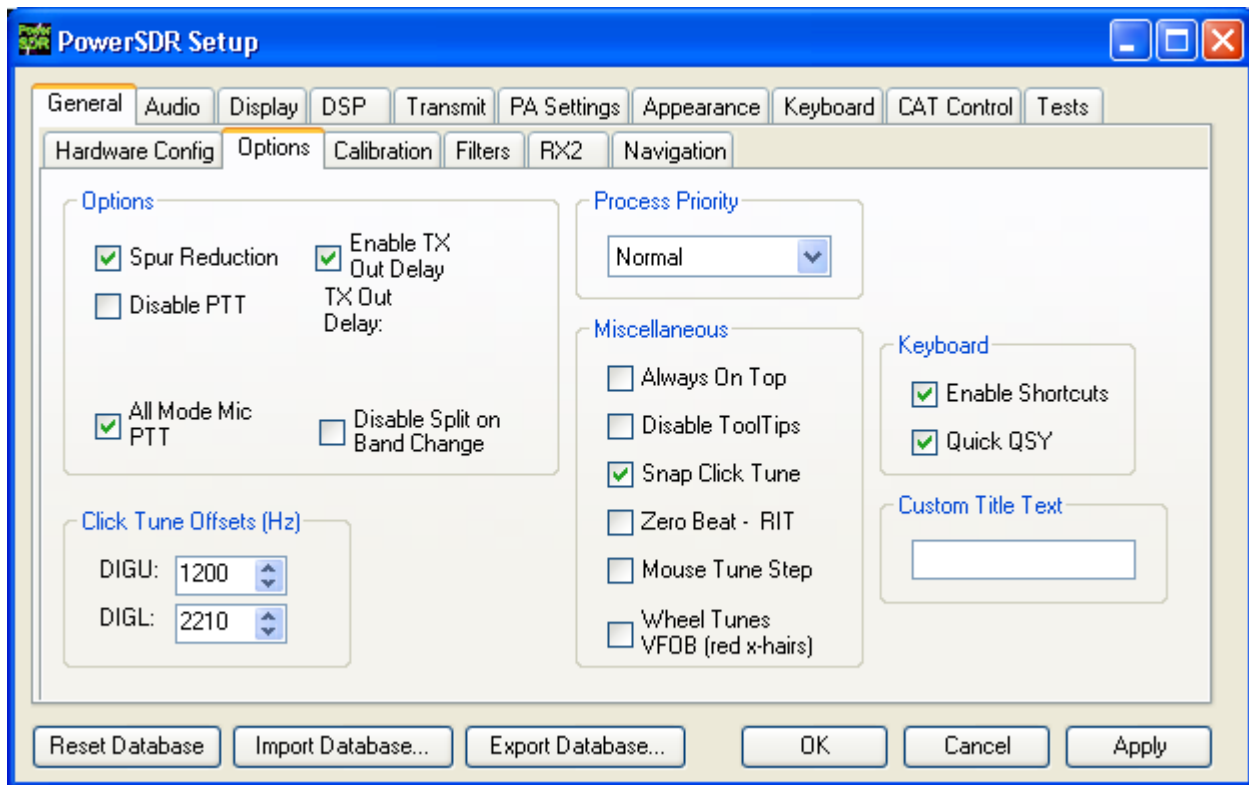


Figure 81: Setup Form - General Tab, Options Sub-Tab

Options

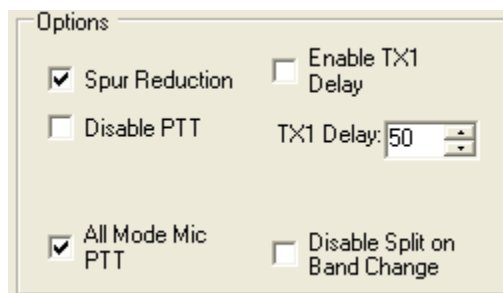


Figure 82: Options

- ❑ **Spur Reduction:** Enables a software oscillator to avoid DDS frequencies known to have a higher phase truncation related spurious response. In short, rather than tuning each frequency using the DDS (this is what happens when this option is turned off), PowerSDR tunes the DDS in 3 kHz steps and the software oscillator does the frequency fine-tuning. Tuning in 3 kHz steps also has the advantage of having to send fewer command signals to the hardware.
- ❑ **Disable PTT:** Disables the ability to use external Push-To-Talk lines (MIC connector and FlexWire I/O pin# 4) to key the radio.

- ❑ **All Mode Mic PTT:** When checked, PTT through the Front Panel **MIC** connector will be enabled. Otherwise, this PTT line will be disabled for digital (**DIGL**, **DIGU**) and **DRM** modes.
- ❑ **Disable Split on Band Change:** When checked and if Split is enabled, Split will be disabled when the band is changed.

Process Priority

Sets the process priority for PowerSDR. Some users have reported that setting the priority higher than Normal can allow slower systems to perform more reliably and with smoother audio. While FlexRadio Systems recommends using the Normal setting, if you are experiencing audio glitches or are using a slower machine, selecting Above Normal or High might improve the performance of the software. Note that FlexRadio Systems does not recommend using the Real Time setting as this could cause timing problems with the operating system.

ClickTune Offsets (Hz)



Figure 83: Digital ClickTune Offsets

- ❑ **DIGU:** Sets the offset in Hz to use when click tuning in DIGU mode. Defaulted to 1200 for SSTV.
- ❑ **DIGL:** Sets the offset in Hz to use when click tuning in DIGL mode. Defaulted to 2210 for RTTY.

Miscellaneous

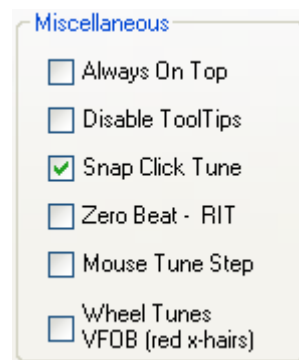


Figure 84: Always On Top

- ❑ **Always On Top:** Check to paint the Front Console on top of any other windows (even an active window).
- ❑ **Disable ToolTips:** Check to avoid seeing the explanatory tool tips that appear when you hover with your mouse over a control.

- ❑ **Snap ClickTune:** When checked, clicking (with the yellow or red cross hairs) on a signal in either the Panadapter or Waterfall will tune the VFO to the nearest multiple of the **Tune Step** (see page 56). E.g. if Tune Step is set to 1 kHz, the VFO will jump to the nearest kHz.
- ❑ **Zero Beat – RIT:** When checked and with **RIT** activated, the **0 Beat** button on the Front Console will offset the peak of a signal by the RIT frequency, such that VFO = actual peak frequency – RIT frequency. This can be useful if you want to zero beat the receive frequency without changing the transmit frequency.
- ❑ **Mouse Tune Step:** When checked, clicking the mouse wheel (middle click) will cycle through the tune steps.
- ❑ **Wheel Tunes VFOB (red x-hairs):** Check to have the mouse wheel tune VFO B when the red cross-hairs are showing (Split or MultiRX enabled).

Keyboard

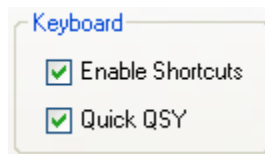


Figure 85: Quick QSY

- ❑ **Enable Shortcuts:** Enables the use of keyboard keys to perform various PowerSDR functions. The keyboard shortcuts can be set on the Setup Form-Keyboards Tab, described on page 142).
- ❑ **Quick QSY:** Enables the user to quickly enter a frequency in MHz on the keyboard and hit [Enter] to jump to that frequency. With this option disabled, using a mouse to tune or to click inside the VFO is the quickest way to change frequency. This feature is normally enabled by default, but can be disabled to prevent changing the VFO frequency due to accidental key presses.

Custom Title Text

Enter the text you would like appended to the standard text (FlexRadio Systems PowerSDR vn.n.n) in the title bar of the Front Console.

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Calibration Sub-Tab

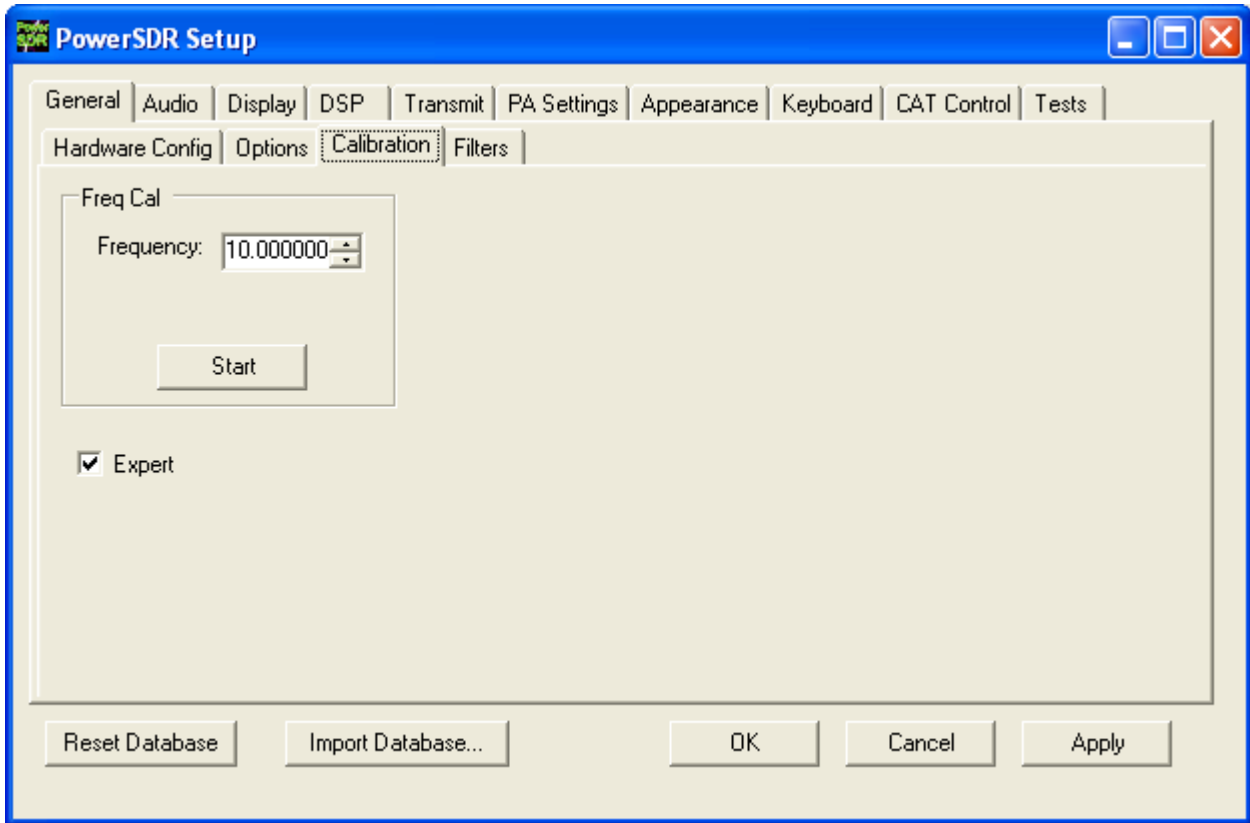


Figure 86: Setup Form - General Tab, Calibration Sub-Tab

To reveal the Frequency Calibration Sub-Tab, you will need to check the **Expert** box, which will generate a warning that this is meant only for experienced users. If you decide to proceed, tune your radio to a known accurate frequency source (e.g. WWV), enter the frequency in the **Frequency** control and click the **Start** button.

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Filters Sub-Tab

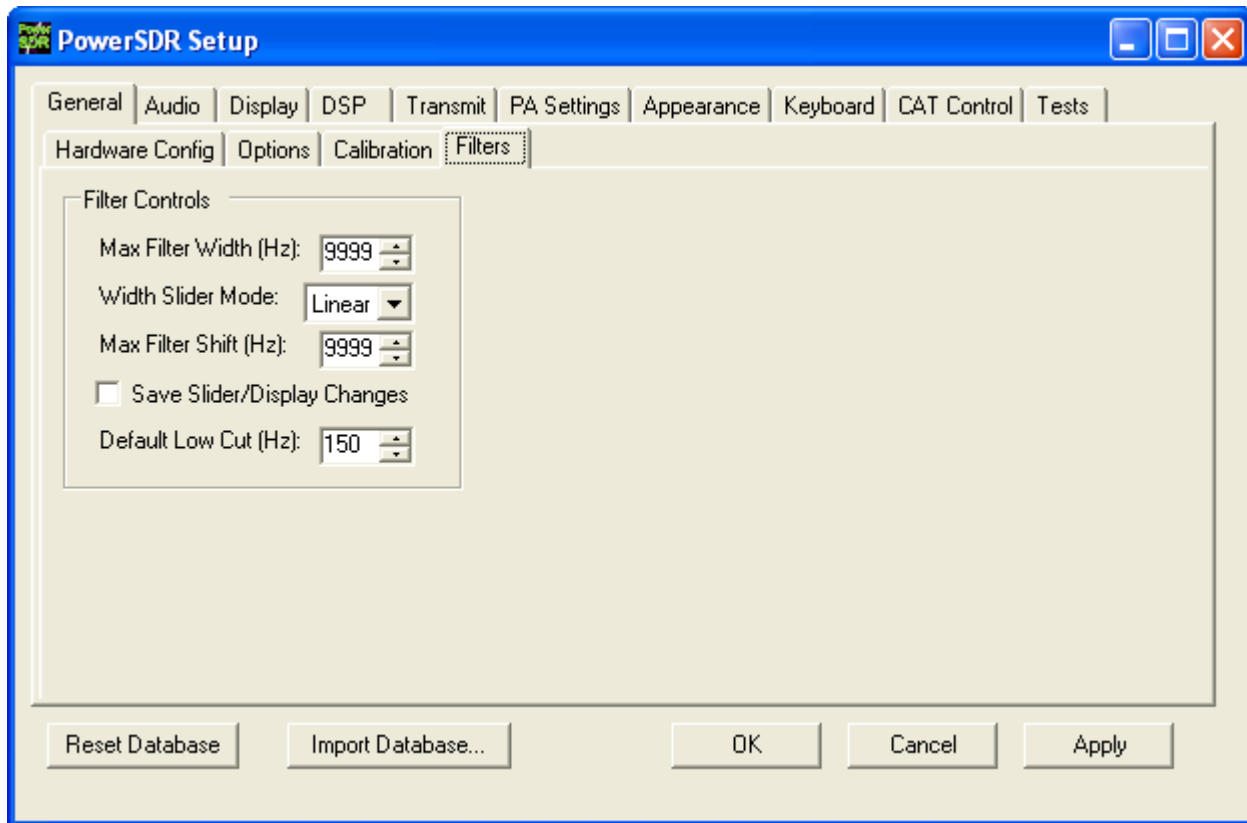


Figure 87: Setup Form - General Tab, Filters Sub-Tab

- ❑ **Max Filter Width:** Sets the maximum filter width to be set by the Filter Width Slider on the front console.
- ❑ **Width Slider Mode:** Sets the behavior of the Width Slider. Linear, Log, and Log10 are the options. The log options offer more resolution on the smaller filter sizes.
- ❑ **Max Filter Shift:** Sets the maximum swing in Hz that the Filter Shift Slider on the front panel will allow in either direction.
- ❑ **Save Slider/Display Changes:** If checked, any changes to the filters made by the filter sliders or by using the click and drag on the filter edges on the display will be saved to the Variable filters and will be recalled as such. If not checked, the Var filters can only be changed by adjusting the Filter Low and High controls on the front panel.
- ❑ **Default Low Cut (Hz):** Sets the default low frequency cut-off for the USB/LSB filters.

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Navigation Sub-Tab

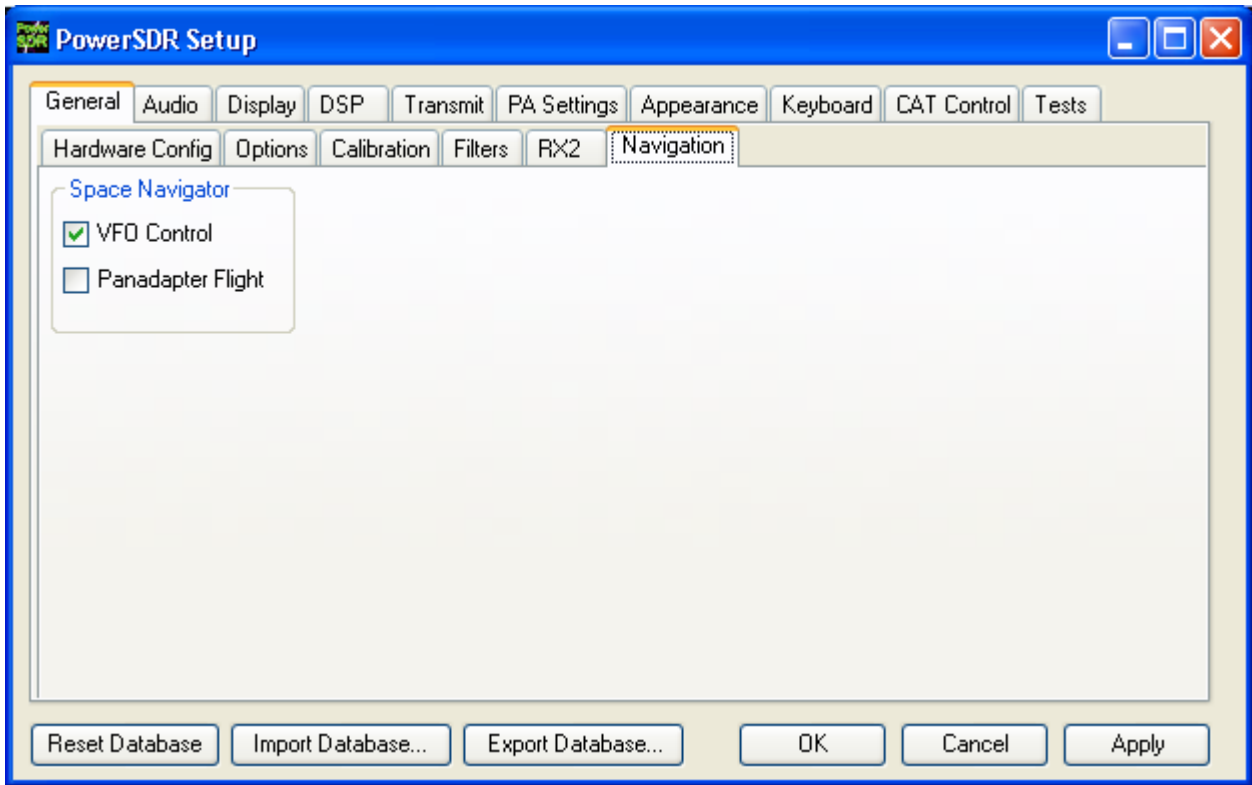


Figure 88: Setup Form - General Tab, Navigation Sub-Tab

These controls are only functional when using a so called *SpaceNavigator*¹ as a means to control PowerSDR. Check to have it control the VFO and/or the panadapter.

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¹ SpaceNavigator is a trademark of 3Dconnexion.

Audio Tab

Primary Sub-Tab¹

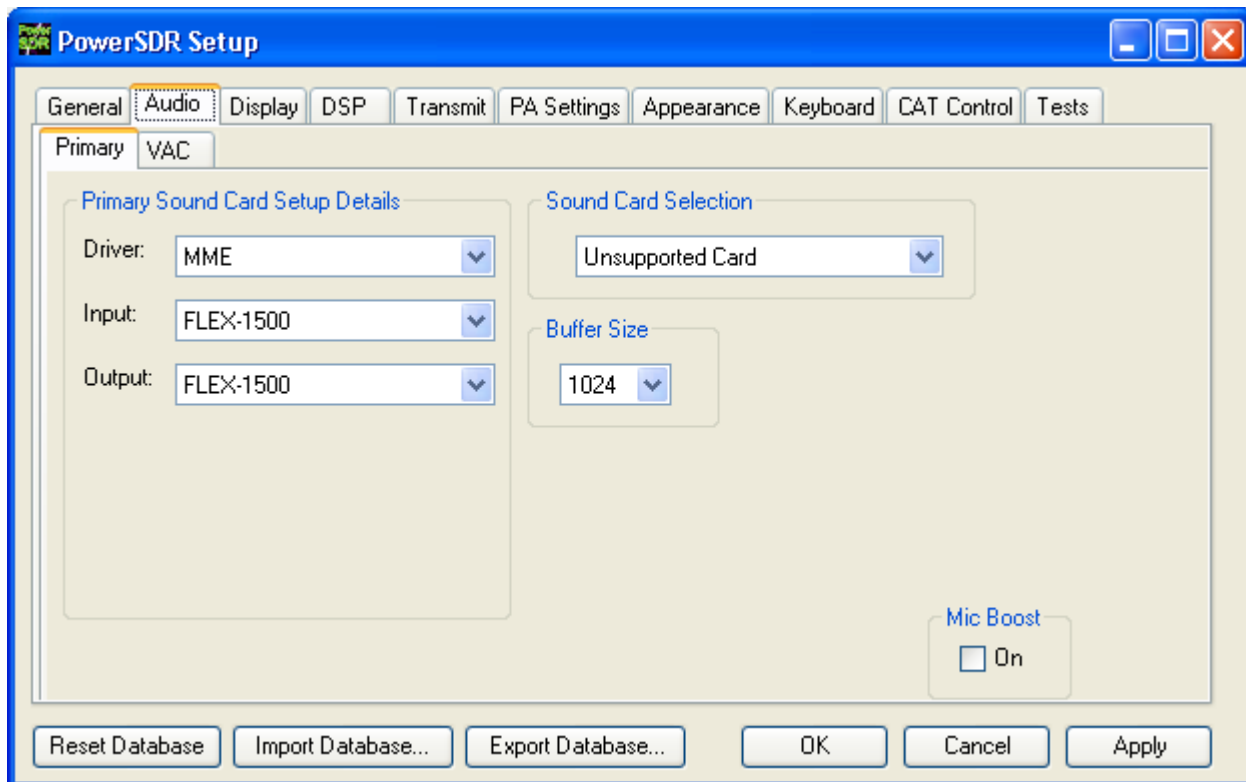


Figure 89: Setup Form - Audio Tab, Primary Sub-Tab

Buffer Size

The audio **Buffer Size** determines the number of samples in the audio Buffer used to transfer audio (IF) samples between PowerSDR and the FLEX-1500. You should set your audio **Buffer Size** as low as your computer system will tolerate. Larger buffers mean more delay, but smoother audio. Smaller buffers yield less latency, but at the cost of CPU load. The 2048 sample buffer size means that a single buffer at 48 kHz sample rate is $2048/48000 = 42.7$ ms in length. Faster machines should be able to run with a buffer size of 512 without issue. For best CW performance (and if your computer can handle it), set the audio buffer to 512 or less. (see also the **DSP Buffer Size** on page 119).

Mic Boost

Check this box if your microphone audio is sounding too weak and you cannot increase it further with the **Mic** gain control on the Front Console and the **Mic Input** control on the Mixer Form (see page 94).

¹ Do not touch the Primary Sound Card Setup Details and the Sound Card Selection controls. They are there for verification purposes only.

VAC Sub-Tab

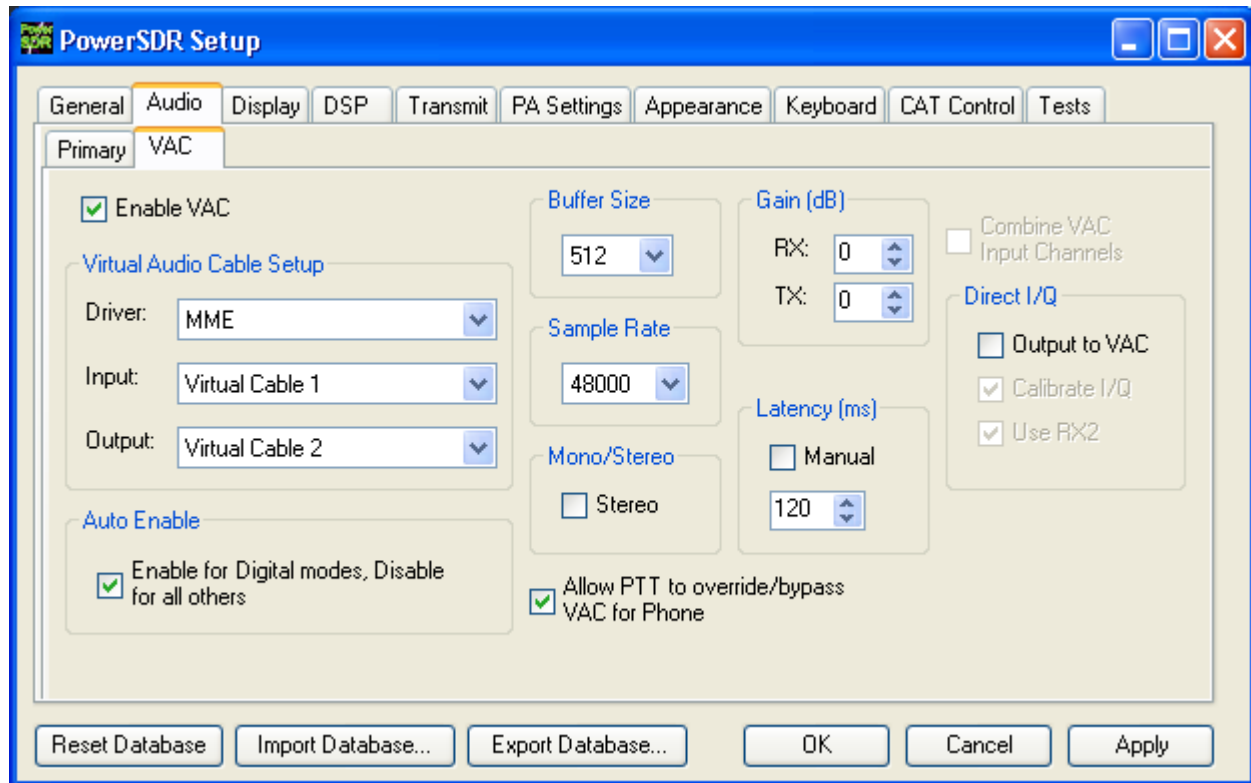


Figure 90: Setup Form - Audio Tab, VAC Sub-Tab

Use these controls to configure the VAC (Virtual Audio Cable) settings for use with PowerSDR. VAC is third party software (search for VAC in our Knowledge Center at <http://kc.flex-radio.com/search.aspx>) and is ideal for running digital modes using PowerSDR and third party digital mode software. VAC can also serve as another way to get audio in and out of PowerSDR. The **Buffer Size**, **Sample Rate** relate to the audio samples transferred between PowerSDR and VAC.

Virtual Audio Cable Setup

Select the driver type you wish to use. With most digital software MME will work well. Using VAC, you typically will have created two Virtual Cables called Virtual Cable 1 and Virtual Cable 2. Select one of these as the Input and the other as the Output as shown in Figure 90 (see also **Digital Operation** on page 49).

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Auto Enable

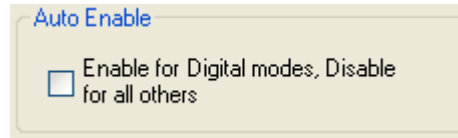


Figure 91: Auto Enable

Use this control to automatically enable VAC when operating digital modes (DIGL, DIGU, DRM). This allows the user to easily switch between digital modes and SSB/AM/FM without having to separately enable/disable VAC.

Gain (dB)

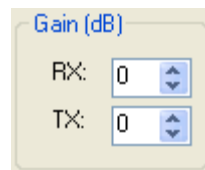


Figure 92: Gain (dB) Controls

These settings adjust the gain for signals coming in and out of the VAC interface.

- ❑ Use the **RX** control (as opposed to the Front Console AF control) to adjust the audio level going to third party programs.
- ❑ Use the **TX** control (as opposed to the Front Console MIC control) to adjust the volume of audio coming from third party applications to calibrate transmit (adjust for 0 dB with the RX-meter set to ALC).

Latency

Using the manual option, the user may add additional latency (in milliseconds) to the audio buffering system for better audio performance. When the manual setting is off, the delay is set to 0ms. Note that some systems will have trouble with the manual setting on and values below approx. 15ms. We recommend using the default automatic latency setting for best results.

Mono/Stereo

Check this box for stereo audio channels. Most third party applications require monaural audio. In this case leave the box unchecked. However, several DRM applications such as DREAM and HamPal require stereo audio.

Combine VAC Input Channels

Becomes enabled when **Mono/Stereo** is checked. Check to combine both L and R stereo input channels.

Allow PTT to override/bypass VAC for Phone

Check this box if you wish to override or bypass VAC when activating PTT, e.g. to use your microphone.

Direct I/Q

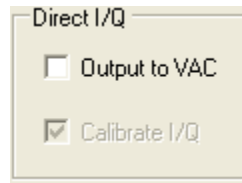


Figure 93: Direct I/Q

- ❑ **Output to VAC:** Check to send pre-processed I/Q to the VAC output instead of post-processed audio, to enable you to use third-party software that has the ability to directly process I/Q signals.
- ❑ **Calibrate I/Q:** Check to correct the raw I/Q signal and avoid any image signals going to the third-party software.

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Display Tab

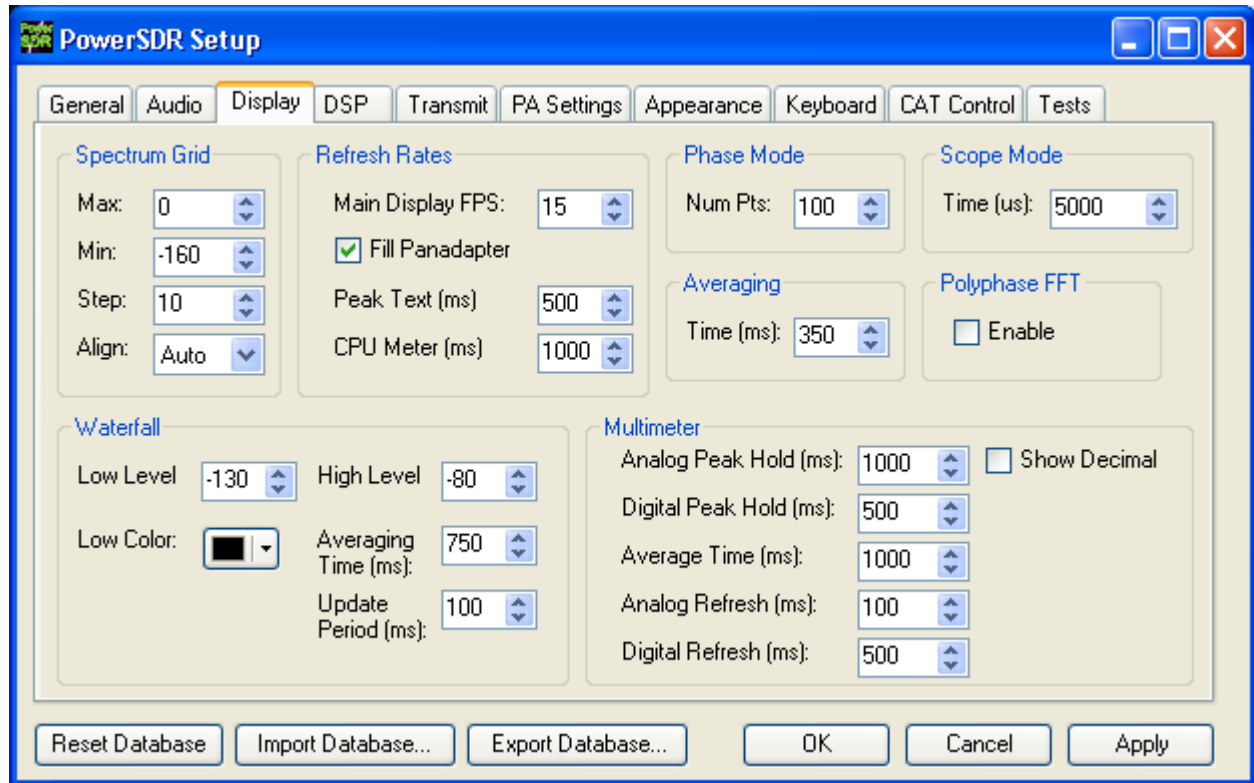


Figure 94: Setup Form - Display Tab

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Spectrum Grid

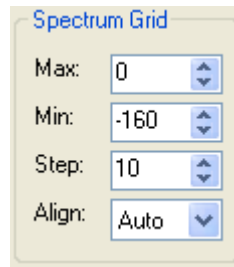


Figure 95: Spectrum Grid

The spectrum grid controls define the range and scale of the vertical axis (in dBm) shown in the Spectrum, Histogram, and Panadapter displays.

- ❑ **Max:** The maximum displayed signal level in dBm (i.e. top of the display).
- ❑ **Min:** The minimum displayed signal level in dBm (i.e. bottom of the display).
- ❑ **Step:** Spacing between the horizontal grid lines in dBm.
- ❑ **Align:** Sets the position of the vertical axis. The Left, Center, Right, and Off settings are self-explanatory. The Auto option automatically places the vertical axis at the 0 Hz position in the Spectrum and Histogram displays.

Refresh Rates

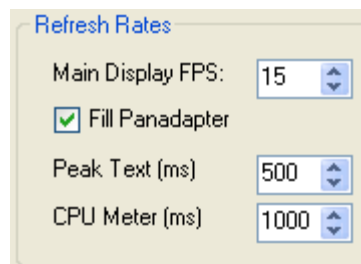


Figure 96: Refresh Rates

- ❑ **Main Display FPS:** Sets the update rate of the main display to the selected value in frames per second. Note that this is a good control to reduce if you are running on a slower machine to save CPU cycles. Raising this value will give faster updates at the cost of CPU load. Lowering the value will slow the display down.
- ❑ **Fill Panadapter:** Check to fill the area below the signal line on the panadapter display.
- ❑ **Peak Text (ms):** Sets the update rate of the peak signal location text box located just beneath the display. Raising the value increases the delay between peak updates and slows the display down. Conversely, lowering the value will accelerate the updates.
- ❑ **CPU Meter (ms):** Sets the update rate of the CPU Meter in the lower left of the front console. Raising the value will add more delay between updates while lowering the value will yield faster responses.

Waterfall

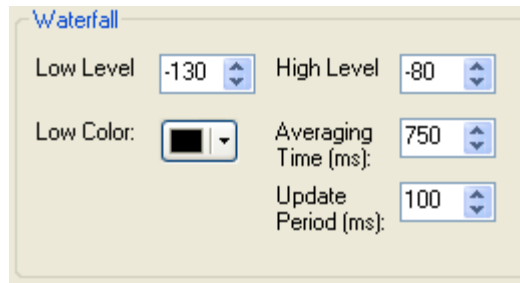


Figure 97: Waterfall

- ❑ **Low Level:** The lower end of the dynamic range to view in dBm. Signals at or below this level will use the **Low Color**.
- ❑ **High Level:** The high end of the dynamic range to view in dBm.
- ❑ **Low Color:** Color used if the signal level is at or below the **Low Level**.
- ❑ **Averaging Time:** Time in ms over which the signal is averaged for the Waterfall Display. The **AVG** button on the Front console has no effect for the waterfall.
- ❑ **Update Period:** Time in ms between updates to the Waterfall. The higher the period, the slower the Waterfall will progress from top to bottom of the display.

Multimeter

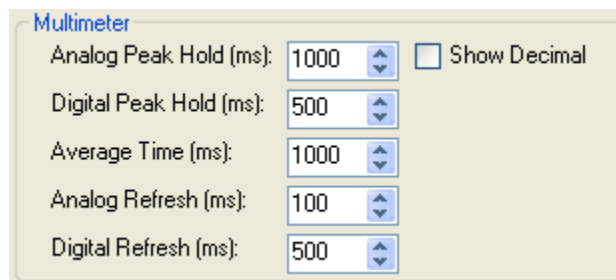


Figure 98: Multimeter Display options

- ❑ **Analog Peak Hold (ms):** The length of time in milliseconds to hold the peak on the analog edge or bar meter. Raising this value will lengthen the hold time and peaks will be held for a longer period of time.
- ❑ **Digital Peak Hold (ms):** The length of time in milliseconds to hold the digital meter when using the **Fwd Pwr** TX Meter. Raising this value will lengthen the hold time and peaks will be held for a longer period of time.
- ❑ **Average Time (ms):** The time over which the signal is averaged when using the **SigAvg** RX Meter setting.
- ❑ **Analog Refresh (ms):** Controls how often the analog meter is updated.
- ❑ **Digital Refresh (ms):** Controls how often the digital meter is updated.

- Show Decimal:** Check to show decimal values in the digital meter.

Phase Resolution

This control sets the Phase display resolution in number of points displayed per 360°.

Scope Time Base

This control adjusts the time base in μs (horizontal time scale) of the Scope Display.

Averaging

This control sets the averaging time in ms of the Spectrum, Panadapter and Histogram displays when **AVG** is enabled on the Front Console.

Polyphase FFT

Check to display sharper peaks in the spectrum displays (Spectrum, Panadapter, Waterfall, Histogram). Expect to see an up to 4 times narrower area of a displayed *spike*, especially when the displayed frequency span is relatively large in comparison.

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DSP Tab

Options Sub-Tab

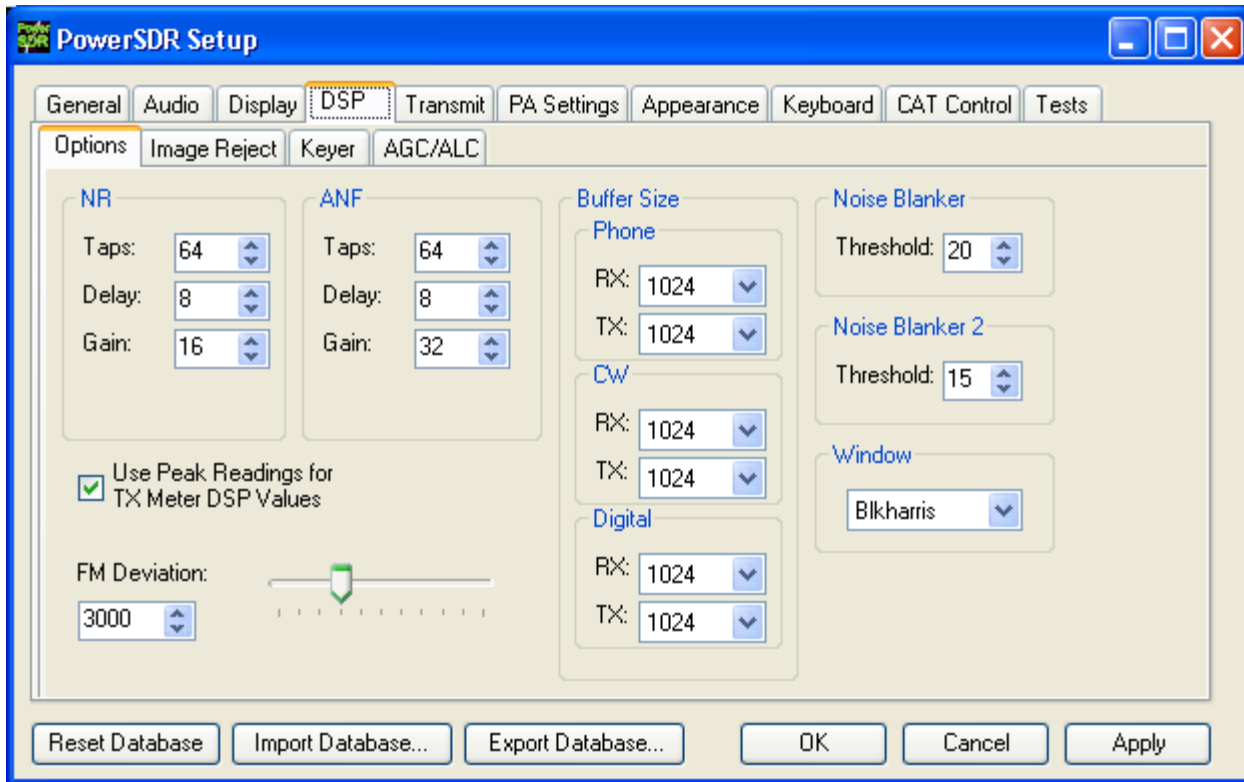


Figure 99: Setup Form - DSP Tab, Options Sub-Tab

Noise Reduction

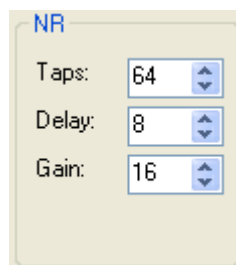


Figure 100: Noise Reduction Controls

Noise Reduction (**NR**) uses a filter to maximize coherent signals and thus filters out noise. It is best used for speech signals with a good signal to noise ratio or tones.

- ❑ **Taps** determines the length of the Noise filter. Increasing Taps leads to heavier filtering, but also lengthens the time it takes for the filter to adapt.

- ❑ **Delay** determines how far back to look in the signal before beginning to filter. Delays that are too large may lead to detrimental affects to normal speech, whereas Delays that are too short may not identify the noise component correctly. The filter's adaptation rate increases with increasing **Delay**.
- ❑ **Gain** determines the adaptation rate of the filter. The larger the number, the faster the filter will converge but the less stable it will be.

Adjust the **Taps**, **Delay** and **Gain** to modify the effectiveness of Noise Reduction. Increasing **Taps** and **Delay** will lead to heavier noise filtering, but may result in too much audio distortion and take the filter too long to adapt. Increasing **Gain** may shorten the adaptation rate, but if too high can lead to instabilities. The values shown in Figure 100 work best for most conditions and serve as a good starting point for further adjustments.

Hint: Try optimizing the **AGC-T** setting on the Front Console before using **NR**. If the signal to noise ratio is large enough, the AGC can be very effective at (almost) eliminating band noise without distorting audio.

Note : With Noise Reduction filtering on you will notice a certain distortion of the audio, which is part of the function of filtering. Adjusting **Taps** and/or **Delay** may reduce the distortion, but will lead to less filtering.

Automatic Notch Filter

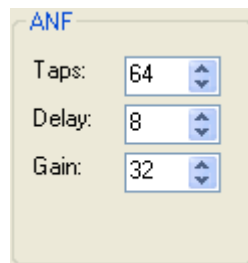


Figure 101: Automatic Notch Filter Controls

The Automatic Notch Filter (**ANF**) uses a filter to remove one or more carrier tones that are interfering with the signal of interest.

- ❑ **Taps** determines the length of the notch filter. The longer the filter, the larger the number of tones that can be canceled and the more effective the cancellation will be. More **Taps** also lengthens the time it takes for the **ANF** to take effect.
- ❑ **Delay** determines how far back to look in the signal before beginning to compute a cancellation filter. The larger the delay, the less the impact on normal speech, and the more likely the filter will be able to concentrate only on longer term coherent signals such as carrier tones. A larger Delay lengthens the time for the **ANF** to take effect.

- ❑ **Gain:** Determines the adaptation rate of the filter. The larger the number, the faster the filter will converge but the less stable it will be.

As with the Noise Reduction filter, an optimum needs to be reached for the best filtering. The values shown in Figure 101 work best for most conditions and serve as a good starting point for further adjustments.

Use Peak Readings for TX Meter DSP Values

When checked, the MIC, EQ, Leveler, CPDR and ALC TX Meters will show peak values instead of RMS values.

FM Deviation

Adjust the FM deviation using either the numerical control or the slider.

Buffer Size

The DSP buffers can be preset separately for receive (RX) and transmit (TX), for each of the Phone, CW and Digital modes. Selecting an operating mode on the front console will then automatically select the corresponding (RX or TX) preset DSP buffer: Phone for LSB, USB, DSB, FMN, AM and SAM; CW for CWL and CWU; Digital for DIGL, DIGU and DRM.

Higher DSP buffer sizes will result in more latency and steeper (*brick wall*) filters. Lower values will allow nearly real time monitoring (low latency), but with wider filter skirts that *roll off* (as opposed to the *brick wall* filters). Therefore a trade-off needs to be made and this trade-off is often different, depending on the mode of operation.

- ❑ For example, with the FLEX-1500's sample rate fixed at 48 kHz and the DSP buffer equal to 512 the minimum attainable 3 dB filter width equals $1.5 \cdot 48000 / 512 \approx 140$ Hz. Increasing the DSP buffer size will enable narrower and sharper filters.

To dramatically illustrate this effect, Figure 102 below shows two traces of the same 25 Hz CW filter. The wide trace is at a DSP Buffer size of 256, yielding a minimum 3 dB filter width of $1.5 \cdot 48000 / 256 \approx 281$ Hz!! The narrow trace at a DSP buffer size of 2048 yields a minimum 3 dB filter width of $1.5 \cdot 48000 / 2048 \approx 35$ Hz.

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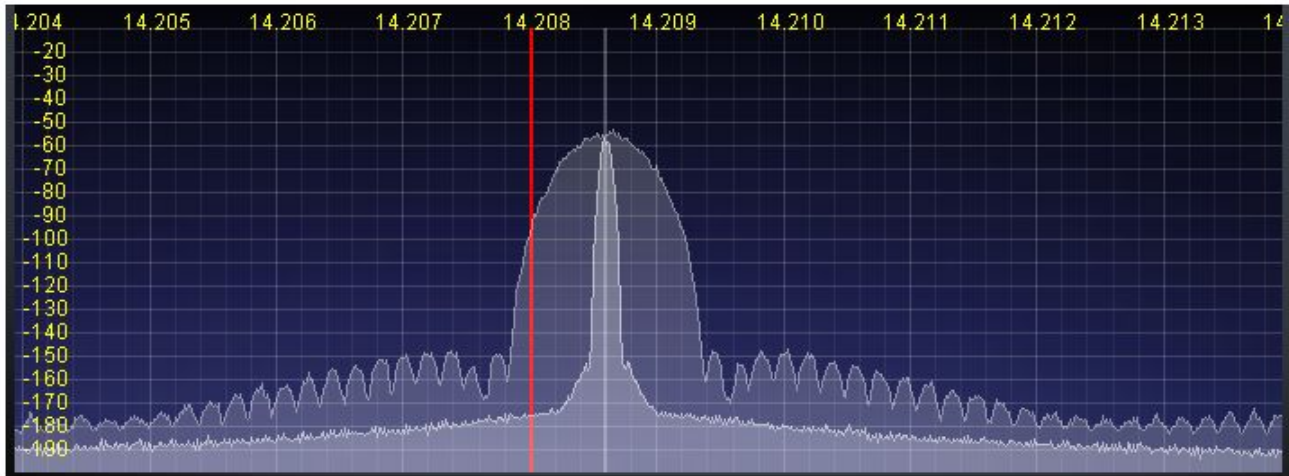


Figure 102: 25 Hz CW Filter at 256 Buffer Size (wide) and 2048 (narrow)

- ❑ The minimum audio (IF) latency is determined by the larger of the DSP Buffer and the audio Buffer (see page 109). If the audio Buffer Size is set to 1024 and the DSP Buffer Size to 2048, then the latency is determined by the latter and equals $2048/48000 = 42.7\text{ms}$.
- ❑ Therefore, you should set your Audio Buffer as low as your computer system will tolerate at the set Sample Rate. Next you should set your DSP Buffer as high as you can, without experiencing noticeable latency. Finally, for the narrowest (CW) filters you may need to lower your Sample Rate further, especially in extreme conditions such as contests.

Noise Blanker

This controls the detection threshold for impulse noise. If a signal sample exceeds this detection threshold, the sample will be set to zero and the filtering in the radio serves to interpolate through this zero sample. This noise blanker is identical in theory to those in traditional radios. The detection threshold in our noise blanker has the unique feature of being signal strength dependent. This enables it to function properly at all signal levels.

This control is preferable when the spikes are very large in comparison to the average signal. However, when the spike is smaller, **Noise Blanker 2** provides a much cleaner reconstruction of the signal since the signal is more likely to look like the mean. For this reason, the Noise Blanker 2 threshold should always be about four or five less than the Noise Blanker threshold.

Noise Blanker 2

This controls the detection threshold for a pulse. If a signal sample, pulse or not, exceeds this detection threshold, the sample will be replaced by an interpolation of the signal samples around it in time. By replacing the noise pulse with an interpolation of the signal, distortion is greatly reduced over that of traditional noise bankers.

When seeing a significant amount of impulsive noise, being too aggressive with **Noise Blanker (NB)** can damage the signal. However, completely removing the large pulses is desirable prior to operating the smoother acting **Noise Blanker 2 (NB2)**. Therefore, when seeing many repetitive noise pulses, it

is probably best to use both NB and NB2. The NB Threshold is adjusted to just begin to lower the noise from the pulses, after which NB2 is turned on, with a threshold of four or five less than that of NB. Both together can spectacularly reduce impulse noise, resulting in increased intelligibility of the signal under severely adverse conditions.

Window

This control selects the DSP windowing function that will be applied to the power spectrum in the main display when using Spectrum, Panadapter, Histogram, and Waterfall displays. The default is Blackman-Harris, which is the best setting for many high-level *signal measurement* needs.

The purpose of the windowing is to diminish bleed-through to adjacent FFT *bins* which results from a tone that is not exactly on the center frequency of one of the *bins* (or parallel filters) in the power spectrum calculation. The bleed-through is caused by using the Fast Fourier Transform (FFT) to calculate the power spectrum, which we need to use for the sake of efficiency. That said, it is important to understand that the FFT writes the data (mathematically speaking) on a circle and not on a line. When the last sample meets the first sample on a circle, it is very probable that it will not meet up or join in a continuous fashion. This discontinuity causes a wide spectrum (just like a key click). The window is used to mitigate this key click-like phenomenon. The Rectangular Window bleeds through the worst. The best for our purposes is the Blackman-Harris Window, which bleeds through the least, but at a penalty of a slightly reduced spectral resolution (=wider filter). For more information on the window functions available in PowerSDR, search for *window functions* in our Knowledge Center at <http://kc.flex-radio.com/search.aspx>.

Figure 103 shows the effect of using various windows with a 1 kHz DSB filter. The effect is most obvious in the stop band attenuation of the filter, where the Rectangular Window (Black) shows the worst result. In this case, the Blackman-Harris Window (Red) is obviously superior.

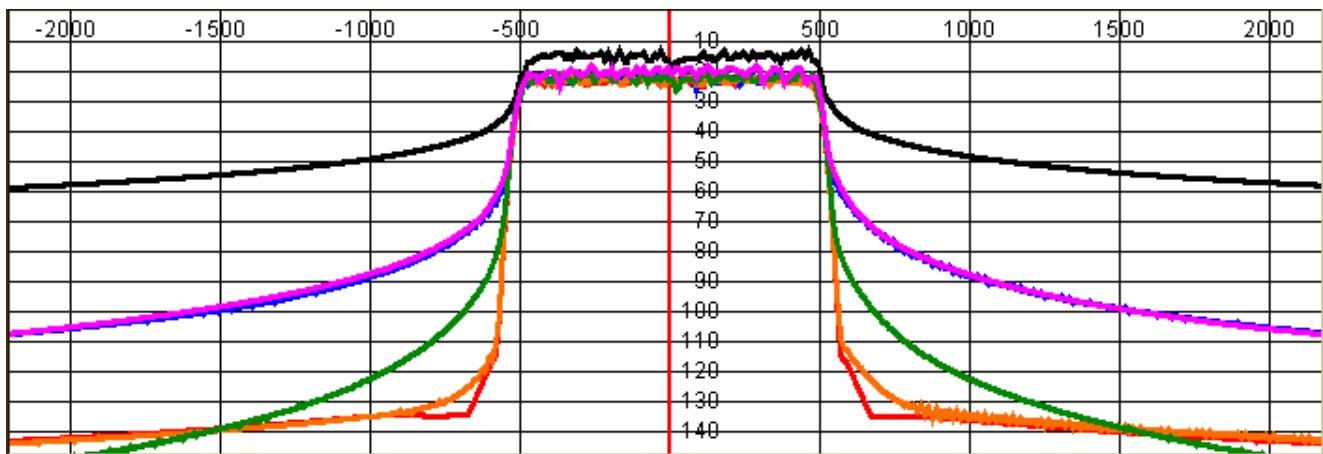


Figure 103: Effect of Various Windows: Rectangle (Black), Welch (Violet), Bartlett (Blue), Hanning (Green), Blackman 3 (Orange) and Blackman-Harris (Red)

Figure 104 displays a 25 Hz CW filter with a Hanning and a Blackman-Harris window. It is clear that the Hanning window offers a narrower passband at the cost of a higher stop band. Blackman-Harris offers a much improved stop band, but at the cost of a slightly wider passband. In almost all cases Blackman-Harris will be preferred, except possibly for weak CW signals, where both stop bands disappear in the noise and where dynamic range is much less important than a narrower passband.

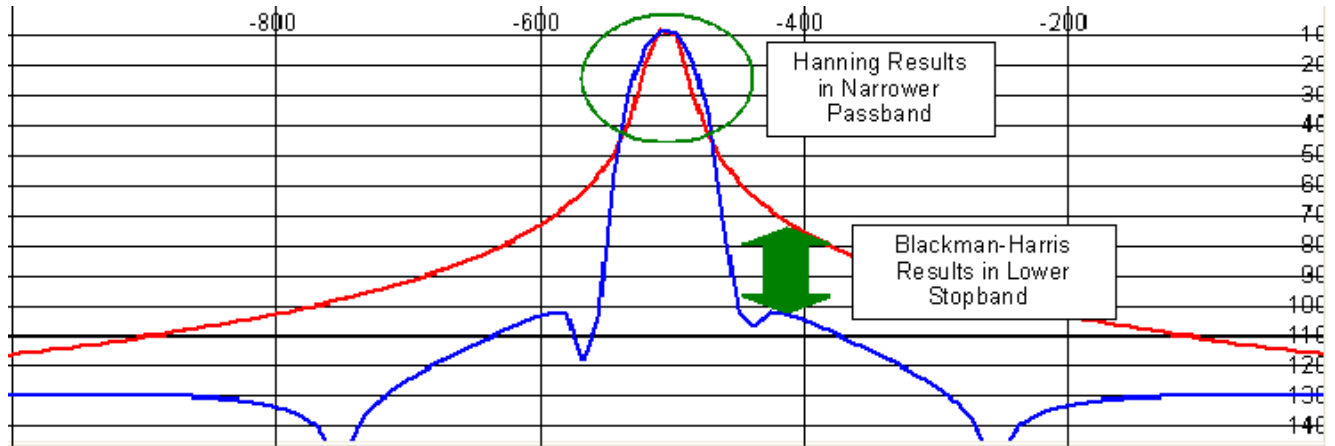


Figure 104: 25 Hz CW Filter with Hanning (Red) and Blackman-Harris (Blue) Windows

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Image Reject Sub-Tab

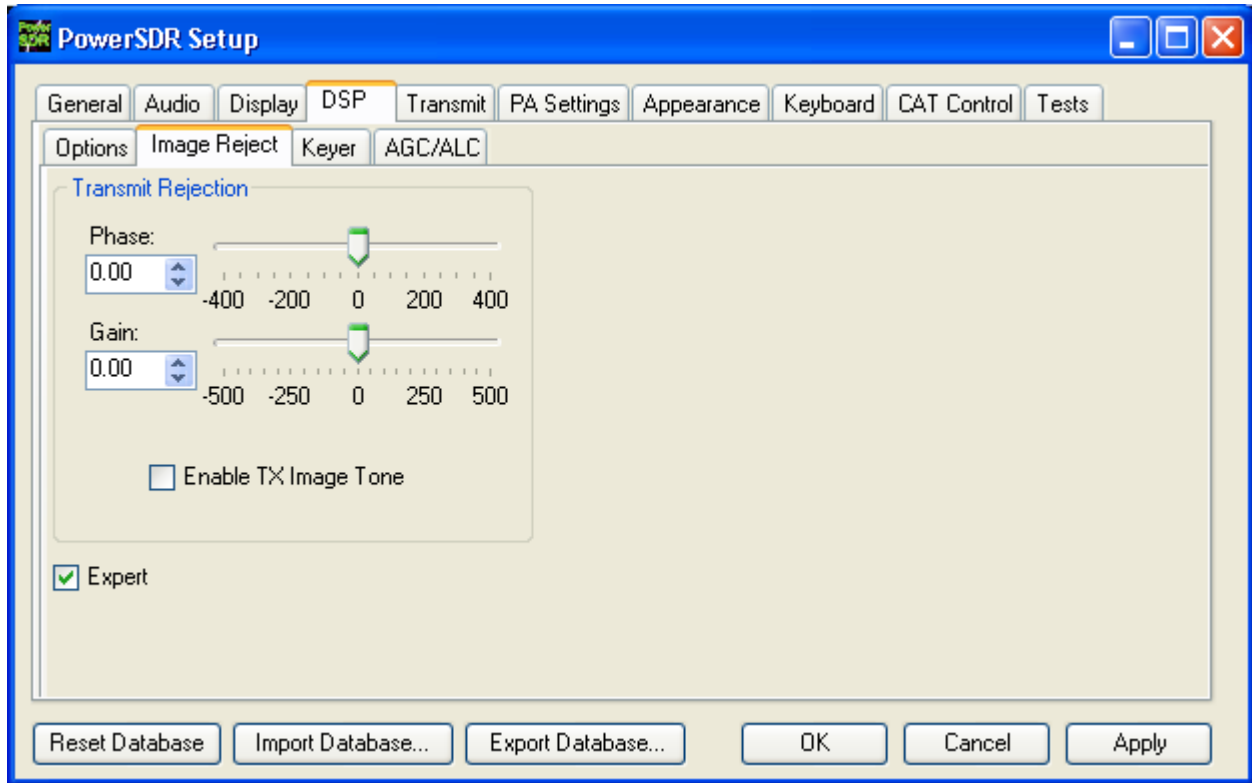


Figure 105: Setup Form - DSP Tab, Image Reject Sub-Tab

Note: Your FLEX-1500 is completely calibrated and needs no further adjustments.

Expert

To reveal the Image Reject controls, check **Expert**. This will show a warning; click **Yes** to proceed. You should proceed with caution and only consider doing this if you are an experienced user. Vary rarely, if ever, will you need to access these controls.

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Transmit Rejection

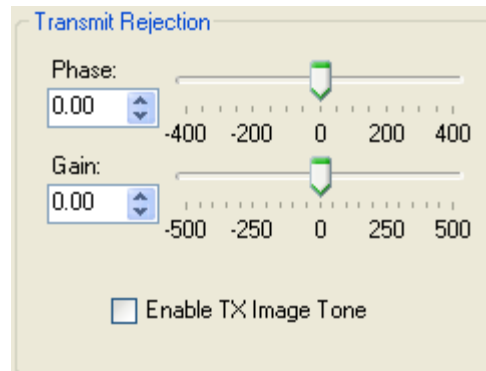


Figure 106: Transmit Rejection

These controls enable the user to adjust the image rejection for the transmitter. The calibration requires external instruments. A spectrum analyzer is ideal but a second receiver should enable you to get satisfactory rejection levels.

To minimize the transmit image, proceed as follows:

1. Set the radio to either USB or LSB. Connect the radio to a dummy load and select **Enable TX Image Tone**.
2. Click **MOX** (front console) and a full strength tone will be transmitted at the frequency shown in **VFO A**. Adjust the output power with the **Drive** control (front console).
3. If the radio is set to **USB**, look at the image signal *BELOW* the carrier in either the spectrum analyzer or the second receiver. If set to **LSB**, look at the image signal *ABOVE* the carrier.
4. Using **Phase** and **Gain** controls, null the relevant image signal.

Note 1: The image rejection will only work in an asymmetric voice mode (SSB). In a symmetric voice mode, like AM, SAM, and FMN any small amount of image problem will likely be covered up.

Note 2: There is no manual image rejection for received signals as PowerSDR uses so called Wideband Image Rejection (WBIR) to adaptively null the receive image across the whole receive bandwidth. This approach is superior to a manual rejection, which nulls the image at one point only.

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Keyer Sub-Tab

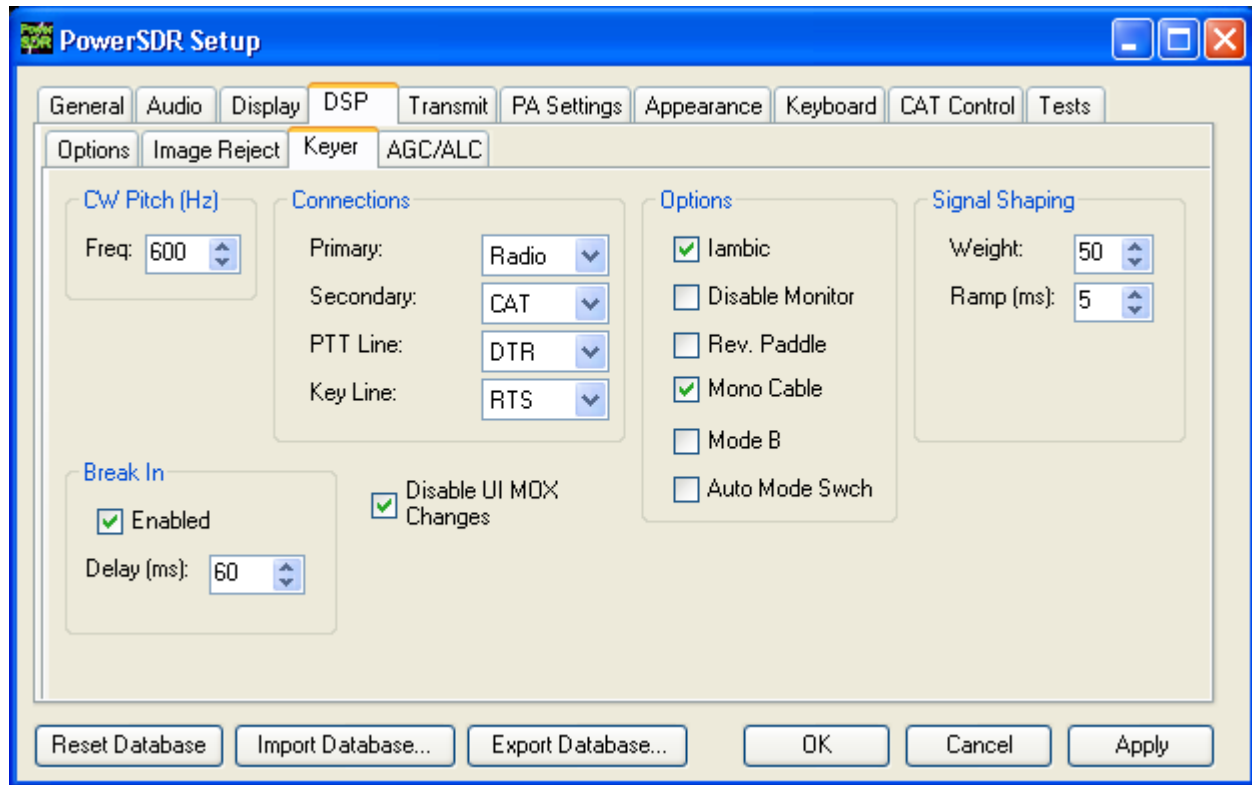


Figure 107: Setup Form - DSP Tab, Keyer Sub-Tab

CW Pitch

This enables the user to set the desired audio frequency for CW listening at the center of the CW filters (1 kHz and lower filters). This will determine the offset that is applied to the carrier in receive and transmit. The display will continue to read the actual carrier frequency, but the software will provide for an offset to get the desired CW tone. This pitch will determine the automated tuning frequency using the display and mouse ClickTune functions.

Connections

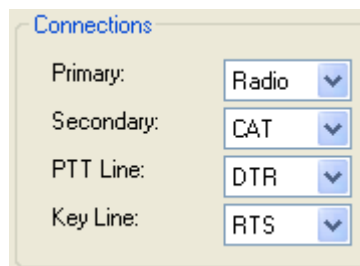


Figure 108: Connections

The internal keyer supports two inputs: the primary and secondary connections. The primary connection will override the secondary. This was designed with the idea that the secondary connection

might be used for automatic CW generation while the primary could be used with manual paddles to override the automatic output.

- ❑ **Primary:** Select the connection to be used for the primary connection. Selecting *Radio* allows the use of the jack on the front of the FLEX-1500.
- ❑ **Secondary:** Select the connection to be used for the secondary connection. Selecting *CAT* will allow use of the COM port that is currently being used by the CAT connection (see page 143). This is useful as some programs allow both CAT commands and COM port line keying for CW. Note that the lower two controls will not show up if *None* is selected.
- ❑ **PTT Line:** Select the COM port line used for PTT.
- ❑ **Key Line:** Select the COM port line to be used to activate the key.

Options

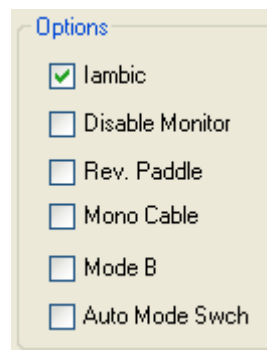


Figure 109: Internal Keyer Options

- ❑ **Iambic:** Check this box to enable Iambic mode A emulation. Select **Mode B** (see below) to emulate mode B. With the box unchecked, the key input will act like a straight key.
- ❑ **Disable Monitor:** The monitor is typically turned on when using **Break In** with the internal keyer. In order to keep the monitor off, check this option.
- ❑ **Rev. Paddles:** Using this option will reverse the paddle inputs so that the dot becomes a dash and vice versa.
- ❑ **Mono Cable:** Check if your key connector only has a tip and shield (i.e. the cable is a mono cable). Leave unchecked if the connector has a tip, ring and shield.
- ❑ **Mode B:** Check this box to enable Iambic mode B emulation. Uncheck it to enable mode A emulation.
- ❑ **Auto Mode Swch:** Check to automatically switch to the appropriate CW mode (if in another mode) when you hit your paddles.

Signal Shaping

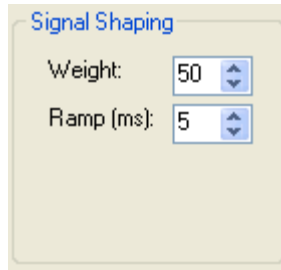


Figure 110: Signal Shaping Controls

- ❑ **Weight:** Sets the width ratio between the dot and dash.
- ❑ **Ramp:** Sets the length of the leading and trailing edge on the tones in milliseconds to avoid key clicks.

Break In

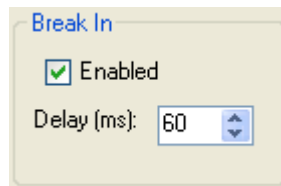


Figure 111: Internal Keyer Semi Break In Controls

- ❑ **Enabled:** Check this box to enable Break In for the internal keyer.
- ❑ **Delay (ms):** Sets the amount of time between the last detected input and when the radio will drop back to receive.

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AGC/ALC Sub-Tab

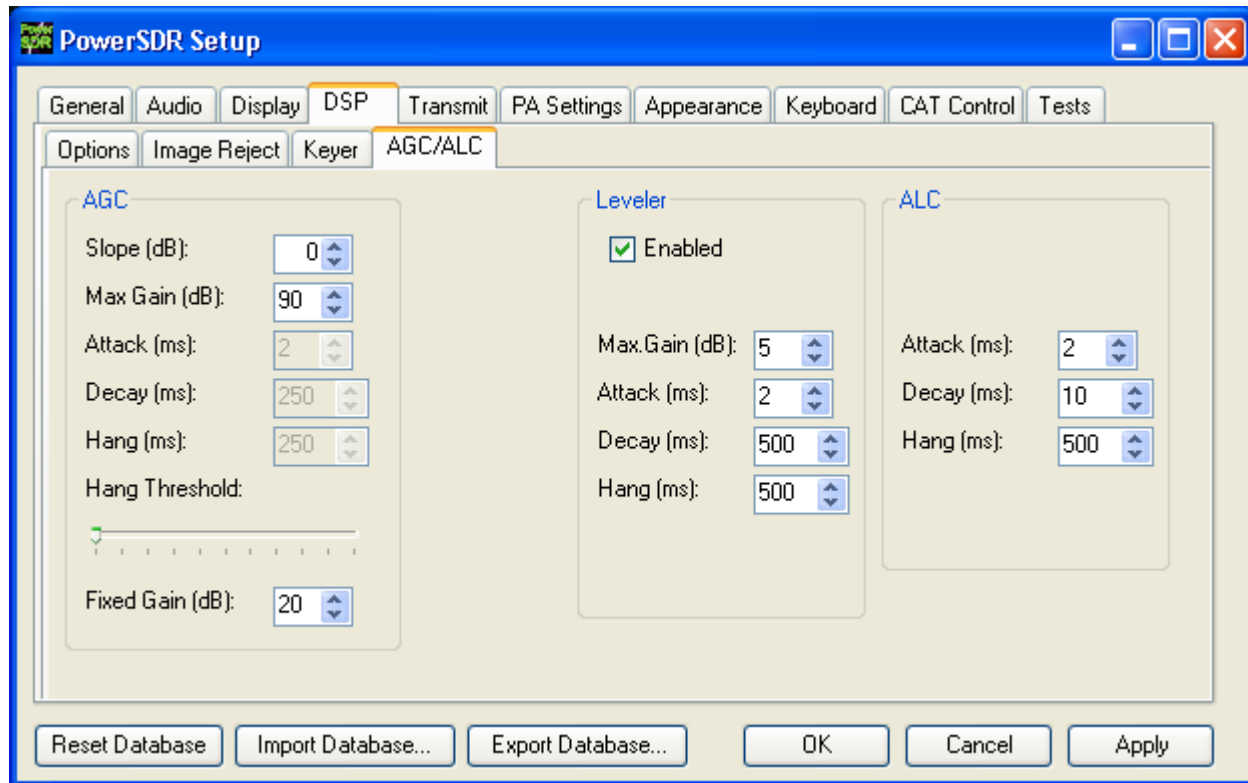


Figure 112: Setup Form - DSP Tab, AGC/ALC Sub-Tab

These controls allow the user to customize the AGC, Leveler and ALC to their own particular tastes.

AGC

The AGC is a state of the art, dual track AGC with anticipatory response on both fast and slower tracks. Or, stated differently, the AGC is in essence the combination of two AGCs, one with a very fast time constant, the other with a much slower time constant (for more detail see the article [A Discussion on the Automatic Gain Control \(AGC\) Requirements for PowerSDR](http://support.flex-radio.com/Downloads.aspx?fr=1) on the Downloads page of our website at <http://support.flex-radio.com/Downloads.aspx?fr=1>). There are several articles on configuring and optimizing the AGC in our Knowledge Center which may also be of use. (Search for AGC in our Knowledge Center at <http://kc.flex-radio.com/search.aspx>).

The **Attack**, **Decay** and **Hang** settings may only be adjusted when the Front Panel **AGC** control is set to Custom. However, they do display the values for the selected **AGC** setting.

- ❑ **Slope (dB):** The AGC gain once the signal is above the AGC threshold (or knee, not to be confused with the Hang Threshold below). Setting a Slope higher than 0 dB allows signals above the threshold to sound louder as they get stronger.
- ❑ **Max Gain (dB):** The maximum amount of gain allowed by the AGC system for signals below the AGC threshold. The total AGC gain equals the Max Gain + the Slope (Gain).

- ❑ **Attack (ms):** This sets the time constant for the attack of the AGC. When a signal gets stronger, this determines how quickly the AGC will respond to the need for decreased gain. Note that in order for this and the two controls below it to be enabled, the **AGC** control on the front panel must be set to *Custom*.
- ❑ **Decay (ms):** This sets the time constant for the decay for the AGC. When a signal gets weaker, this determines how quickly the AGC will respond to the need for increased gain.
- ❑ **Hang (ms):** To keep the AGC system from adjusting too much, an adjustable hang time is provided. This Hang time will only be applied if the signal level is above the Hang Threshold (see below), otherwise a fixed Fast Hang time of 100ms is applied. After this time has expired, the Decay will then determine how quickly the AGC gain recovers.
- ❑ **Hang Threshold:** The Hang will NOT occur if the signal is weaker than this threshold. Instead the Fast Hang will be applied.
- ❑ **Fixed Gain:** When you choose *Fixed* on the front panel **AGC** control, this control is used to amplify the signal.

Table 11 details the AGC parameters used in the various settings.

Table 11: AGC Setting Details

Setting	Attack	Decay	Hang	Fast Hang
Fast	2ms	100ms	100ms	100ms
Med	2ms	250ms	250ms	100ms
Slow	2ms	500ms	500ms	100ms
Long	2ms	2000ms	750ms	100ms

Leveler

The Leveler is intended to even out the sound level variations through your microphone caused by varying distance from or angle to it. It is an attempt to level the amplitude presented to the rest of the DSP audio processing. The leveler is **disabled** in DIGU and DIGL modes.

ALC

The ALC is what you would typically consider ALC to be in a transmitter. It is an attempt to prevent overdrive of the power amplifier and the distortion that would result. Because of the dual track ALC algorithm we use (similar to the AGC), this ALC will allow very high average power while maintaining peaks at a controlled level. The Compander (**DX** and **CPDR** on the Front Console - see Mode Specific Controls – Phone on page 63) work very well together with the ALC to increase average power without overdrive.

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Transmit Tab

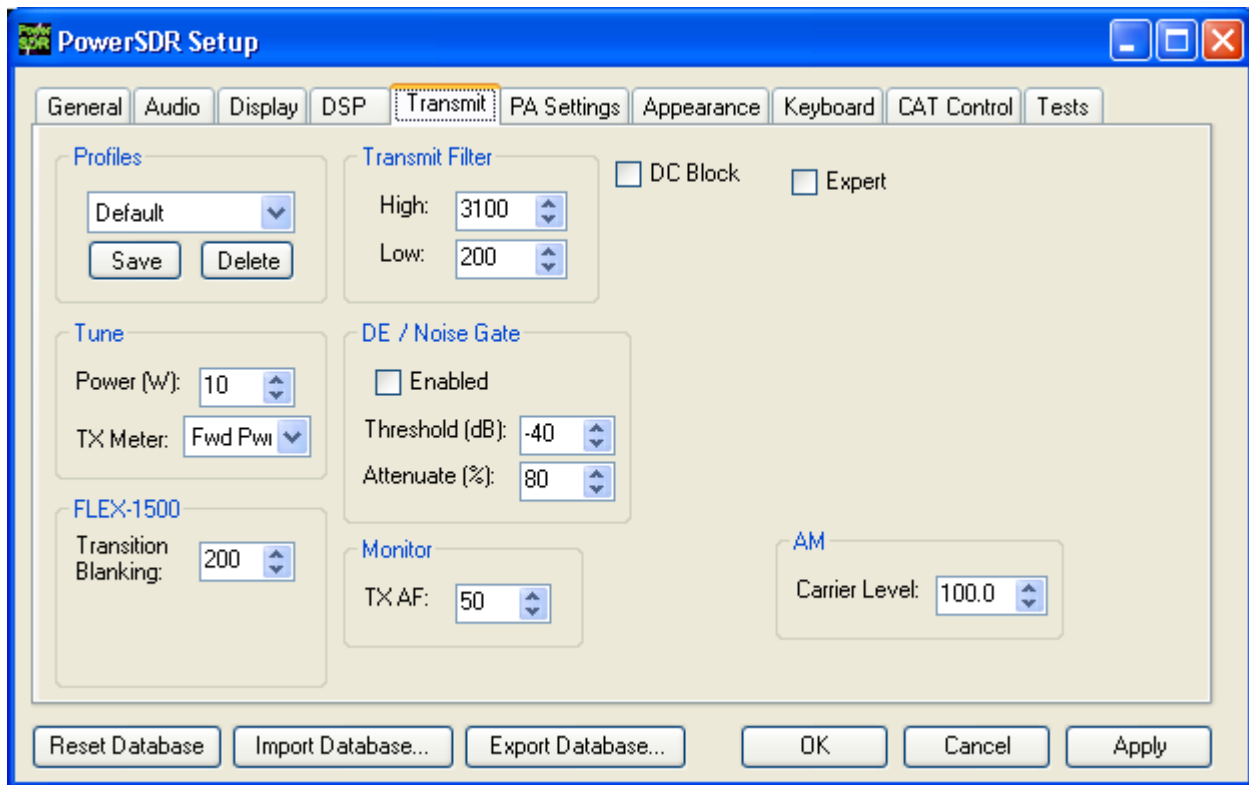


Figure 113: Setup Form - Transmit Tab

The transmit Tab has controls that allow the user to tailor the transmit signal characteristics using features like compression and filtering.

TX Profiles

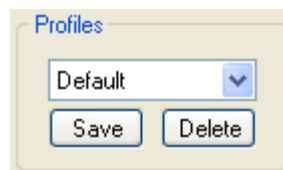


Figure 114: TX Profiles

The two default TX Profiles are **Default** and **Default DX**. The TX Profiles selection allows the user to save and restore the various TX settings with ease. The TX profile includes settings for: EQ, Filter, MIC Gain, Drive, DX, CPDR, Leveler, and ALC. Click the **Save** button to save the current profile. You will be prompted for a name. To remove a profile, select it using the drop down menu, and then click the **Delete** button.

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Hint: Check the **Expert** box to reveal many more standard TX Profiles. See below.

Transmit Filter

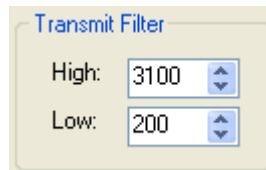


Figure 115: Transmit Filter Controls

- ❑ **High:** Controls the high cut of the Transmit Filter.
- ❑ **Low:** Controls the low cut of the Transmit Filter.

Note 1: You will receive a good practice warning if the transmit filter bandwidth exceeds 3 kHz.

Note 2: You can view the transmit filter on the Panadapter or Waterfall displays when you enable **Show TX Filter on Display** on the Front Console.

DC Block

Attempts to block any DC noise from entering the filter.

Tune

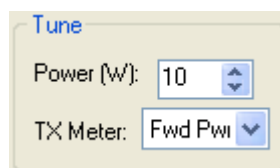


Figure 116: Tune Settings

- ❑ **Power:** Sets the power in as a percentage of 5W to be used whenever **TUN** (Tune) is clicked on the Front Console (sets the **Drive** control). Changes made to the **Drive** level while **TUN** is active will be reflected in this control.
- ❑ **TX Meter:** Selects which TX Meter to use when **TUN** on the Front Console is clicked.

Downward Expander/Noise Gate

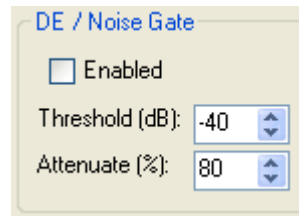


Figure 117: Noise Gate

The function of a good 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. It does this by comparing the signal level to a threshold. When the signal level drops below this threshold, the downward expander decreases the system gain by some ratio.

A noise gate on the other hand does not decrease the gain but switches it completely off below the threshold level. A noise gate works well if the ambient background noise level is low or mostly constant. If the background noise levels are close to your voice level or not constant, it will not provide good gating between words, or the threshold setting will be so sensitive that it displays a pumping effect of the gate opening and closing in rapid succession while talking.

- ❑ **Enabled:** Enables the Downward Expander.
- ❑ **Threshold (dB):** The threshold below which the downward expander reduces the system gain.
- ❑ **Attenuate(%):** Percentage by which a signal below the Threshold level will be attenuated. Setting this to 100 effectively creates an on/off switching noise gate.

To adjust the downward expander:

1. While wearing headphones, activate **MON** and **MOX** on the Front Console (use a dummy load or set **Drive** to 0). Disable **DEXP** and turn up the Monitor **AF** so that you can hear your ambient noise clearly and preferably louder than without headphones.
2. You will see a green/red indicator just below the DEXP Threshold slider. Move the slider just beyond the total length (green + red) of the indicator. The threshold should be set slightly higher than the ambient noise level (about 5 dB higher often works well).
3. Without speaking, enable **DEXP**. If you still hear your ambient noise, increase the threshold level further. If your ambient noise disappears when enabling DEXP, decrease the threshold level until you just start to hear it. Then increase the threshold a little further (about 5 to 10 dB) beyond the point where the ambient noise disappears.
4. Decrease the **Attenuate(%)** (see Figure 117 above) slowly until you can just start to hear your background noise. Then lower it a little more (about 5%-10% is a good starting point) to provide more of a soft knee between your voice level transitions.
5. With the **DEXP** adjusted, speak into the microphone and verify that your voice sounds as natural as possible. There should be a very smooth transition between not speaking and speaking. Fine tune the **Threshold** and **Attenuate(%)** settings as desired.

Transition Blanking

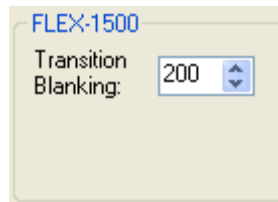


Figure 118: FLEX-1500 Transition Blanking

The **Transition Blanking** control helps deal with the few milliseconds of noise that is sometimes sent at the first dit of a session in CW, or the beginning of a transmission in SSB. This is a temporary solution until the new custom drivers are available. The **Transition Blanking** control mutes, for the time shown (in ms), the speaker and transmitted signal during receive/transmit (or transmit to receive) change over.

- ❑ Increase the **Transition Blanking** time if a noise burst is heard at the beginning of a transmission.
- ❑ Decrease the **Transition Blanking** time if no noise burst is heard to speed up receive to transmit switching times.
- ❑ The optimum value varies for different systems and different DSP buffer size settings. If you are running different DSP buffer settings for different modes, you will have to either change this setting when switching modes, or set it at the largest setting for any of the modes.

Monitor

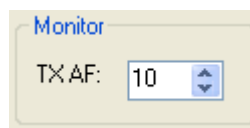


Figure 119: Transmit Monitor AF Control

Use the Monitor **TX AF** control to set the value that the **AF** control (Front Console) will use as an initial value when transmitting. Any change made on the Front Console **AF** control will be remembered.

AM Carrier Level

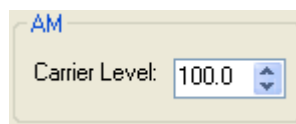


Figure 120: AM Carrier Level

The **Carrier Level** determines the percentage of carrier level to be applied to the transmit signal where 100% is one quarter of full power output (1.25W when **Drive** on the front console is set to 100). So a setting of 80 would yield roughly 1W when **Drive** is set to 100. This is useful as it allows the modulation to appear much stronger due to the weaker carrier.

Standard TX Profiles

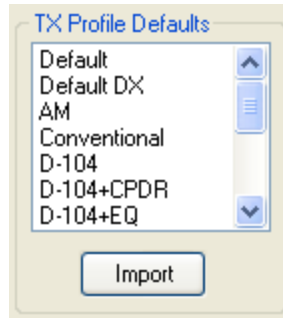


Figure 121: TX Profile Defaults

Click to place a check mark in the **Expert** box to reveal many more **TX Profile Defaults**, as shown in Figure 121. To use one of these, click to select it from the list and then click **Import**. It will now be active and show up in the **Profiles** list described on page 130.

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Appearance Tab

The appearance controls allow the user to customize the appearance of the front console.

General Sub-Tab

These controls change the appearance of the buttons and the VFOs.

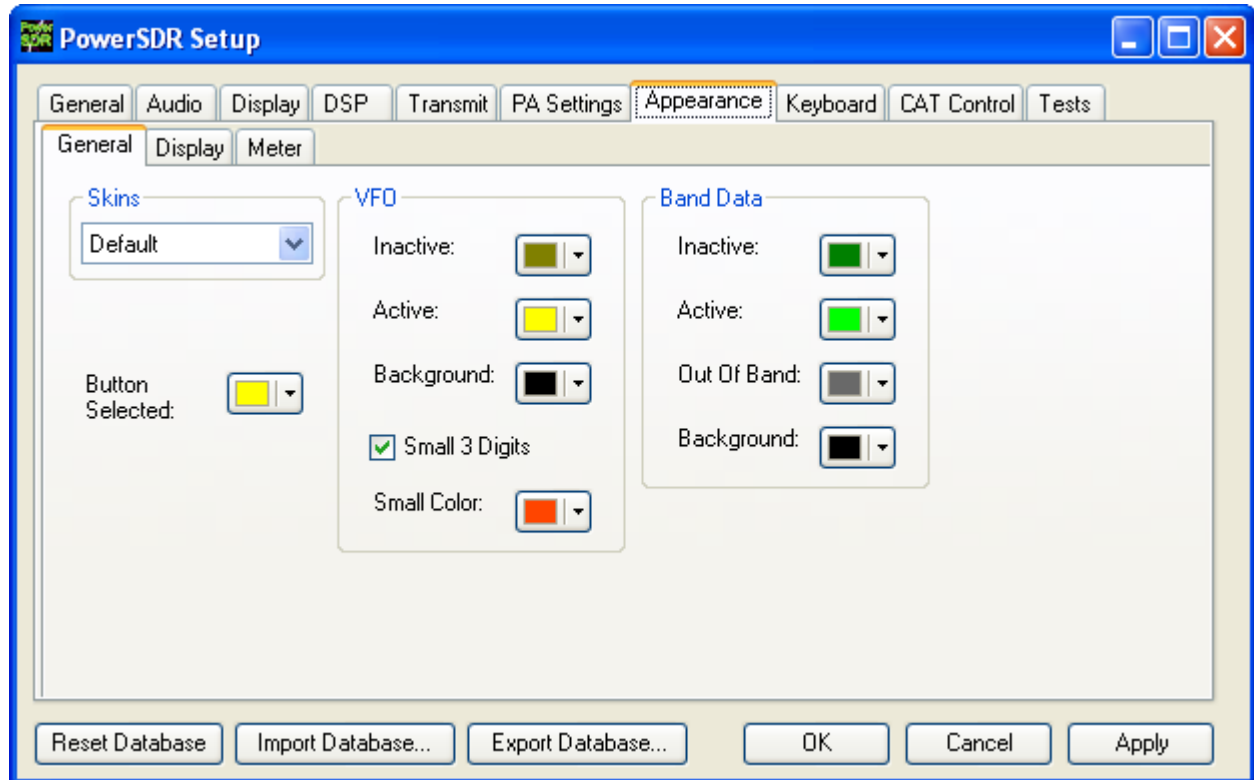


Figure 122: Setup Form-Appearance Tab, General Sub-Tab

Button Selected: The color of buttons on the operating forms and the setup form when they are selected.

Skins

If you have installed more than just the Default skin, they will be listed in the drop-down box. Select a skin to change the appearance of your Front Console.

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VFO

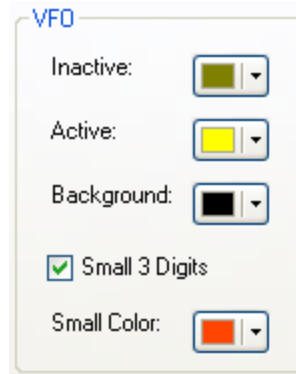


Figure 123: VFO Appearance Controls

- ❑ **Inactive:** The color of the text in the VFOs when they are inactive.
- ❑ **Active:** The color of the text in the VFOs when they are active.
- ❑ **Background:** The background color of the text in the VFOs.
- ❑ **Small 3 Digits:** When selected, the three least significant digits of the frequency displayed in the VFOs are shown smaller than the other digits for clarity.
- ❑ **Small Color:** The color of the smaller, least significant digits.

Band Data

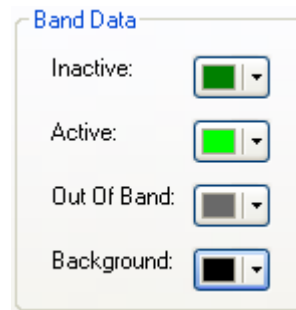


Figure 124: VFO Band Data Appearance Controls

- ❑ **Inactive:** The color of the band information text when that VFO is inactive.
- ❑ **Active:** The color of the band information text when that VFO is active.
- ❑ **Out Of Band:** The background color of the VFO band information when outside the amateur radio bands.
- ❑ **Background:** The background color of the VFO band information when inside the amateur radio bands.

Display Sub-Tab

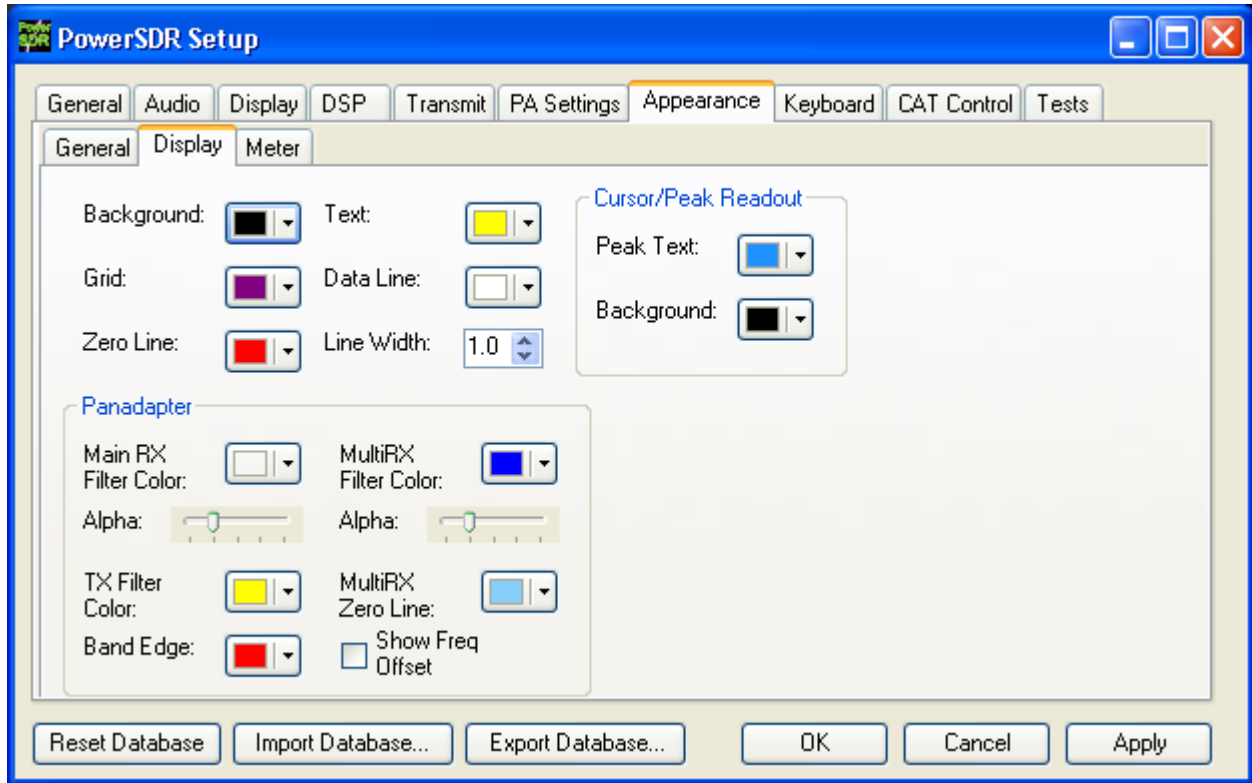


Figure 125: Setup Form-Appearance Tab, Display Sub-Tab

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Overall Display

These controls change the appearance of all the display types, where relevant.



Figure 126: Overall Display Appearance Controls

- ❑ **Background:** The background color for the display (not for *Panadapter* and *Scope*)
- ❑ **Grid:** The color of the grid in display types where a grid is necessary (not for *Panadapter*).
- ❑ **Zero Line:** The color of the zero line in frequency displays.
- ❑ **Text:** The color of the frequency and level axis labels on the display.
- ❑ **Data Line:** The color of the actual data being displayed.
- ❑ **Line Width:** The width in pixels of the actual data being displayed.

Cursor/Peak Readout

These controls change the appearance of the cursor and peak texts under the frequency domain displays.

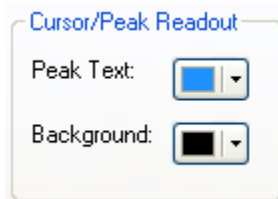


Figure 127: Cursor/Peak Readout Appearance Controls

- ❑ **Peak Text:** The color of the Peak signal location text located under the display.
- ❑ **Background:** The background color of the Peak signal location text.

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Panadapter

These controls change the appearance unique to the Panadapter display (and Waterfall for the filters across the top).

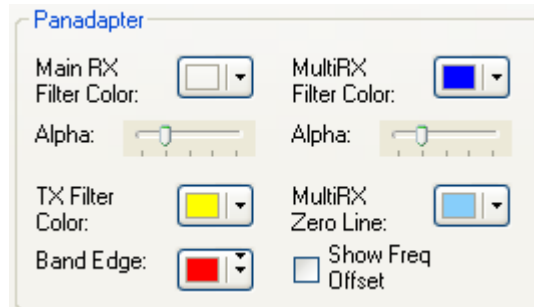


Figure 128: Panadapter Appearance Controls

- ❑ **Main RX Filter Color:** The color of the Main RX Filter. Control the transparency with the **Alpha** slider from completely transparent (left) to completely opaque (right).
- ❑ **MultiRX Filter Color:** The color of the MultiRX Filter. Control the transparency with the **Alpha** slider from completely transparent (left) to completely opaque (right).
- ❑ **TX Filter Color:** The color of the TX filter-edges.
- ❑ **MultiRX Zero Line:** The color of the 0 Hz line of the Sub RX Filter.
- ❑ **Band Edge:** The color of the lines marking the edge of an Amateur band.
- ❑ **Show Freq. Offset:** When selected, the offsets from the Main RX Filter 0 Hz line are shown across the top as opposed to the actual frequencies.

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Meter Sub-Tab

These controls enable selection of the analog meter style and change the appearance of the meters.

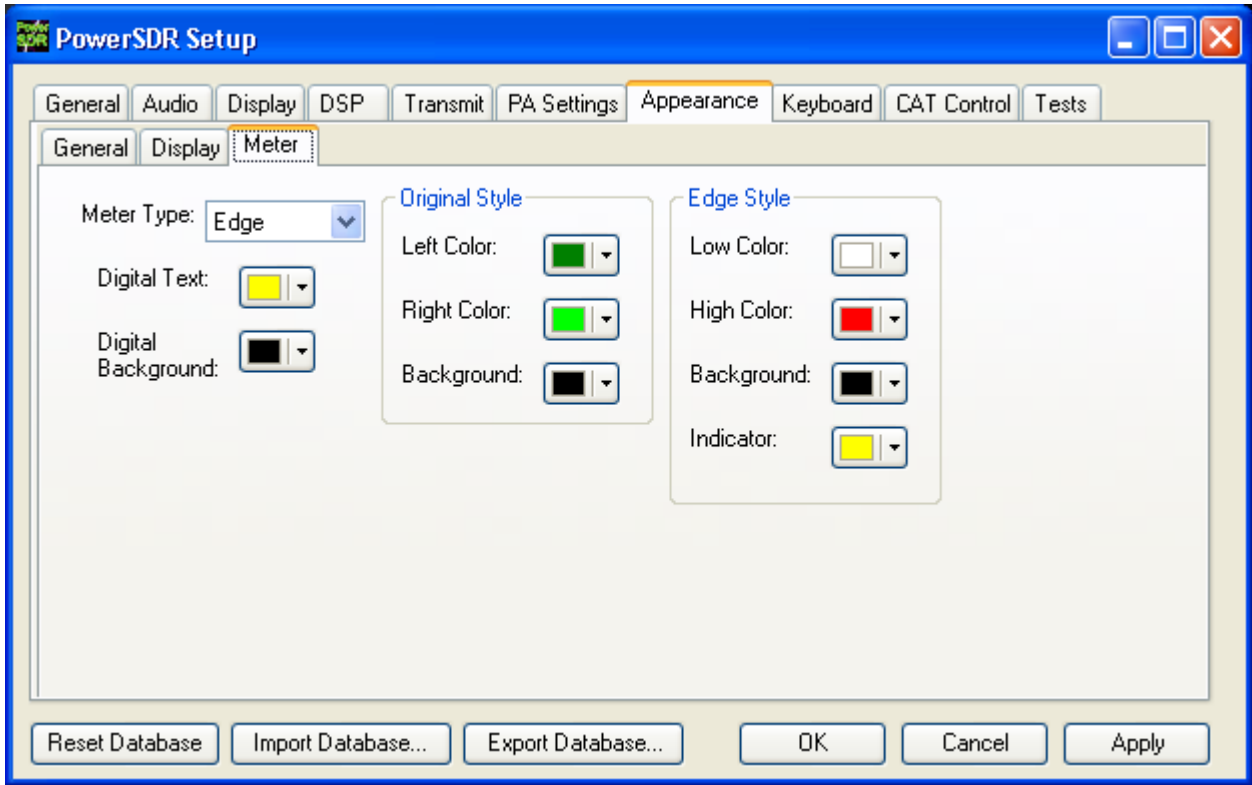


Figure 129: Setup Form-Appearance Tab, Meter Sub-Tab

- ❑ **Meter Type:** Selects the type of graphical meter to display: **Original** displays the bar graph meter and **Edge** displays an analog edge style meter.
- ❑ **Digital Text:** The color of the text of the digital meter.
- ❑ **Digital Background:** The background color of the digital meter.

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Original Style



Figure 130: Appearance Controls for the Original Style Meter

- ❑ **Left Color:** The color of the left side of the original style meter gradient.
- ❑ **Right Color:** The color of the right side of the original style meter gradient.
- ❑ **Background:** The background color of the original style meter.

Edge Style

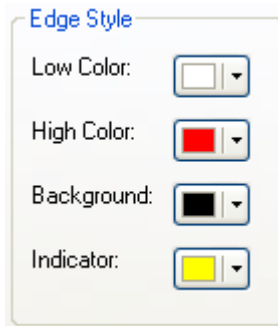


Figure 131: Appearance Controls for the Edge Style Meter

- ❑ **Low Color:** The color of the low values of the edge meter’s scale.
- ❑ **High Color:** The color of the high values of the edge meter’s scale.
- ❑ **Background:** The background color of the edge meter.
- ❑ **Indicator:** The color of the indicator in the edge meter.

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Keyboard Tab

These controls associate keys on the keyboard with several operating functions as keyboard shortcuts.

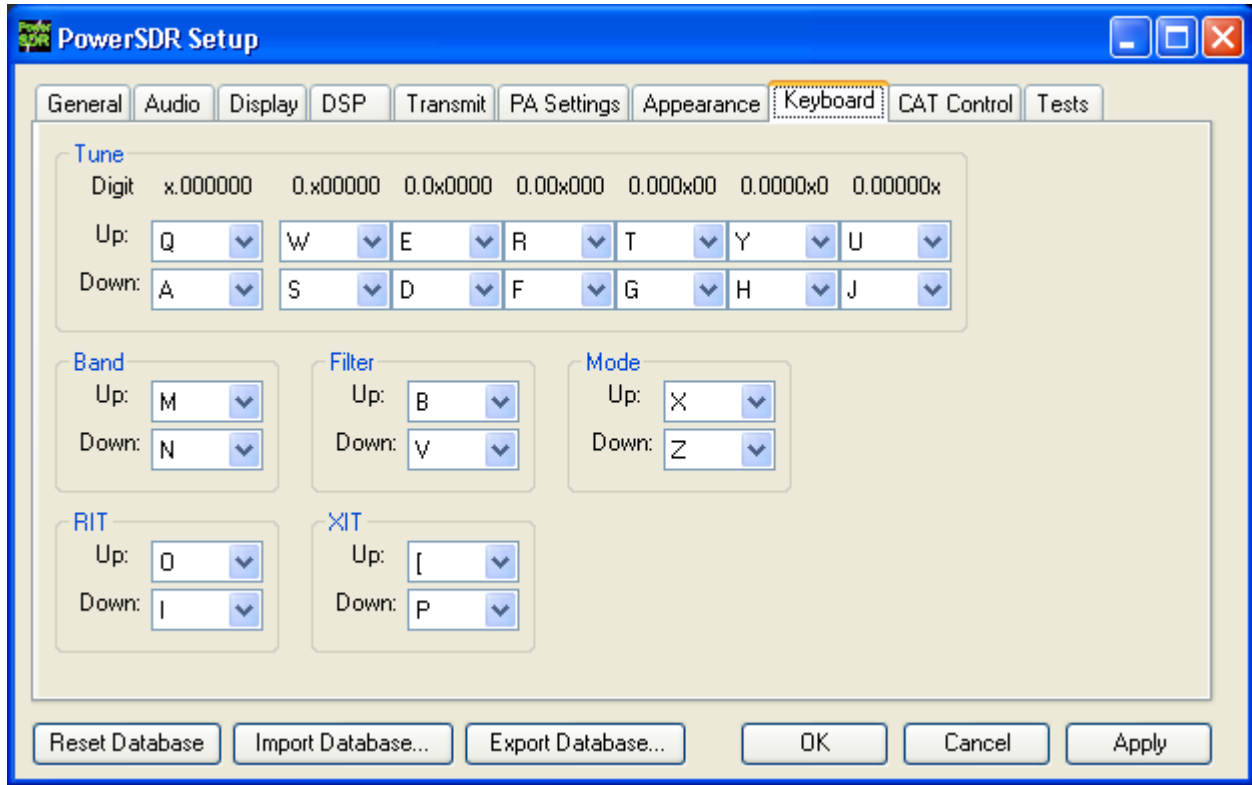


Figure 132: Setup Form - Keyboard Tab

The **Tune** mapping options allow you to tune each digit (with resolution to 1 Hz) up or down using the key of your choice. The digit to be tuned is shown in the labels above these hot keys as an 'x'. Similarly, you can map keys to change the **Band**, **Filter**, **Mode**, **RIT** and **XIT** up or down using the drop down controls in the respective sections.

Note: Choosing any of the arrow keys will require using Alt + [arrow key].

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Cat Control Tab

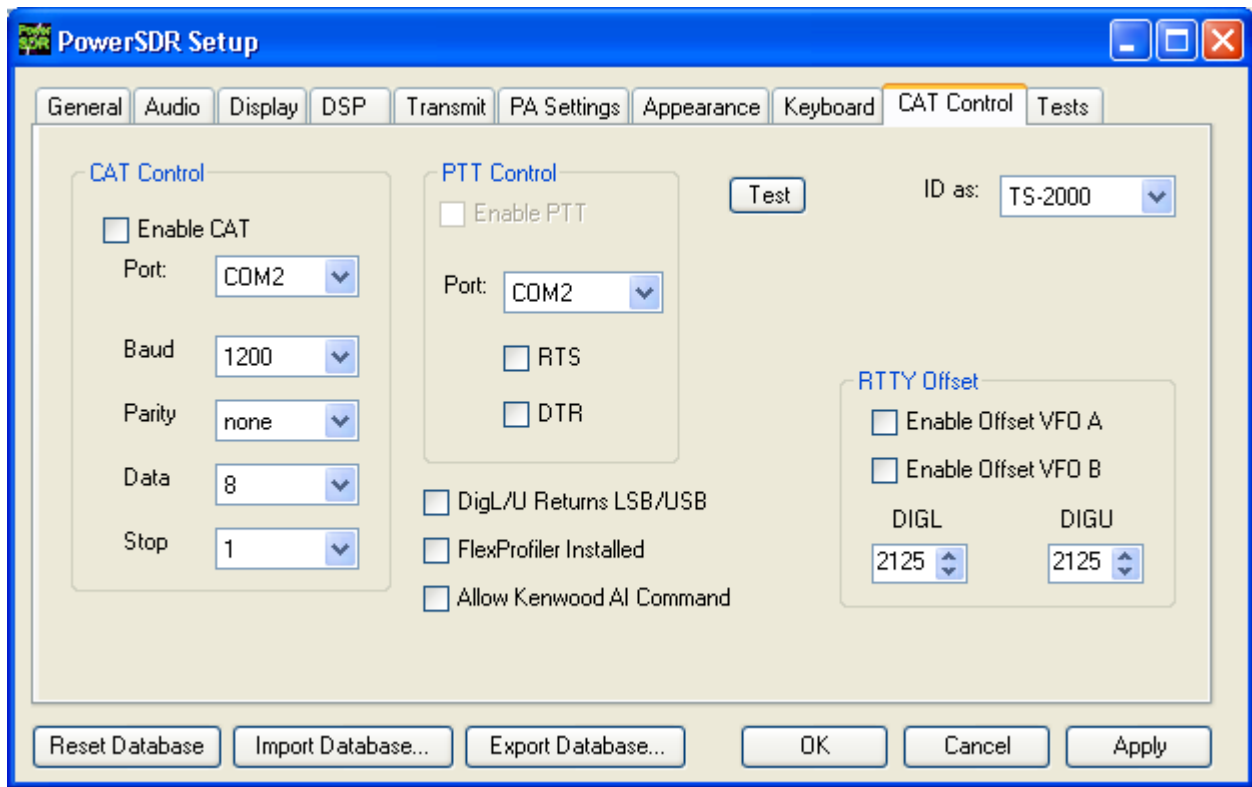


Figure 133: Setup Form - Cat Control Tab

The **CAT** (Computer Aided Transceiver) **Controls** enable PowerSDR to provide the user with a way to interface with third-party logging and remote control software. In conjunction with null-modem virtual serial port pairs (see pages 47 and 49) interaction is possible with third party programs such as digital mode programs and logging programs.

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Cat Control

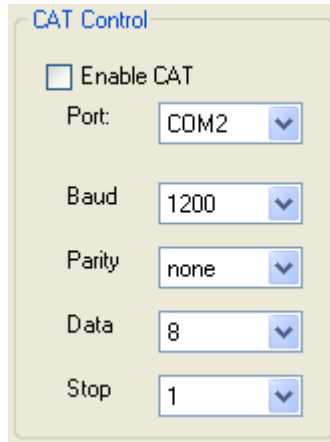


Figure 134: CAT Control

- ❑ **Enable CAT:** Check this box to open the com port using the settings below. Note that you will need to uncheck this box in order to adjust the settings.
- ❑ **Port:** Com port number to use. If using null-modem virtual serial port pairs, note that you will use one end of the pair here and the other in the third-party software.
- ❑ **Baud:** The speed at which to transfer data.
- ❑ **Parity:** Sets whether to send a parity bit.
- ❑ **Data:** Sets how many data bits are sent with each byte.
- ❑ **Stop:** Sets whether to send a stop bit.

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PTT Control

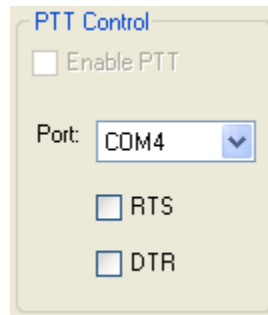


Figure 135: PTT Control

Some software utilizes a separate COM port to activate PTT than that used for CAT control. These controls allow the user to configure this separate port to handle these signals.

- Enable PTT:** Used to enable the hardware PTT. This control is unavailable (grayed out) unless a check mark is placed in at least one of the RTS or DTR boxes (see below).
- Port:** The COM port used for the PTT signal.
- RTS:** Select this box to use the RTS line to engage PTT.
- DTR:** Select this box to use the DTR line to engage PTT.

DigiL/U Returns LSB/USB

By default DigiL sends or returns the CAT command FSK-R and DigiU sends or returns the CAT command FSK. If this check box is checked, they will instead send or return LSB and USB respectively. The third party digital program you are using will determine which behavior is required.

FlexProfiler Installed

Enables the PowerSDR menu for selection of *Remote Profiles*. When this menu option is available, the user can select console profiles created remotely in FlexProfiler¹ from the local PowerSDR console.

Allow Kenwood AI Command

Enables the Kenwood AI command which causes PowerSDR to broadcast changes to the transmit frequency (normally VFO A, but VFO B if in Split) to the CAT system. Normally, CAT only responds to polling from the remote program. There are a few programs that expect frequency changes to be broadcast.

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¹ FlexProfiler is a program developed by K5KDN. It is no longer actively supported.

Test

Click **Test** to bring up the CAT Command Tester form as shown in Figure 136 below. A valid CAT command may be entered in the **CAT Command** text box. The command will execute when the Enter key is depressed or the **Execute** button is clicked. Typing the semicolon, the CAT terminator, at the end of the command is optional. The CAT response will appear in the **CAT Response** text box.

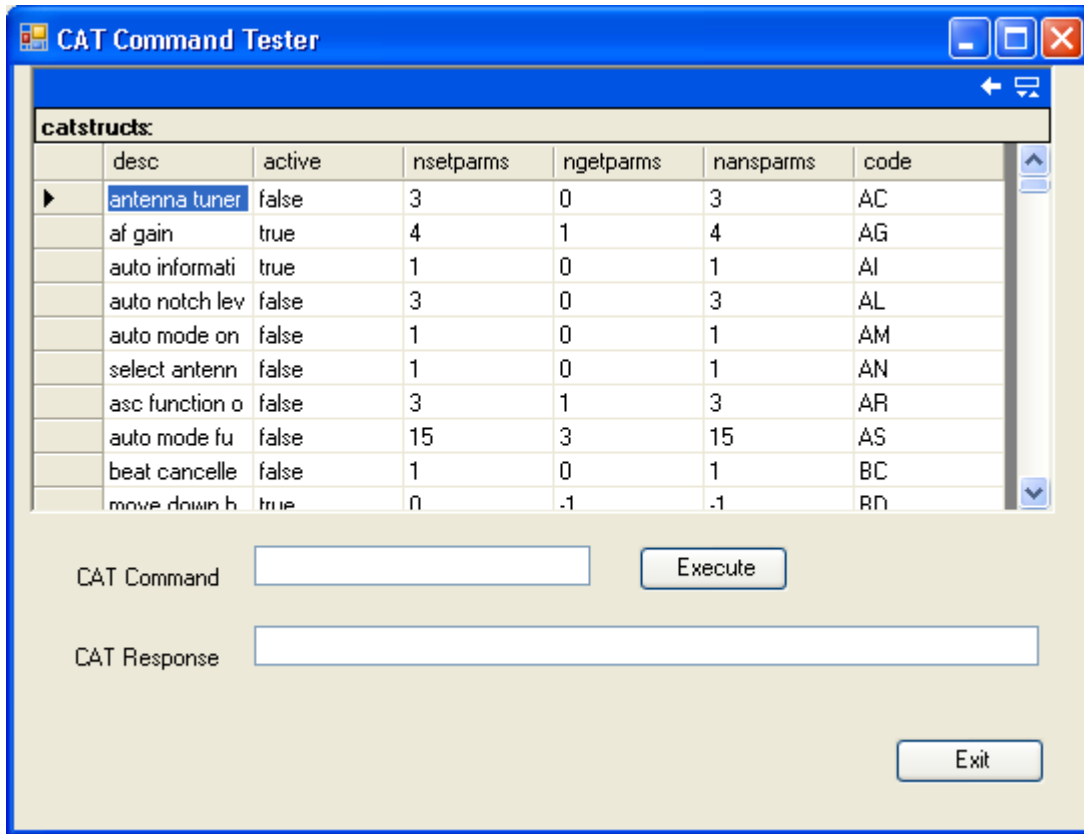


Figure 136: CAT Command Tester Form

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ID AS

Select how PowerSDR should ID itself to third party programs for the purposes of passing CAT control commands. PowerSDR supports the CAT command set as defined for the Kenwood TS-2000 transceiver, and various other Kenwood transceivers. PowerSDR's complete command set is an extension of the TS-2000 command set, to account for the many control functions unique to PowerSDR.

However, most third party programs do not (yet) support the full PowerSDR command set. In these cases the best setting will usually be *TS-2000*. If this is unavailable in your third party software, you might try one of the other ID selections.

RTTY Offset

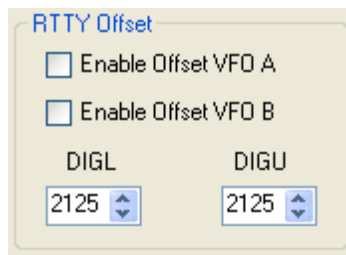


Figure 137: RTTY Offset

The **RTTY Offset** controls add or subtract the offset entered in **DIGU** and **DIGL** respectively, from the VFO frequency before CAT reports it to a third party program.

- ❑ **Enable Offset VFOA:** Check to apply the RTTY Offset to VFOA
- ❑ **Enable Offset VFOB:** Check to apply the RTTY Offset to VFOB
- ❑ **DIGL/DIGU:** Select the offset to be applied when in DIGU and DIGL mode respectively.

Note: This differs from **ClickTune Offsets** (see page 103), as the **ClickTune Offsets** actually change the Front Console VFO frequency, whereas the **RTTY Offset** only offsets the frequency reported by CAT.

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Tests Tab

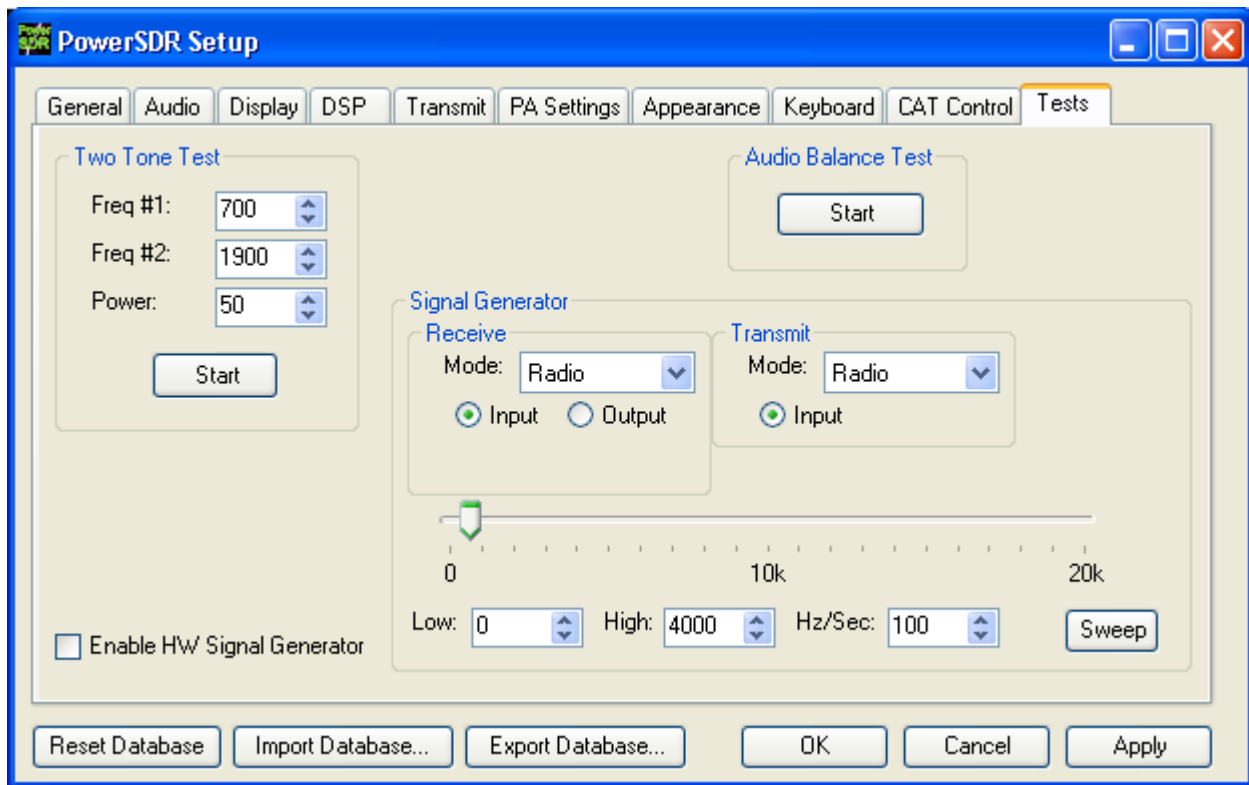


Figure 138: Setup Form - Tests Tab

Two Tone Test:

Used to test the two-tone IMD of the transmitter. To run the test, enter the two tone frequencies in the **Freq #1** and **Freq #2** controls. Enter the **Power** to be sent to the front panel **Drive** control. Make sure you have a dummy load connected. Click the **Start** button to begin transmitting a side-tone signal using the parameters entered. Manually adjust the **Power** control on this tab to set the tones to 6 dB below PEP using a spectrum analyzer. Click the **Start** button again to stop the test and read the **Power** value thus found. A single sweep function on a spectrum analyzer is an excellent tool to capture the output for analysis.

Audio Balance Test

Use this test to ensure that the Phones cable is getting both output channels. The test will send a tone to each speaker and prompt to see if you hear audio in that one speaker. If you hear no audio or audio in both channels during this test, then either the connector is not properly seated or you may have a problem with the cable going to the Phones jack on the Front Panel.

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Signal Generator

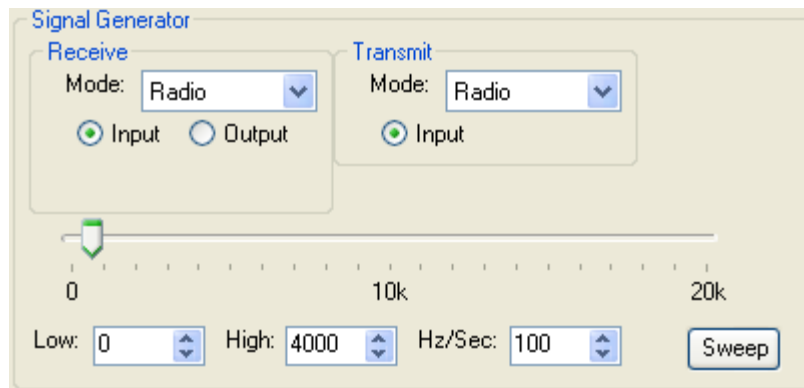


Figure 139: AF Signal Generator

This Signal Generator sends an AF signal to either the input or output of either the receiver or the transmitter DSP. It is used to test PowerSDR.

- ❑ **Mode:** Select the type of signal to generate. *Radio* means the Signal Generator is turned off and FLEX-1500 hardware can be used.

Note: When finished with the Signal Generator, do not forget to place the Signal Generator back to *Radio*.

- ❑ **Scale:** A scaling factor to adjust the level of the signal being generated. This is only available when *Tone* is selected. Only values smaller than 1 are possible.
- ❑ **Input:** The generated signal is sent to the Input of the DSP, as if it were coming from the ADC like your antenna signals would. The generated signal is therefore perceived as an IF signal by PowerSDR.

For example, if your IF is set at the default 9 kHz, then a 0 Hz generated *Tone* would be displayed 9 kHz below the VFO frequency on the Panadapter. As you increase its frequency, upper and lower side band mixing products appear. If you have selected USB mode on the Front Console you will only start to hear a tone when the frequency slider is above 9 kHz such that the tone's upper side band is within the audio passband. If you select the Scope display, you will only see the signal when it is within the audio passband.

- ❑ **Output:** The generated signal is sent directly to the output, bypassing the DSP. The tone of the Receive Signal Generator is available from pin# 9 of the FlexWire I/O jack on the back panel for viewing on an external scope, for example. The effect of the DSP can be observed by comparing the Output signal to the Input signal.
- ❑ **Frequency Slider:** Determines the frequency of the generated signal.
- ❑ **Sweep:** Click this button to sweep the generated signal frequency from **Low** to **High** at a rate of **Hz/Sec**. While sweeping, the button will be yellow. To prematurely stop the sweep click the **Sweep** button again.

Hint:

Together with the **Peak** display setting the Receive Signal Generator's *Noise* setting allows you to display the actual shape of your audio passband filter. To do so, set your PowerSDR display to **Spectrum**, activate **Peak** and set the **Receive Signal Generator** to *Noise* with **Input** selected. After a few moments, click the **Start** button to stop PowerSDR and select a wider filter setting to see more of your filter.

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