

# FLEX-5000™

**HF-6m Transceiver**  
**2m-70cm Transceiver with optional VU5K**

# Owners Manual

Version 2.8

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## SOFTWARE DEFINED RADIO

# The FLEX-5000 Series Owner's Manual

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# Table of Contents

<b>PREFACE.....</b>	<b>XI</b>
<b>ACKNOWLEDGMENTS.....</b>	<b>XIII</b>
<b>USING THIS MANUAL IN ITS PDF FORM .....</b>	<b>XV</b>
<b>REFERENCE TO SOFTWARE CONTROLS.....</b>	<b>XVII</b>
<b>1 HARDWARE INSTALLATION .....</b>	<b>1</b>
<b>    CONTENTS OF THE CARTON .....</b>	<b>1</b>
<b>    LOCATION CONSIDERATIONS.....</b>	<b>2</b>
<b>    RADIO RELATED CONNECTIONS.....</b>	<b>2</b>
Front Panel.....	3
(1) LED Push Button Power Switch .....	4
(2) Headphone Jack .....	4
(3) Microphone Connector .....	4
(4) Internal Speaker ( <i>FLEX-5000C Only</i> ) .....	5
Back Panel.....	6
(1) Primary Antenna Ports ( <i>ANT1, ANT2 &amp; ANT3</i> ).....	7
(2)-(3) Receive Only Antenna Ports ( <i>RX1 IN &amp; RX2 IN</i> ).....	7
(2) External RX1 OUT to RX1 IN Receive Loop.....	7
(4)-(5) Dedicated Transverter Connections .....	7
(6) 13.8 VDC Power Socket .....	7
(7) Dual IEEE 1394 FireWire Jacks.....	8
(8) Straight Key or Paddles ( <i>KEY</i> ) .....	9
(9) External Keying Lines ( <i>AMP RLY TX1, TX2 &amp; TX3</i> ).....	9
(10) External Frequency Reference Input.....	10
(11) Powered Speaker/Line Out Jack .....	10
(12) FlexWire™ Peripheral Interface Bus.....	10
(13) Line-Out and Line-In Audio Jacks.....	11
(14) Balanced Line Input .....	11
Connecting to a Balanced XLR Connector .....	12
(15) PTT Jack.....	12
(16) RF Ground Terminal .....	13
<b>    FLEX-5000C COMPUTER CONNECTIONS AND INITIALIZATION.....</b>	<b>13</b>
Computer Connections .....	13
<i>Wireless Keyboard and Mouse</i> .....	13
<i>FireWire Cable</i> .....	13
<i>Monitor or LCD Display</i> .....	13
<i>Computer Speakers</i> .....	14
<i>Network Connection</i> .....	14
Computer Initialization .....	14

Power-up and Connect Keyboard and Mouse .....	14
Set up and Configure the Computer .....	15
Set Your Time Zone and the System Date/Time .....	16
Reference Documents .....	16
Installer Library .....	16
Hard Drive Restore Process .....	17
<b>SPECIFICATIONS AND ARCHITECTURE .....</b>	<b>17</b>
FLEX-5000A and FLEX-5000C Transceiver Specifications .....	17
FLEX-5000C Embedded Computer Specifications .....	19
FLEX-5000 Architecture .....	20
Declarations of Conformity .....	21
FCC .....	21
EU Compliance .....	21

## 2 SOFTWARE INSTALLATION ..... 23

<b>SWITCH OFF THE FLEX-5000A AND RUN THE INSTALLER .....</b>	<b>23</b>
Collecting Your Information .....	24
Installing the FireWire Driver .....	30
Installing PowerSDR .....	37
<b>POWER UP THE FLEX-5000A TO COMPLETE THE INSTALLATION .....</b>	<b>38</b>
Windows Vista and Windows 7 .....	39
Windows XP .....	39

## 3 POWERSDR SETUP & CONFIGURATION ..... 43

<b>SETUP WIZARD .....</b>	<b>43</b>
<b>CONFIGURATION .....</b>	<b>47</b>
Transfer of Calibration Data .....	47
Audio Mixer .....	48
Antenna Port and External Keying Lines .....	49
<b>READY TO START OPERATING .....</b>	<b>50</b>

## 4 OPERATION ..... 51

<b>POWER-UP PROCEDURE .....</b>	<b>52</b>
<b>POWER-DOWN PROCEDURE .....</b>	<b>53</b>
<b>TUNING METHODS .....</b>	<b>54</b>
<i>Spectrum Drag and Click</i> .....	54
<i>Mouse Wheel</i> .....	54
<i>Mouse Wheel Hover</i> .....	54
<i>Spectrum Click Tuning</i> .....	54
<i>Keyboard Keys</i> .....	55
<i>USB Tuning Knob</i> .....	55
<b>VOICE OPERATION .....</b>	<b>56</b>
Initial Settings .....	57
Continued .....	58
Continued .....	59
<b>CW OPERATION .....</b>	<b>60</b>
Initial Settings .....	61
Internal Keyer .....	62
DSP keyer .....	63
External Keyer .....	64
CWX Form .....	64
DSP keyer .....	65
Third Party CW Program .....	66

<b>DIGITAL OPERATION .....</b>	<b>67</b>
continued.....	68
Initial settings.....	69
VAC settings.....	70
Digi settings.....	71
<b>5 FRONT CONSOLE.....</b>	<b>73</b>
<b>(1) VFO A.....</b>	<b>74</b>
<b>(2) Band Text and TUNING CONTROLS .....</b>	<b>75</b>
Tune Controls continued.....	76
<b>(3) VFO B.....</b>	<b>77</b>
<b>(4 AND 4B) MULTIMETERS.....</b>	<b>77</b>
RX1 and RX2 Meters .....	78
TX Meters .....	79
<b>(5 AND 5B) BAND SELECTION &amp; BAND STACKING MEMORIES .....</b>	<b>80</b>
<b>(6 AND 6B) MODE SELECTION .....</b>	<b>81</b>
<b>(7 AND 7B) FILTER CONTROLS.....</b>	<b>82</b>
Labeled Filter Buttons.....	83
Variable Filter Buttons .....	83
<b>(8) MODE SPECIFIC CONTROLS.....</b>	<b>84</b>
Phone Controls .....	85
CW Controls.....	86
Digital Controls.....	87
<b>(9 AND 9B) DISPLAY CONTROLS.....</b>	<b>88</b>
Screen Controls.....	88
Display Selection Controls.....	89
Display Type Descriptions.....	90
<i>Spectrum</i> .....	90
<i>Panadapter</i> .....	91
<i>continued</i> .....	92
<i>Waterfall</i> .....	93
<i>Histogram</i> .....	94
<i>Scope</i> .....	94
<i>Phase</i> .....	95
<i>Panafall</i> .....	95
<i>Panascope</i> .....	95
<i>Off</i> .....	95
<i>RX2 Display</i> .....	95
<i>Cursor and Peak Position</i> .....	96
<b>(10) MULTIRX CONTROLS .....</b>	<b>97</b>
<b>(11 AND 11B) DSP CONTROLS .....</b>	<b>98</b>
<b>(12) VFO CONTROLS.....</b>	<b>99</b>
<b>(13) CPU %.....</b>	<b>100</b>
<b>(14) START/STOP BUTTON .....</b>	<b>100</b>
<b>(15) MON (MONITOR) .....</b>	<b>100</b>
<b>(16) MOX (MANUALLY OPERATED TRANSMIT) .....</b>	<b>100</b>
<b>(17) MUT (MUTE) .....</b>	<b>101</b>
<b>(18) RECORD (○) AND PLAY (▷).....</b>	<b>101</b>
<b>(19) TUN (TUNE) .....</b>	<b>101</b>
<b>(20) ATU AND BYP .....</b>	<b>102</b>
<b>(21) AF (AUDIO FREQUENCY GAIN) .....</b>	<b>102</b>
<b>(22 AND 22B) AGC-T (AGC THRESHOLD) .....</b>	<b>102</b>

(23) DRIVE (TRANSMITTER POWER OUTPUT/TUNE POWER) .....	103
(24 AND 24B) AGC (AUTOMATIC GAIN CONTROL) .....	103
(25 AND 25B) PREAMP .....	103
(26 AND 26B) SQL (SQUELCH) .....	103
(27) ANTENNA SELECTION DISPLAY .....	104
(28) DATE/TIME DISPLAY .....	104
(29) RX2 ON/OFF .....	104
(30) RX2 AUDIO CONTROLS .....	104
(31) SETUP FORM .....	105
(32) – (39) OPERATING FORMS .....	105
 <b>6 OPERATING FORMS .....</b>	<b>106</b>
(32) MEMORY FORM .....	107
Save.....	107
Recall.....	107
(33) WAVE FORM .....	108
Playback .....	108
Playlist .....	108
Record .....	109
TX Gain (dB) .....	109
Quick Rec and Quick Play .....	109
Record Options .....	110
Receive .....	110
Transmit .....	110
Sample Rate.....	110
(34) EQUALIZER FORM .....	111
3-Band Equalizer .....	111
10-Band Equalizer .....	112
28-Band Equalizer .....	113
9-Band Parametric Equalizer PEQ .....	114
(35) XVTRS FORM .....	115
continued.....	116
(36) CWX FORM .....	117
Standard CWX Controls .....	117
<i>CWX Memories</i> .....	118
<i>Special Characters</i> .....	119
Keyboard and Extended Controls .....	119
<i>Extended CWX Controls</i> .....	120
<i>Morse Definition Editor</i> .....	121
(37) MIXER .....	122
Input .....	122
Output .....	122
(38) ANTENNA .....	123
Simple .....	124
Expert .....	125
Delay .....	126
(39) ATU .....	127
Operating Mode .....	127
Tuning Options .....	127
SWR Threshold .....	128
Tuner Feedback .....	128
<b>VOLTAGE AND TEMPERATURE INFORMATION .....</b>	<b>128</b>
(40) ESC .....	129
An explanation of Diversity Reception techniques for the Flex-5000 .....	130

<b>(41) FlexControl Basic</b>	131
Advanced	132
<b>(42) Gray Wtr (Color Wtr)</b>	132
<b>(43) TX WaterID</b>	133
<b>(44) Callsign box (for TX WaterID)</b>	133
<b>(45) Scanner (Memory, SWL)</b>	134
SWR, Freq Scanner	135
<b>(46) Spotter</b>	136
PC Time Sync	136
DX Spotting	137
LoTW	137
NCDXF beacon scanner	138
Maps (Live DX Spotter)	139
Maps (Live F-layer,D-layer,lightning,Clouds)	140
SWL	141
Beam Antenna pointing	141
<b>(47) MAPS (Live F-layer,D-layer,lightning,Clouds)</b>	140
<b>(48) SWL Search</b>	141
<b>(46) Spotter Menu</b> (Spotter Settings, Spot DX Call Watch, VOACAP Override, Time Server list)	142
<b>(49) PDF-Manuals</b>	143
<b>(50) Heros filter</b>	143
<b>(51) About</b>	143

## 7 SETUP FORM ..... 144

<b>GENERAL TAB</b>	145
Hardware Config Sub-Tab	145
Radio Model	145
FLEX-5000 Config	145
Receive Only	146
DDS	147
Options Sub-Tab	147
Options	148
Process Priority	148
Click Tune Offsets (Hz)	149
Miscellaneous	149
Keyboard	149
Custom Title Text	149
Calibration Sub-Tab	150
Filters Sub-Tab	151
RX2 Sub-Tab	152
Navigation	153
<b>AUDIO TAB</b>	154
Primary Sub-Tab	154
Buffer Size	154
Sample Rate	154
Mic Boost	155
Expert	155
Latency (with Expert checked)	155
VAC Sub-Tab	156
Virtual Audio Cable Setup	156
Auto Enable	157
Gain (dB)	157
Latency	157
Mono/Stereo	157
Combine VAC Input Channels	157
Allow PTT to override/bypass VAC for Phone	157

Direct I/Q.....	158
<b>DISPLAY TAB.....</b>	<b>159</b>
Spectrum Grid.....	159
Refresh Rates.....	160
Waterfall.....	161
Multimeter .....	161
Phase Resolution .....	162
Scope Time Base.....	162
Averaging.....	162
Polyphase FFT.....	162
<b>DSP TAB .....</b>	<b>163</b>
Options Sub-Tab .....	163
Noise Reduction.....	163
Automatic Notch Filter.....	164
Use Peak Readings for TX Meter DSP Values.....	165
Buffer Size.....	165
Noise Blanker .....	166
Noise Blanker 2.....	166
Window.....	167
continued.....	168
Image Reject Sub-Tab .....	169
Expert.....	169
Transmit Rejection .....	170
Keyer Sub-Tab .....	171
CW Pitch.....	171
Connections.....	171
Options .....	172
Signal Shaping .....	173
Break In.....	173
AGC/ALC Sub-Tab.....	174
AGC.....	174
Leveler .....	175
ALC.....	175
<b>TRANSMIT TAB.....</b>	<b>176</b>
Profiles .....	176
Transmit Filter .....	177
DC Block.....	177
Tune.....	177
Downward Expander/Noise Gate.....	178
VOX.....	179
Monitor.....	179
AM Carrier Level .....	179
Standard TX Profiles.....	180
<b>APPEARANCE TAB.....</b>	<b>181</b>
General Sub-Tab .....	181
Skins.....	181
VFO.....	182
Band Data .....	182
Display Sub-Tab .....	183
Overall Display .....	184
Cursor/Peak Readout.....	184
Panadapter .....	185
Meter Sub-Tab .....	186
Original Style.....	187
Edge Style .....	187
<b>KEYBOARD TAB.....</b>	<b>188</b>
<b>CAT CONTROL TAB.....</b>	<b>189</b>
Cat Control .....	190
PTT Control .....	191
DigL/U Returns LSB/USB.....	191
FlexProfiler Installed .....	191
Allow Kenwood AI Command .....	191
Test .....	192
ID AS .....	193

RTTY Offset.....	193
<b>TESTS TAB.....</b>	<b>194</b>
Two Tone Test.....	194
Audio Balance Test.....	194
Signal Generator .....	195
Enable HW Signal Generator.....	196
<b>8 DRIVER CONTROL PANEL.....</b>	<b>197</b>
<b>GLOBAL SETTINGS.....</b>	<b>198</b>
Bus Settings .....	199
DPC Latency Checker.....	199
<b>DEVICE SETTINGS.....</b>	<b>200</b>
General.....	200
Firmware Loader.....	201
continued.....	202

# Preface

Welcome to the exciting world of software defined radio. The FLEX-5000™ software defined transceiver is the culmination of many years of experience gained with FlexRadio's ground breaking SDR-1000™ transceiver. The experience gained and lessons learned have resulted in an SDR platform that is truly state of the art, offering unsurpassed Amateur Radio performance. And unlike most other transceivers, which once acquired, rarely if ever change, the FLEX-5000 will continue to (rapidly) evolve, offering future capabilities currently only dreamed of.

Although the rapid development of the FLEX-5000 can be exhilarating, it can also be somewhat daunting. When first confronted with an FLEX-5000 and its PowerSDR™ operating software, the sheer number of connections, controls, and settings can seem mind boggling even to the most seasoned Ham radio operator. This operating manual attempts to both guide a 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-5000, 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.

FlexRadio Systems is committed to ensuring that your experience with the FLEX-5000 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-5000, 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 reflectors ([http://www.flex-radio.com/Support.aspx?topic=Reflector\\_Description](http://www.flex-radio.com/Support.aspx?topic=Reflector_Description)). 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-5000 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®<sup>1</sup> 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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- ❑ 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.

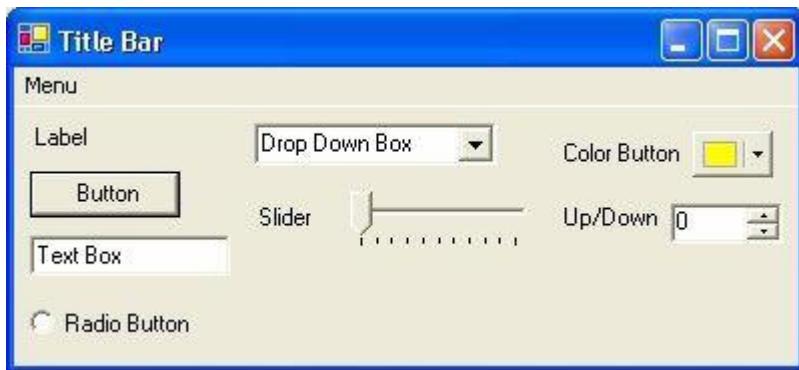
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# Reference to Software Controls

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

## Contents of the Carton

Inside the carton you should find the following items:

*Table 1: Contents of Carton for each FLEX-5000 Model*

Item	FLEX-5000 Model	
	A	C
FLEX-5000 Transceiver	5000A	5000C
6-pin to 6-pin FireWire® cable (6 feet) <sup>1</sup>	✓	✓
Unterminated 12 AWG power cable (4 feet)	✓	✓
T-20 Torx driver	✓	✓
Quick Start Guide	✓	✓
CD ROM/USB Flash Drive with Owner's manual, Installation & Configuration Guide, Quick Start Guide, PowerSDR 2.0 or later, FLEX 5000 FireWire Driver	✓	✓
Wireless keyboard and mouse		✓
2 AA and 2 AAA batteries (for keyboard and mouse)		✓
Keyboard installation CD		✓
Keyboard Instructions		✓
Microsoft® Windows® <sup>2</sup> XP Professional CD		✓
Acronis® <sup>3</sup> True Image License		✓

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

The FLEX-5000 power cable is unterminated on 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 2 red wires to the positive terminal and the 2 black wires to the negative terminal of your power supply<sup>4</sup>.

<sup>1</sup> For the FLEX-5000A, you may need to acquire a 4-pin to 6-pin cable if using a laptop. FireWire and the FireWire logo are registered trademarks of Apple, Inc.

<sup>2</sup> Microsoft, Windows, Windows XP, Windows Vista and Windows 7 are registered trademarks of Microsoft Corporation

<sup>3</sup> Acronis is a registered trademark of Acronis, Inc.

<sup>4</sup> Older radios may have only 1 red and 1 black wire, which are connected to the + and – terminals respectively.

**Note 1:** Do not apply power to the FLEX-5000 until you are instructed to do so.

**Note 2:** Retain the FLEX-5000 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-5000 anywhere, especially back to FlexRadio Systems, this is the preferred packaging to use.

## Location Considerations

To facilitate integrating your FLEX-5000 into your shack you may want to consider the following:

- ❑ Place the FLEX-5000A in close proximity to your computer. It is best to use the shortest FireWire cable possible to connect to your computer to minimize data errors and limit possible RFI getting into the computer. High quality, quad-shielded FireWire cables up to 10m in length have been used successfully with the FLEX-5000.
- ❑ Ensure convenient access to the back panel. The FLEX-5000 back panel is where most of your connections will be made. Having easy access to the back panel without moving the transceiver is optimal while getting started.
- ❑ Avoid placing the FLEX-5000 in direct sunlight. Placing the transceiver in direct sunlight will increase the ambient temperature inside the chassis (especially while transmitting) and make the high volume cooling fan's job more difficult.
- ❑ Heed air flow requirements. Air is drawn in through the bottom air vent in the front of the FLEX-5000 and is exhausted through the top vent in the rear for optimal cooling. Do not block either the front intake or the rear exhaust vent since this will reduce the cooling efficiency.
- ❑ Avoid contact with liquids. Although this is usually not a problem unless you are operating maritime mobile, accidental spills of liquids in the shack on the FLEX-5000 could result in voiding the warranty. Placing the FLEX-5000 away from food and drinks is highly recommended.

## Radio Related Connections

To facilitate integrating the FLEX-5000 into your station, it is worth taking a moment to study the radio's front and back panels. The many antenna and audio connections are not immediately intuitive. This is a direct consequence of the FLEX-5000's versatility in accommodating many configurations, including receive-only antennas, external signal enhancing equipment and transverters, all of which can be assigned on a per band basis, without requiring complex external switching arrangements.

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We will first discuss the front panel and then the back panel radio related connections<sup>1</sup>. The computer related connections for the FLEX-5000C only are described on page 13).

**Hint:** You can also visit the interactive virtual tour on our website of the FLEX-5000A [front panel](#) and [back panel](#) respectively (on our website select Products and then Interactive Virtual Tours), where you can hover over a connector with your mouse to pop up its description.

## Front Panel



Figure 2: FLEX-5000A (top) and FLEX-5000C (bottom) Front Panel

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<sup>1</sup> Identifiers refer to the same controls and connectors on the FLEX-5000A and C models.

## (1) LED Push Button Power Switch

The FLEX-5000 uses a delayed start push button to power up the radio.

- ❑ To turn on the radio, push the button in fully and release. 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 and release.
- ❑ For the **FLEX-5000C** the power switch turns on both the radio and the computer, but only turns off the radio. To shut down the computer, click **Start** (bottom left of screen) and select **Turn Off Computer**.

**Note 1:** Make sure the FLEX-5000 is turned on and then wait 10-15 seconds before starting PowerSDR. Otherwise, PowerSDR will indicate a communication error and offer the option to run in Demo mode. Click **No** to close PowerSDR, turn on the FLEX-5000 and restart PowerSDR.

**Note 2:** Make sure PowerSDR is shut-down before turning off the radio. Otherwise, close PowerSDR and power cycle the FLEX-5000 (turn on, off and on again) and restart PowerSDR.

## (2) Headphone Jack

Accepts headphones with standard 1/4" stereo (TRS) plug. Recommended ratings for headphones are 40 mW into 16 Ohm load (typ) with a 1% THD+N. Higher impedance headphones will also work.

**Note:** Lower impedance headphones and headphones using a mono plug can result in popping audio as soon as PowerSDR is started.

## (3) Microphone Connector

The 8-pin microphone connector offers the ability to connect a microphone and to key the radio via a PTT line. The pin-out is shown in Table 2 below<sup>1</sup>. To engage PTT, pin 6 must be grounded to pin 5 (Shield Ground) and not to pin 7, which is the microphone ground.

*Table 2: Microphone Connector Pin-Out*

Pin #	Signal	Diagram
1	Not Connected	
2	+5 VDC (max 65 mA)	
3	Not Connected	
4	Not Connected	
5	Chassis GND (Shield)	
6	PTT (+)	
7	Mic (-)	
8	Mic (+)	



<sup>1</sup> The pin-out is similar to that normally found on Yaesu radios

**Note:** The FLEX-5000 has a 20 dB microphone preamp built in. If you do not require this additional gain, you may want to try using either the unbalanced Line-In (13) or Balanced Line Input (14) jack on the back panel (see pages 6 and 10).

We recommend use of the Heil microphones, especially the PR series; however, the HM-10 and Goldline microphones will also work well with the FLEX-5000<sup>1</sup>.

#### **(4) Internal Speaker (FLEX-5000C Only)**

The FLEX-5000C does not require external, powered speakers as it comes with an internal speaker. However, you will need to use external powered speakers to take advantage of spatial diversity (such as binaural audio or spatially positioning multiple audio channels).

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<sup>1</sup> These microphones may not sufficiently drive the rear audio inputs (13) and/or (14) (see page 10) without an external preamp.

## Back Panel



*Figure 3: FLEX-5000A (top) and FLEX-5000C (bottom) Back Panel*

**Note:** The right half of the FLEX-5000C back panel is identical to the back panel of the FLEX-5000A; the left half has all the connections for the built in computer.

The FLEX-5000 has the ability to connect up to three different antennas to the receiver and or transmitter and up to two additional receive only antennas. All of these are assignable on a per band basis. The antenna connections are as follows:

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## (1) Primary Antenna Ports (ANT1, ANT2 & ANT3)

Three SO239 antenna ports that can be software selected on a per band basis and assigned as either receive, transmit or both.

## (2)-(3) Receive Only Antenna Ports (RX1 IN & RX2 IN)

Up to two additional receive only antennas can be connected, each of which is separately selectable on a per band basis.

- ❑ **RX1 IN** is the receive only antenna port for the first receiver.
- ❑ **RX2 IN** can be used to connect a receive only antenna to the optional second receiver.

## (2) External RX1 OUT to RX1 IN Receive Loop

With PowerSDR a dedicated receive path can be selected by band so that all of the receive signals input to either **ANT1**, **ANT2** or **ANT3** are output to the **RX1 OUT** port and input back into the **RX1 IN** port. This enables the insertion of external signal enhancing devices such as preamps, filters and preselectors, without requiring complicated switching mechanisms to avoid transmitting through them.

## (4)-(5) Dedicated Transverter Connections

The FLEX-5000 has been designed to support transverters through both a 28 MHz and/or 144 MHz IF interface.

- ❑ **XVTX/COM** outputs a 28 MHz IF signal, adjustable up to +5 dBm to drive external transverters
- ❑ **XVRX** accepts a 28 MHz IF signal from external transverters. If your transverter does not have a separate IF output, then only use **XVTX/COM**
- ❑ **144 MHz** is the output of the optional, internal transverter.

## (6) 13.8 VDC Power Socket

The FLEX-5000A requires a stable 13.8 VDC power source rated for at least 20 A and 25 A peak for proper operation; the FLEX-5000C for at least 25 A and 30 A peak. Supplied with your radio was an unterminated 4-pin keyed Molex type power connector 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, or tinned ends for screw terminals. Connect the 2 red wires to the positive terminal and the 2 black wires to the negative terminal of your power supply<sup>1</sup>. The Molex type connector is inserted into the white Molex receptacle labeled **-13.8 VDC+**.

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<sup>1</sup> Older radios may have only 1 red and 1 black wire, which are connected to the + and – terminals respectively.

## (7) Dual IEEE 1394 FireWire Jacks

The FLEX-5000 has two 400 Mb/s 6-pin IEEE 1394 FireWire jacks. These are 1394a connections not the 1394b (FireWire 800) type which run at 800 Mb/s. Connect the ferrite core end of the supplied 6-pin FireWire cable to either of these two jacks and connect the other end to

- ❑ **FLEX-5000A:** your computer's FireWire jack (the host controller).
- ❑ **FLEX-5000C:** the computer jack marked "FireWire" in Figure 3 on page 6.

The second FireWire jack (7) can be used to "daisy chain" or extend the FireWire bus so that additional IEEE 1394 FireWire devices may be connected.

**WARNING! DO NOT FORCE THE FIREWIRE CONNECTOR IN UPSIDE DOWN. DOING SO WILL DESTROY THE RADIO'S FIREWIRE PORT.**

**CAUTION 1:** Do not connect the second FireWire jack to a second PC. Only one PC can be connected to the FLEX-5000.

**CAUTION 2:** Do not remove the ferrite cores as they are required for CE compliance and to minimize RFI at this ingress point.

**Note 1:** Even though the 1394b standard is supposedly downward compatible (9-pin to 6- or 4-pin cables are used), you should preferably only use 1394a host adapters to connect to the FLEX-5000. Please also refer to the Knowledge Center article [Selecting High Performance FireWire Cards for FlexRadio Transceivers](#) (search for *firewire card* in our Knowledge Center at <http://kc.flex-radio.com/search.aspx>).

**Note 2:** The FLEX-5000 FireWire controller does not supply voltage, so if you are connecting a device "down stream" that normally receives power from the FireWire cable you must supply external power to use that device.

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

#### **(8) Straight Key or Paddles (KEY)**

For CW operation, the ¼" 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

**Note:** Alternatively, you may prefer to connect your paddles to a serial port on your PC using the pin-out shown in Table 4.

**Table 4: PC Serial Port Pin-Out**

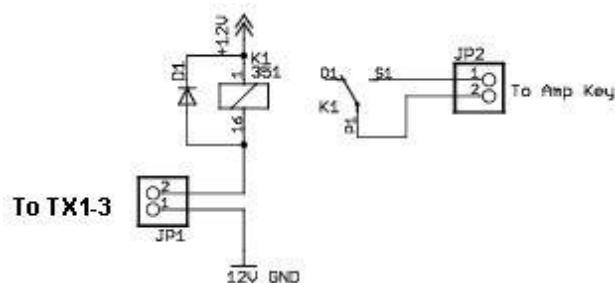
Serial Port Pin*	Keyer Signal
4 (DTR)	Common
6 (DSR)	Dot
8 (CTS)	Dash

\* Assumes a 9-Pin connector

#### **(9) External Keying Lines (AMP RLY TX1, TX2 & TX3)**

These three independent keying lines can be used to key external devices such as linear power amplifiers or transverters. One or more of the keying lines can be used at any one time, can be given a delay and can be assigned on a per band basis on the Antenna Form (see page 120). For example, you may have an HF amplifier that covers 160-10 meters and another amplifier for 6 meters. You can assign **TX1** to bands 160 -10 meters to key the HF amplifier and **TX3** to 6 meters to key that amplifier when you select the 6 meter band.

These keying lines each use an open collector Darlington transistor switch that is rated at 400 mA, 50 VDC maximum. To ensure that your amplifier keying circuit does not damage the Darlington transistor switch, it is safest (even for modern amplifiers) to insert the circuit shown in Figure 4 below between each of TX1, 2 and/or 3 and your amplifier(s).



**Figure 4: Protective PTT Circuit Between TX1-3 and Amplifier**

## (10) External Frequency Reference Input

Accepts input from an optional 10 MHz, 0 to +10 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.

## (11) Powered Speaker/Line Out Jack

This standard 1/8" TRS jack provides line-level (-10 dBV, 600 Ohms) receive - *not computer* - audio<sup>1</sup>. For the FLEX-5000A (and if desired for the FLEX-5000C) connect this jack to an external audio amplifier, to computer-type powered speakers or any other external equipment that accepts line-level audio input. This jack provides two-channel (stereo) audio to enable binaural audio, MultiRX™ (single receiver) or dual receive (with optional second receiver installed). The audio level can be set on the FLEX-5000 Mixer Form (see page 118).

You will find it best to buy a good PC powered speaker system with a sub-woofer and its own volume adjustment.

## (12) FlexWire™ Peripheral Interface Bus

FlexWire is an 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 I<sup>2</sup>C (pronounced "I squared C") protocol along with AF I/O lines.

*Table 5: FlexWire Connector Pin-Out*

Pin #	Signal	Diagram
1	Ground	
2	Line In	
3	(Blocked Pin)	
4	Interrupt (/INT 1)	
5	Ground	
6	I <sup>2</sup> C Clock (SCL)	
7	I <sup>2</sup> C Data (SDA)	
8	+13.8 V, 1 A max	
9	Line Out (in parallel with RCA Line Out)	

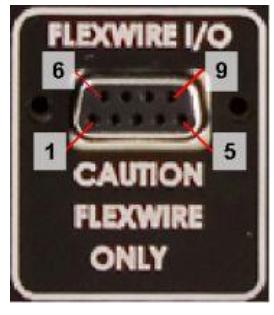


Table 5 above Shows the FlexWire connector pin-out. Complete specifications and the programming interface will be published to allow home brew and third-party add-on products.

**CAUTION:** Do NOT attempt to connect a PC serial port to the FlexWire connector (pin 3 has been blocked to stop this). Doing so may void your warranty and severely damage your FLEX-5000.

<sup>1</sup> The FLEX-5000C also has a built-in speaker

### (13) Line-Out and Line-In Audio Jacks

Consumer level (-10 dBV) audio connections. Audio levels can be set on the FLEX-5000 Mixer Form (see page 118).

- ❑ **Line-Out** can drive external sound card-based applications if VAC is not, or cannot be used. It can also provide audio for external audio equipment such as recorders and audio spectrum analyzers. Line Out impedance equals 600 Ohms.
- ❑ **Line-In** allows the connection of external audio equipment, VAC or an external sound card, e.g. to play back prerecorded audio over the air. Line In impedance equals 5 kOhms.

### (14) Balanced Line Input

1/4" TRS jack to connect to audio processing equipment supplying balanced audio (+4 dBu max), such as a microphone preamplifier or (chain of) equalizers, compressor/limiters, aural excitors and other effects processors. This jack can be used instead of the Microphone connector on the front panel. However, unlike the front panel Microphone connector, there is no 20 dB preamp in line. The Pin-Out is shown in Table 6 below. Balanced Line Input input impedance is >50 kOhms.

*Table 6: Pin-Out of Balanced Line-In Connector*

Contact	Description	Connector
Tip	Positive phase for balanced mono signals or mic (+)	 Tip Ring Sleeve
Ring	Negative phase for balanced mono signals or mic (-)	
Sleeve	Ground or shield connection	

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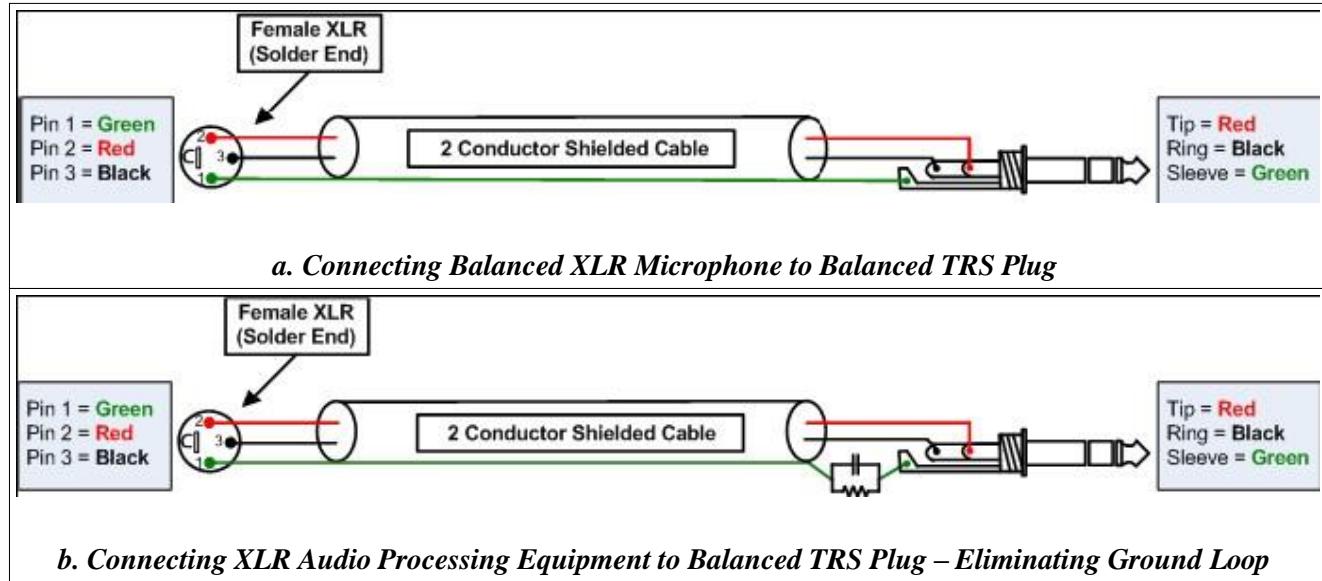
## Connecting to a Balanced XLR Connector

The most common way to use the balanced line-in connector is when using a balanced microphone, usually having a male XLR connector (see Table 7 below).

*Table 7: XLR Male and Female Connector Pin-out*

Contact	Description	Connector
Pin 1	Ground or shield connection	
Pin 2	Positive phase for balanced mono signals or mic (+)	
Pin 3	Negative phase for balanced mono signals or mic (-)	

To interface this type of microphone to the FLEX-5000 a balanced XLR (female) to balanced 1/4" TRS (male) cable is necessary, which should be wired as shown in Figure 5a. You can also connect audio processing equipment using a similar cable. If you have a ground loop or a lack of proper grounding (indicated by hum or buzz in your output), adding a simple filter to the shield may resolve the problem (see Figure 5b). The filter consists of typically a 100 Ohm resistor to attenuate small DC currents, decoupled for RF by typically a 4pF – 10nF capacitor.



*Figure 5: Wiring Diagrams to Connect Between Balanced TRS and XLR Connectors*

### (15) PTT Jack

Connect to external hardware devices such as foot pedals or hand switches to key the rig. The transmitter will be engaged when the center conductor is grounded.

## (16) 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-5000 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).

# FLEX-5000C Computer Connections and Initialization

This section is relevant for the FLEX-5000C only. If you have a FLEX-5000A, this section is not relevant and you may skip to the next section.

## Computer Connections

### Wireless Keyboard and Mouse

- ❑ Insert (2) AAA batteries into the battery compartment in the bottom of the wireless computer keyboard. Additional instructions may be found on the label underneath the keyboard.
- ❑ Insert (2) AA batteries into the wireless mouse. The battery door covers the lower half of the mouse and may be removed by a pressing/sliding motion on top of the product logo. With the mouse in the operating position, the battery cover slides away from the buttons/scroll wheel and toward you as you remove it.
- ❑ Plug the USB connector of the wireless receiver into one of 4 USB ports, indicated as **USB** in Figure 3 on page 6. (The green and purple 6-pin MiniDIN PS/2-style connectors on the wireless interface are not used if a USB connection is made.)
- ❑ If connecting additional USB devices, any USB jack will work with any USB device.

### FireWire Cable

Connect the supplied FireWire cable between the Computer FireWire jack (**FireWire** in Figure 3) and one of the two radio's FireWire jacks (**7**) as described on page 8. Make sure the ferrites are closest to the radio's FireWire jacks (**7**). Do not remove these ferrites since they are required for CE compliance and to minimize RFI.

### Monitor or LCD Display

Connect a monitor or LCD display to the **VGA** connector.

**Note:** Even though the system supports digital video through the two additional **DVI** connectors, it is necessary to use the **VGA** connector to initialize the computer. Either **DVI** or **VGA** connector(s) may be used after initialization

## Computer Speakers

If desired, connect external computer speakers to the green jack marked **Speaker** in Figure 3. These are used to output audio from the operating system and any programs you may use.

**Note:** Do not confuse these with the internal speaker or external speakers you may have connected to the Powered Speakers jack (**11**), which are strictly used for receive audio by the FLEX-5000.

## Network Connection

**WARNING!** **Install an anti-virus protection application before connecting to networks or the Internet. FlexRadio is not responsible for problems caused by virus, spyware or other malware exposure.**

Using one of the three Ethernet network jacks (marked **Network** in Figure 3 on page 6), you may connect your FLEX-5000C computer to your local area network or to your Internet modem. To make the connection, use a standard CAT5 network cable. The Network jacks support 10/100/1000 Ethernet.

## Computer Initialization

Before proceeding, write down the **Product Key** (see Figure 3 on page 6) from the label on the rear of the radio. This Microsoft **Product Key** appears in 5 groups with 5 letters/numbers in each group. You will enter these during the setup process.

### Power-up and Connect Keyboard and Mouse

Position the radio, display, keyboard, mouse and wireless keyboard controller in their operating positions

1. Turn the mouse and keyboard upside down for easy access to the **connect** buttons.
2. Turn on your display/monitor/LCD panel and select D-sub or analog source if applicable .
3. Turn on your 13.8 VDC power supply.
4. Turn on the FLEX-5000C using the power button on the front panel (press momentarily). A delay of a few seconds until seeing the LED light is normal (see page 3).

The power button LED should illuminate, the fans should start inside and the light on the wireless keyboard controller should illuminate. If not, cut the 13.8 VDC power and recheck your connections.

5. Press and release the **connect** button on the wireless keyboard controller and press and release the **connect** button on the bottom of the keyboard. Wait at least 20 seconds before the next step.

6. Press and release the **connect** button on the wireless keyboard controller again and press and release the **connect** button on the bottom of the mouse.
7. Move the mouse and check for pointer motion on the display.

**Note:** The mouse and keyboard reference sheet provides additional details.

At this point you should see the Microsoft opening screen (and hear sound if you added computer speakers). If you are unable to spend about 5 minutes completing the next section, you may turn off the system by turning off the power supply. It will not be possible to stop the computer by using the front panel button.

## ***Setup and Configure the Computer***

The operating system is preinstalled but in a “sealed” state. It is not usable until you accept the *End User Licensing Agreement* contained in the operating system. FlexRadio is not in control of this process since the software use agreement is between you, the end user, and Microsoft.

**Note:** The following steps summarize much of the more detailed information in your *Start Here* operating system booklet from Microsoft. That booklet is packed in the box with your new radio. Please refer to that booklet for additional information if needed during the setup process.

The screens you will see during the setup process and the suggested actions are:

1. Welcome to Microsoft Windows: click **Next**.
2. End User License Agreement: if you agree, click **Yes** to accept, then click **Next**.
3. Is this a genuine copy of Microsoft Windows?/Product Key Entry: enter the Product Key you copied from the back panel label, then click **Next**.
4. What's your computer's name?: accept the default name or enter a name of your choosing, click **Next**.
5. What's your Administrator Password?: enter a password if desired (recommended if on a network), click **Next**.
6. Is this computer in a Domain?: for almost all users - click **next**. Users in a large network **with a domain controller** should get specific instructions from the network administrator.
7. Checking your Internet Connectivity: results will depend on whether a network cable is connected:
  - o If an Internet connection is found, several screens will follow to set up your Internet connection.

- If the search times out, you will see "An Internet connection could not be chosen". Click **Next**.
  - To skip the search, click **Skip** and go directly to the next screen.
8. Ready to Activate Windows?:
- If connected to the Internet, you may activate by clicking **Yes** and then **Next**.
  - If you will activate Windows later or by phone click **No** and then **Next**.
9. Thank you: click **Finish**.

### ***Set Your Time Zone and the System Date/Time***

To set your computer time zone and the correct date/time:

1. Double-click the clock in the lower right corner of the desktop view.
2. Click the **Time Zone** tab at the top.
  - Select your time zone from the list (above the map).
  - Click **Apply**.
1. Click the **Date & Time** tab at the top
  - Set your date by clicking on the calendar
  - Set your time by entering where shown then click apply

You are now ready to operate your FLEX-5000C. Please skip to chapter 2 on page 43 to learn how to setup PowerSDR.

### ***Reference Documents***

Your reference documents are accessible from the startup menu and by double-clicking the **FlexRadio Documentation** folder shortcut shown on your desktop. Most reference documents are in Adobe PDF format and are read by using the PDF Reader application. **You must install the PDF reader before attempting to open any PDF document.** Your Owners Manual is also in PDF format. The PDF reader may be downloaded from the Adobe web site and is free software. Please see <http://www.adobe.com>

### ***Installer Library***

Drivers and documentation for your computer system board as well as software, firmware and drivers used by FlexRadio are stored in your *Installer Library*. These items are preinstalled and are provided as backup copies in the event you need to remove/reinstall any of them. The folder is located at the root level of the C: drive. There is also a menu entry under *All Programs*.

## Hard Drive Restore Process

The computer within your radio has a hidden restore partition on the hard drive called the Secure Zone<sup>®</sup><sup>1</sup>. It contains a complete copy of the originally shipped factory software. In the event you have a virus infection, major problem with the operating system, accidental folder deletion or other major disturbance, it is possible to completely reinstall the operating system, application programs, FlexRadio programs and tools from this restore partition.

**CAUTION:** Any files you added or modified along with all new software and data will be erased and replaced with only the files FlexRadio installed at time of manufacture. This means the loss of all logs, email, photos, new programs and your PowerSDR memory file (called PowerSDR.mdb in the PowerSDR vn.n.n folder). These files may be preserved by copying them to a USB memory key or even e-mailing them.

The restore software is included in the purchase price of your radio. A serial number for your copy of this software is listed on a separate page packed with your system. You also have the opportunity (but not the obligation) to upgrade this software and use additional features by contacting the software vendor (Acronis) directly. Your Secure Zone will restore the original configuration additional times if future errors occur. It is not necessary to register or upgrade the Acronis software to use the restore process again in the future. If the hard drive fails, the secure zone and restore image could be lost. In this case, contact FlexRadio for instructions.

When your computer first starts, a brief screen image will display the Acronis logo. By quickly pressing the <F10> key, the Recovery Manager<sup>®</sup> will appear. You may have to press this key several times starting after you power up your radio since some monitors might not show any image before this screen has disappeared. The Recovery Manager screen will offer three choices. You may elect to restore your system, shut it down, or continue to start Windows normally. If you click the Restore option and click yes on the warning notice, the restore process will begin. It is normal for 1-2 minutes to elapse as the program loads. After that, information screens will describe each step. Restarting your system at the end of the process will return you to the same software experience as new, out-of-the-box. The entire restore process should take less than ten minutes.

## Specifications and Architecture

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

## FLEX-5000A and FLEX-5000C Transceiver Specifications

Table 8 on page 18 displays an overview of the specifications for the FLEX-5000A and the FLEX-5000C transceiver.

<sup>1</sup> Secure Zone and Recovery Manager are registered trademarks of Acronis, Inc.

**Table 8: Overview of FLEX-5000A Specifications**

General	
<b>Receiver Frequency Range</b>	10 kHz – 65 MHz (operating – requires external, customer provided filters below 1.8 MHz to eliminate images); 160 m – 6 m (specified Amateur bands only)
<b>Transmitter Frequency Range</b>	160 m – 6 m (specified Amateur bands only)
<b>Frequency Stability</b>	±0.5 ppm 32 °F to 122 °F (0 °C to +50 °C)
<b>Operating Temperature Range</b>	14 °F to 122 °F (-10 °C to +50 °C)
<b>Emission Modes</b>	A1A (CW), A3E (AM), J3E (LSB, USB), F3E (FM), F1B (RTTY), F1D (PACKET), F2D (PACKET)
<b>Frequency Steps</b>	1 Hz minimum
<b>Antenna Impedance</b>	50 Ohms, unbalanced 6 - 1000 Ohms, unbalanced (With Optional Tuner ON, 160 m – 10 m Amateur bands) 16 - 150 Ohms, unbalanced (With Optional Tuner ON, 6 m Amateur band)
<b>Max Rating TX1-3 Key Lines</b>	50 V, 400 mA
<b>Audio In/Out</b>	Unbalanced: 10 dBV nominal (consumer level), Input Impedance: 5 kOhms Output Impedance 600 Ohms Balanced: +4 dBμ, Input Impedance >50 kOhms
<b>Recommended Headphones</b>	40 mW, 16 Ohms, 1% THD+N; higher impedance headphones will also work
<b>Frequency Reference Input</b>	0 to +10 dBm required
<b>Power Consumption</b>	Rx 1.5 A (typ); Tx (100 W): FLEX-5000A 25 A (max.), FLEX-5000C 30 A (max.)
<b>Supply Voltage</b>	DC 13.8 V ± 10%
<b>Maximum Interconnect Cable Length</b>	10 feet (3 m), No restriction on DC cable within voltage tolerance limits under load.
<b>Special EMI/RFI Requirements – CE Compliance Cable Requirements</b>	1 snap on ferrite bead on DC cable (supplied), 2 snap on ferrite beads on FireWire cable (supplied), and 1 snap on ferrite bead on FlexWire cable. All beads to be located adjacent to rear panel of radio.
<b>Dimensions:</b>	FLEX 5000A: (WxHxD): 9.3" x 9.0" x 12.4" (23.5 cm x 22.9 cm x 31.6 cm) FLEX-5000C: (WxHxD): 17.7" x 9.0" x 14.7" (44.9 cm x 22.9 cm x 37.3 cm)
<b>Weight (approx.):</b>	FLEX-5000A: 13 lbs (5.9 kg); FLEX-5000C: 34 lbs (15.4 kg)
<b>Receiver</b>	
<b>Circuit Type</b>	Direct conversion, low IF
<b>Intermediate Frequency</b>	Software selectable from DC to 20 kHz
<b>MDS</b>	14 MHz Preamp off/on: 1.3/0.3 μV; MDS: -123 dBm/-133 dBm in 500 Hz BW
<b>IP3</b>	+30 dBm at 14 MHz with preamp off at 2 kHz or less tone spacing (S5 IM3 method)
<b>Selectivity (-6/-60 dB)</b>	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
<b>Image Rejection</b>	70 dB or better (160 - 6m Amateur bands)
<b>Transmitter</b>	
<b>Power Output</b>	1-100 W PEP CW and SSB (25 W AM carrier)
<b>Power Out XVT</b>	0 dBm
<b>Emission Modes</b>	A1A (CWU, CWL), J3E (USB, LSB), A3E (AM), F3E (FM), DIGITAL
<b>Harmonic Radiation</b>	Better than -55 dB (160 – 10 m Amateur bands) Better than -65 dB (6 m Amateur band)
<b>SSB Carrier Suppression</b>	At least 55 dB below peak output
<b>Undesired Sideband Suppression</b>	At least 55 dB below peak output
<b>Audio Response</b>	(SSB): Flat Response 10 Hz to 20 kHz, 3-band or 10-band Software EQ
<b>3<sup>rd</sup> Order IMD</b>	Better than 33 dB below PEP @ 14.2 MHz 100 W PEP
<b>Microphone Impedance</b>	600 Ohms (200 to 10 kOhms)
<b>Balanced Line In Impedance</b>	600 Ohms (200 to 10 kOhms)

## FLEX-5000C Embedded Computer Specifications

Table 9 displays an overview of the specifications for the embedded computer in the FLEX-5000C.

*Table 9: FLEX-5000C Embedded Computer Specifications*

Hardware	
<b>Motherboard</b>	High performance Mini-ITX, incorporating mPGA478 socket, which is able to accommodate a wide range of Intel® Core 2 Duo™ Processors. Front Side Bus 533/667 MHz Intel 945GM + Intel ICH7R chip set Intel GMA950 graphic controller on board Dual independent display support (two DVI interfaces) DDR2 memory support SATA 150/300 IDE memory controllers 10/100/1000 Mbps Ethernet ports USB 2.0 ports External RS232C serial port IEEE 1394 FireWire ports
<b>Processor</b>	Core 2 Duo x86 processor (installed)
<b>Memory</b>	1 GB dual-channel DDR2 (installed)
<b>Hard Drive</b>	160 GB SATA/150 (installed)
<b>Keyboard and Mouse</b>	Wireless keyboard and mouse supplied
<b>Monitor(s)</b>	External (not supplied); VGA or (dual) DVI; Resolution: 1024 x 768 min/2048 x 1536 max
<b>Software</b>	
<b>Operating System</b>	Windows XP Professional
<b>PowerSDR</b>	Latest version installed
<b>Other</b>	Collection of Ham Radio Software installed, including vCOM virtual serial port software

**IMPORTANT NOTE:** In order to run PowerSDR ke9ns v2.8.0 you must upgrade your 5000c computer board with a modern Micro ATX (mATX) form factor motherboard. Preferably any motherboard capable of supporting an AMD Ryzen CPU will be more than enough power to run your Flex-5000c with no issues. or an Intel with at least 6 cores and threads combined. You will also need to make sure the motherboard has onboard Video card output in either DVI, HDMI, Display port, or Thunderbolt. Most likely you will need to also purchase a FireWire card that will plug into a PCIe slot and have a cable to allow you to move the 1394A port, since there are not slots on the 5000c case.

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## FLEX-5000 Architecture

The FLEX-5000 full duplex/triplex architecture is shown in Figure 6 below.

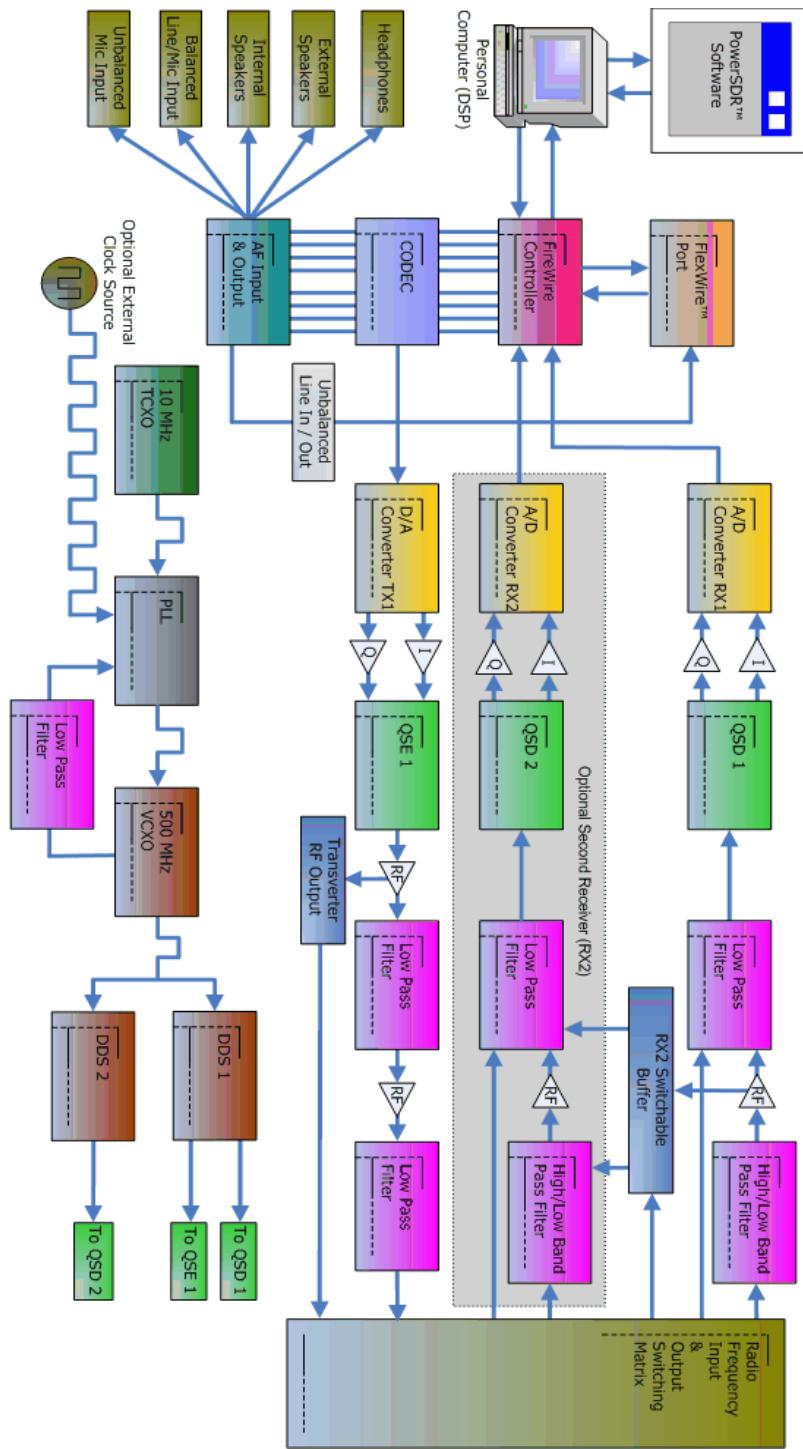


Figure 6: FLEX-5000 Full Duplex/Tripex Architecture

## Declarations of Conformity

### FCC

The FLEX-5000 complies with FCC Part 97 rules for the Amateur Radio Service.

### EU Compliance



European Union Declaration of Conformity

### Flex-5000A 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: August 23, 2007

FlexRadio Systems  
8900 Marybank Drive  
Austin, TX 78750

Person Responsible: Gerald Youngblood (Signature on File)



## Software Installation

**Note :** This chapter is relevant for a new FLEX-5000A installation. The FLEX-5000C comes pre-installed with the latest version of the software at the time of shipping. However, should you own a FLEX-5000C and need to re-install or replace the software (with a later version), you will need to follow the procedures outlined in this chapter.

### Switch Off the FLEX-5000A and Run the Installer

**Note 1:** To install the software, you must at least connect the FLEX-5000A to a 13.8 VDC power supply and an IEEE 1394 FireWire computer port.

**Note 2:** If there is a (Edirol FA-66 or Presonus Firebox) sound card connected to the same FireWire host controller you are planning to use with the FLEX-5000A, **disconnect** it until the installation is complete and the FLEX-5000A is fully operational.

**WARNING!** It has been reported that data corruption occurred when trying to use a FireWire hard disk. We do not recommend that you have a FireWire hard disk connected to the same FireWire controller (bus) as the FLEX-5000. Both of these devices use the FireWire bus extensively and performance of both will be degraded significantly.

Also, do not connect both a FLEX-3000 and a FLEX-5000 to the same computer. The drivers cannot differentiate between the two and erratic behavior may occur.

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Make sure **the FLEX-5000A is turned off** (Power switch LED is **not** illuminated, see Figure 2 on page 3). Alternatively, disconnect the FireWire cable between your FLEX-5000 and the computer. It is also a good idea to close all other applications.

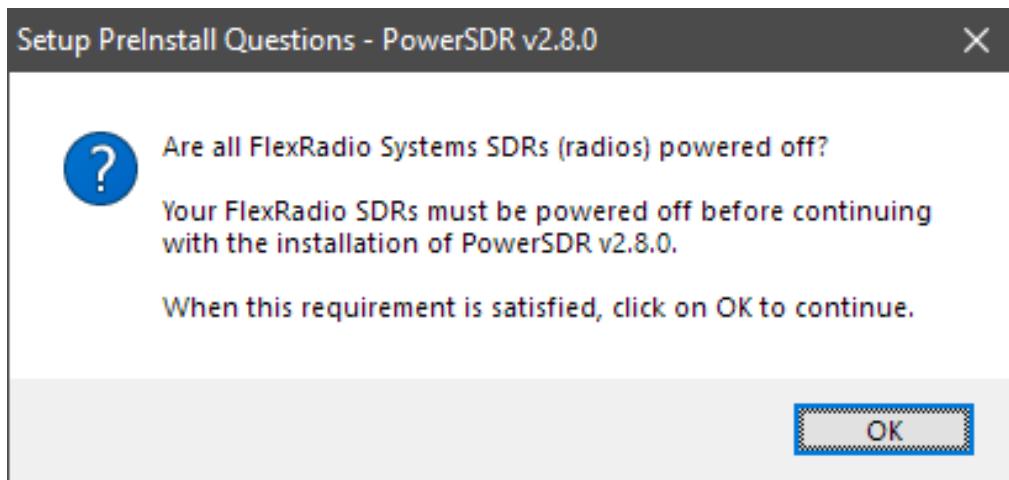
All the software required for the FLEX-5000 is installed through the PowerSDR Setup application.

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. The PowerSDR Setup Application runs the PowerSDR InstallShield Wizard which will:

1. Collect your information.
2. Start the FlexRadio Driver Setup Wizard to install the FireWire driver.
3. Install PowerSDR.

## Collecting Your Information

Double click the downloaded application to start the InstallShield Wizard (Figure 7<sup>1</sup>).



*Figure 7: FlexRadio Setup Install Wizard - Welcome*

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

<sup>1</sup> 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.

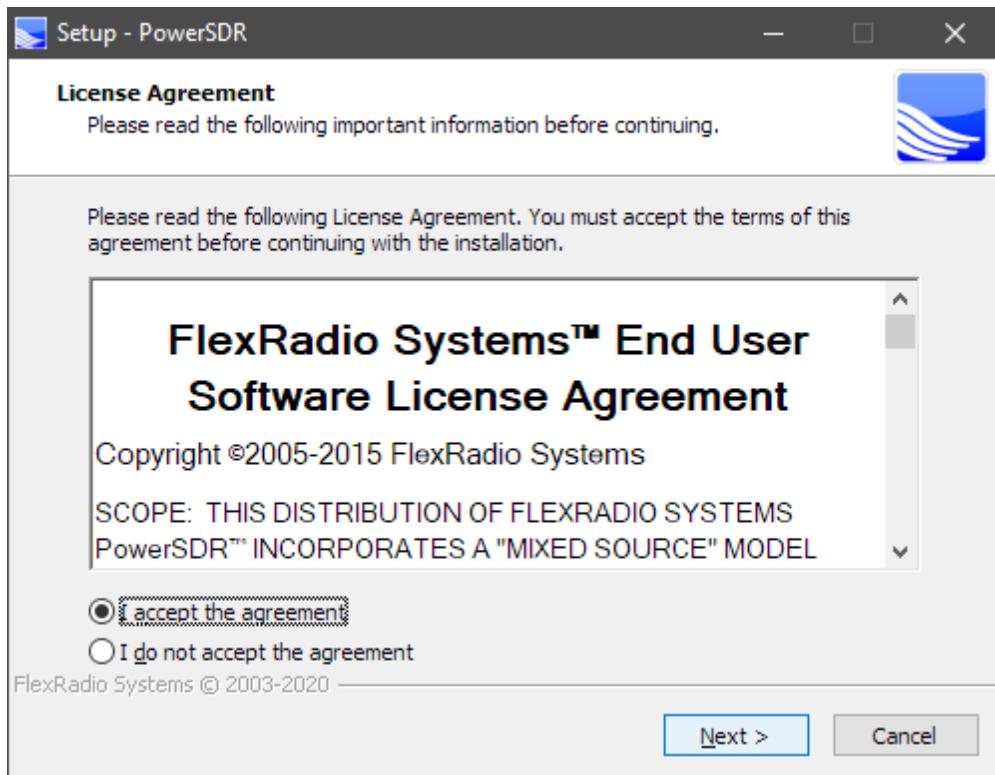
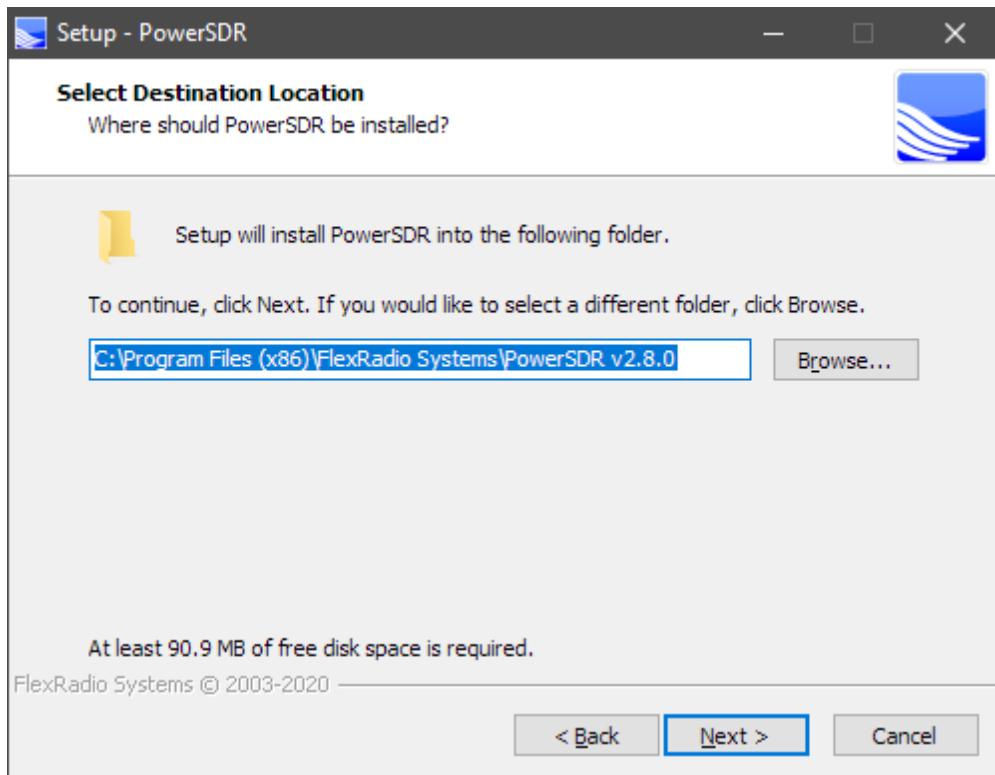


Figure 8: FlexRadio Install Wizard – Proprietary Software License

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 9).

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

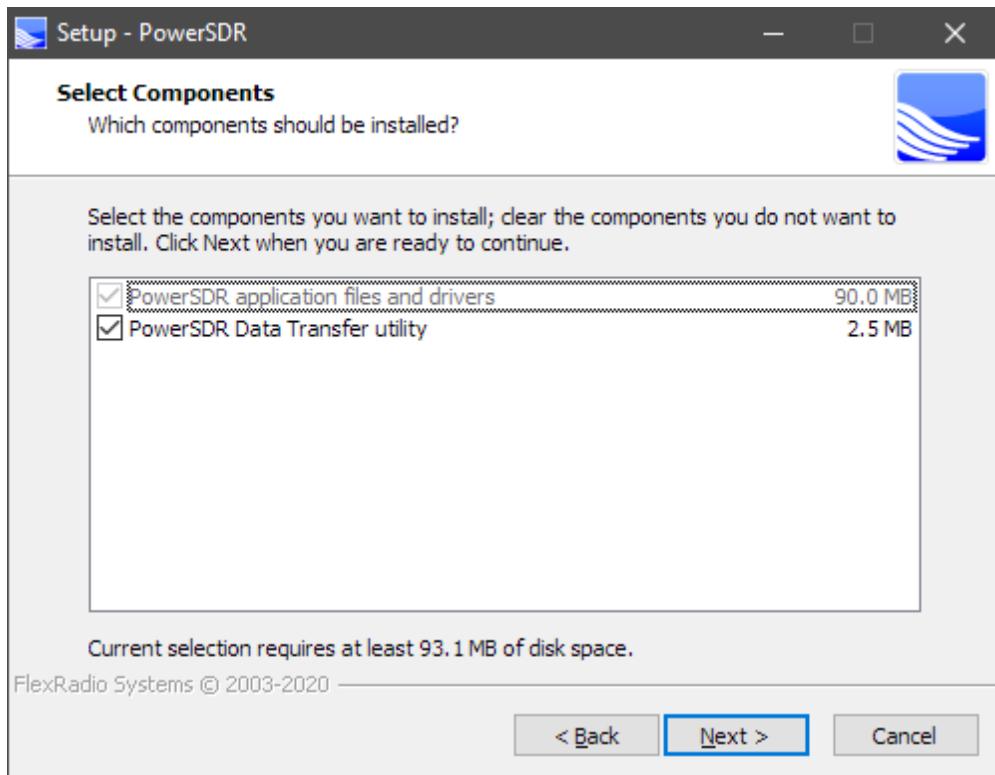
[The rest of this page has been left blank intentionally]



**Figure 10: FlexRadio Install Wizard – install location (don't change)**

Enter your information and click **Next** to select the setup type (Figure 11).

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



*Figure 11: FlexRadio Install Wizard –*

Select **Complete** to install all the software<sup>1</sup>. Click **Next** to select the radio(s) (Figure 12).

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

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

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

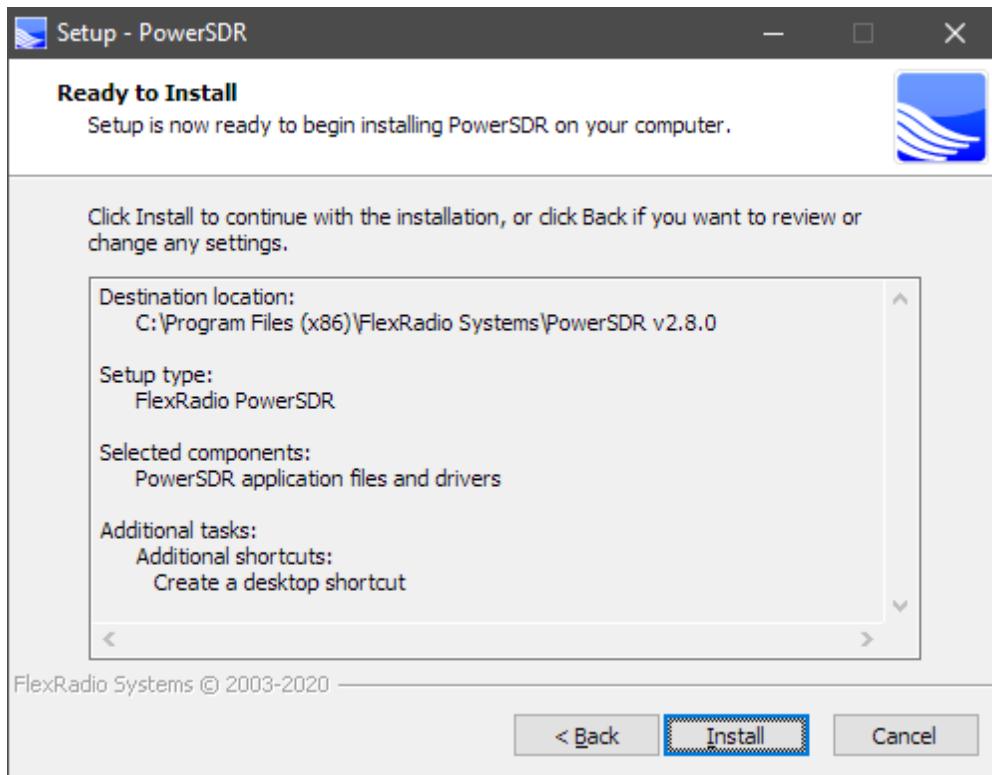


Figure 13: FlexRadio InstallShield Wizard – Ready to Install

To review and/or change your installation settings, click **Back**. Otherwise, click **Install** and the InstallShield Wizard will proceed to install the FireWire Driver.

## Installing the FireWire Driver

Before the FlexRadio FireWire Driver can be installed your radio must be turned off. You will see a reminder to check that it is. (Figure 14).

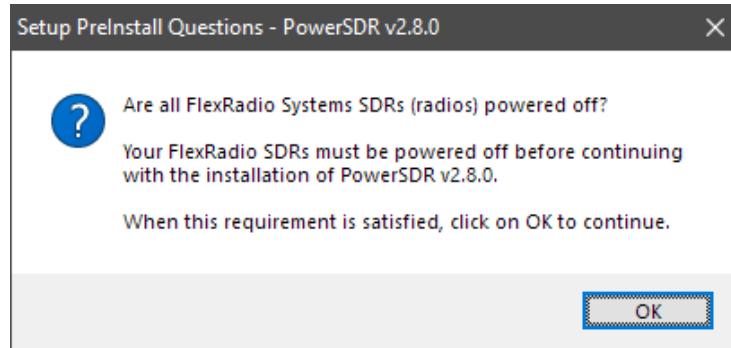


Figure 14: FlexRadio InstallShield Wizard - Reminder to Turn Off Radio

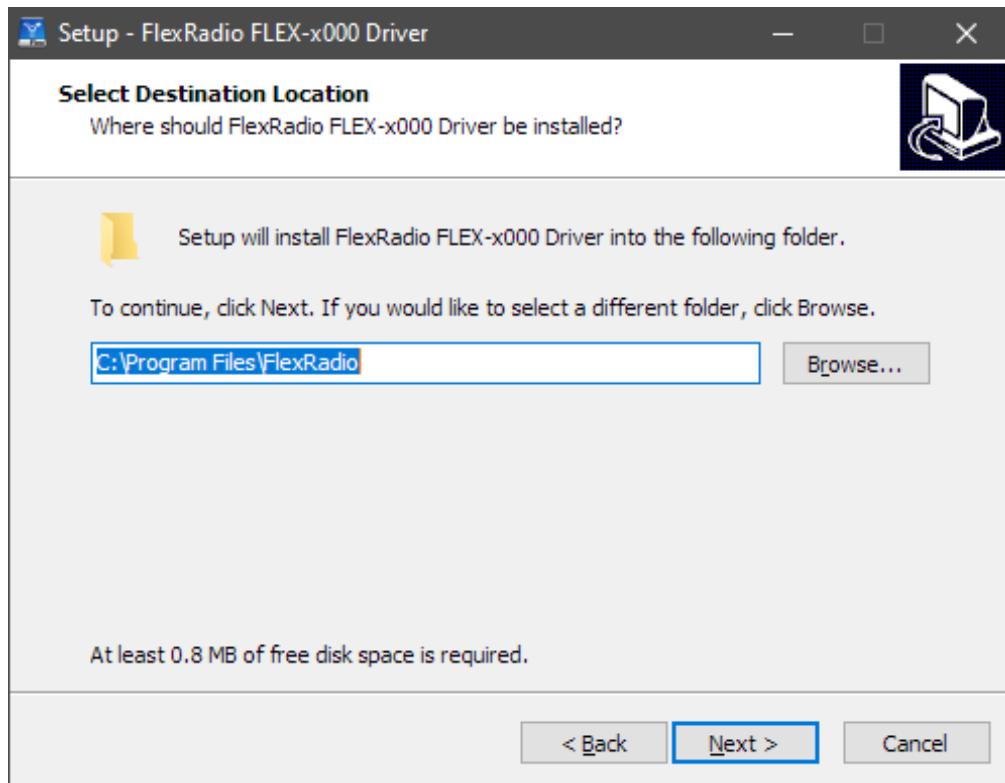
Make sure your radio is indeed turned off and click **Continue**. The FlexRadio InstallShield Wizard will start the FlexRadio Driver Setup Wizard and you will see a Welcome screen (Figure 15).



*Figure 15: FlexRadio Driver Setup Wizard - Welcome*

Click **Next** to select the destination folder for the Driver (Figure 16).

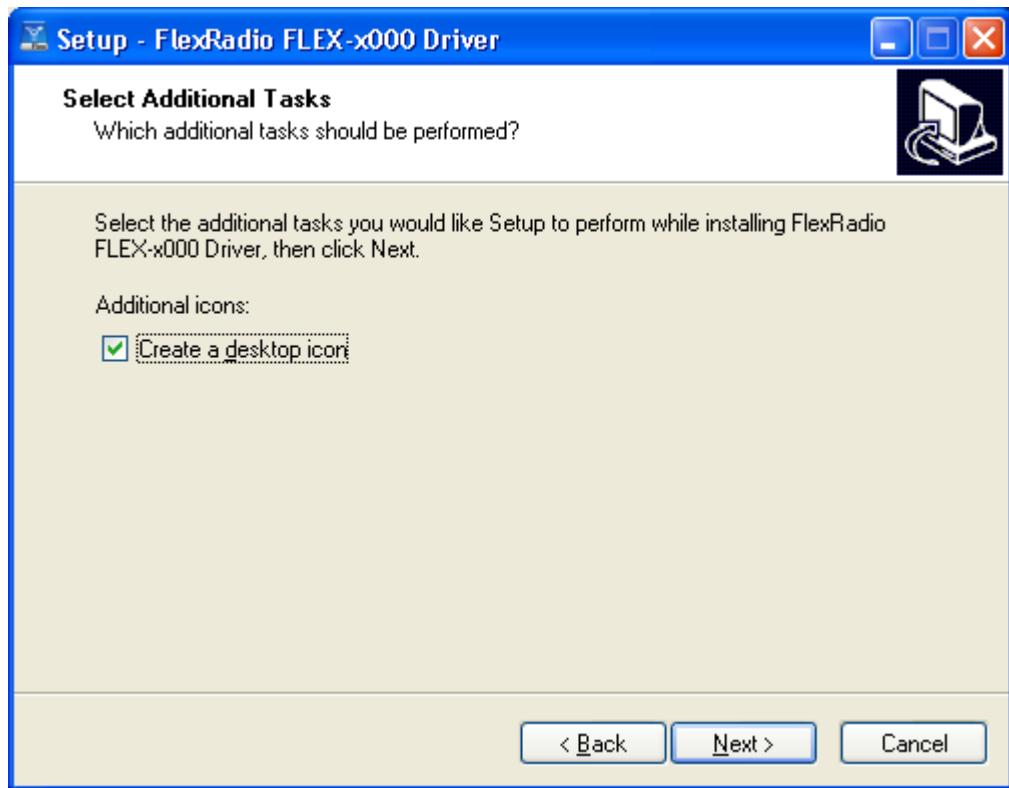
[The rest of this page has been left blank intentionally]



*Figure 16: FlexRadio Driver Setup Wizard - Destination Location*

The driver will be installed in the default location shown. Although we recommend you accept this default location, you may change it; click **Browse** and Navigate to an alternative location. When done, click **Next** to select additional Tasks (Figure 17).

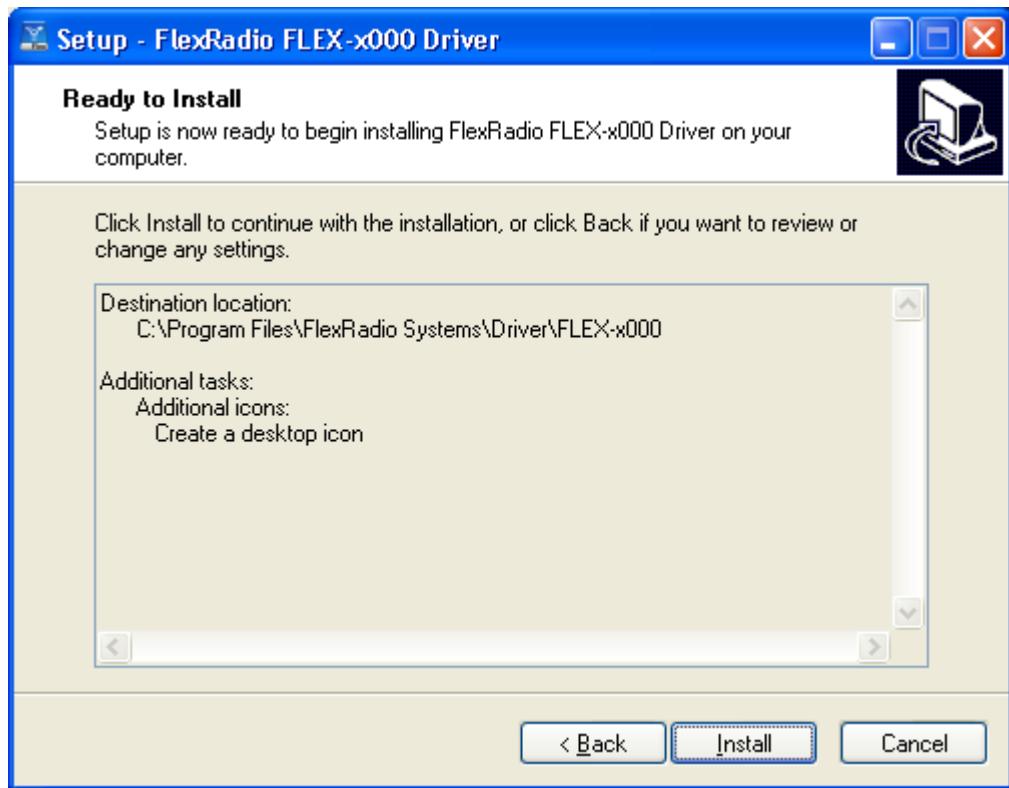
[The rest of this page has been left blank intentionally]



**Figure 17: FlexRadio Driver Setup Wizard - Additional Tasks**

We recommend that you elect to Create a desktop icon as shown for easy access to the Driver's Control Panel. Select Next and the Wizard will now display that it is Ready to Install (Figure 18).

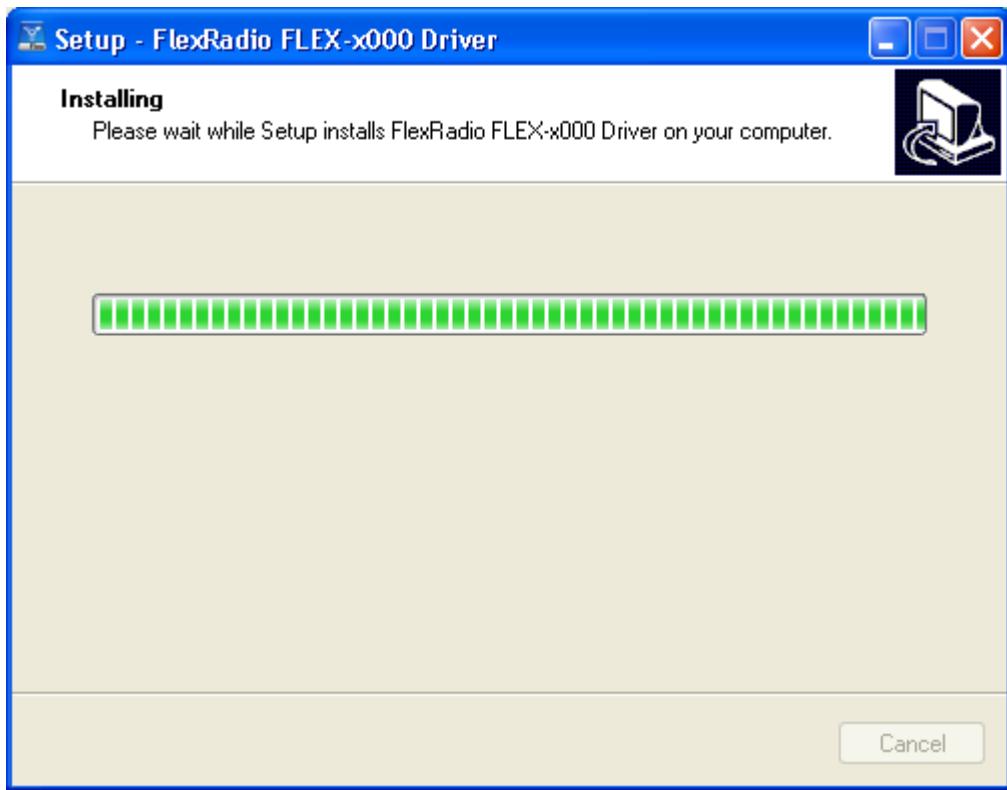
[The rest of this page has been left blank intentionally]



**Figure 18: FlexRadio Driver Setup Wizard - Ready to Install**

To review and/or change your installation settings, click **Back**. Otherwise, click **Install** and the Driver Setup Wizard will proceed to install all the required software (Figure 19).

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



**Figure 19: FlexRadio Driver Setup Wizard - Installing**

While the software is installing the Driver Setup Wizard will display a progress bar. If a Software Installation warning appears, click **Continue Anyway** to proceed. When completed, the Driver Installation Wizard will indicate that it has successfully installed the Driver (Figure 20).

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



*Figure 20: FlexRadio Driver Setup Wizard - Installation Complete*

Click **Finish** to exit the FlexRadio Driver Setup Wizard.

NOTE: Make sure your FireWire card does not have an IRQ conflict with other PC devices. Go to [ke9ns.com/flexpage.html](http://ke9ns.com/flexpage.html) Click on the FireWire (left side) link. This will explain how to check and how to deal with this.

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

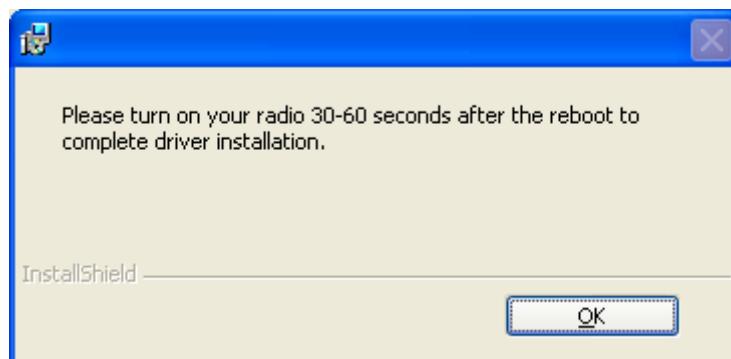
## Installing PowerSDR (requires Windows 7 Service pack1, Windows 10 or Windows 11)

The FlexRadio Systems InstallShield Wizard will now continue by installing PowerSDR (Figure 21).



*Figure 21: FlexRadio Install Wizard – Installing*

While the software is installing, which may take several minutes, the InstallShield Wizard will display a progress bar. When completed you will see a screen requesting you to turn on your radio 30-60 seconds after restarting your computer (Figure 22).



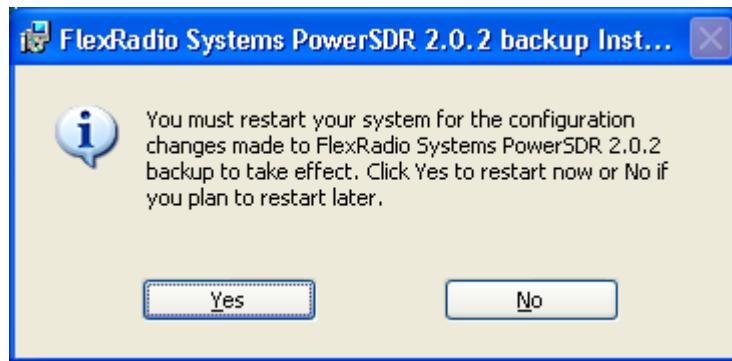
*Figure 22: FlexRadio Install Wizard - Notice to Power-Up Radio After Reboot*

Click **OK** and the FlexRadio InstallShield Wizard will indicate that Installation is Complete (Figure 23).



*Figure 23: FlexRadio InstallShield Wizard – Installation Complete*

Click **Finish** to exit the FlexRadio InstallShield Wizard. You will then be instructed to restart your computer (Figure 24).



*Figure 24: Instruction to Restart Computer*

Click **Yes** to restart your computer now.

## Power Up the FLEX-5000A to Complete the Installation

After your computer has restarted, wait at least 30-60 seconds and then press and release the power button on the FLEX-5000A to power it up. After a brief moment, you will hear the power relay click and the LED will illuminate the power button. What happens next depends on which operating system you are using:

## Windows 7 Service pack1, Windows 10 or Windows 11

Windows will indicate that it recognizes the FLEX-5000 and will load the drivers in the background. Please allow this process to finish. This will take between 10-30 seconds to complete. To ensure driver loading is indeed complete, open the FlexRadio Driver Control Panel by clicking on its icon (Figure 25) on your desktop and verify that the Device Description is a FlexRadio Systems FLEX-5000.

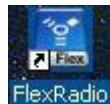


Figure 25: FireWire Driver Icon

You are now ready to setup and configure PowerSDR (see page 43).

## Windows 7 Service pack1, Windows 10 or Windows 11

Three drivers will be loaded in succession: first the FlexRadio FLEX-5000, followed twice by the FlexRadio MIDI. We will describe in detail how to proceed for the FlexRadio FLEX-5000. These steps are identical for each of the other two.

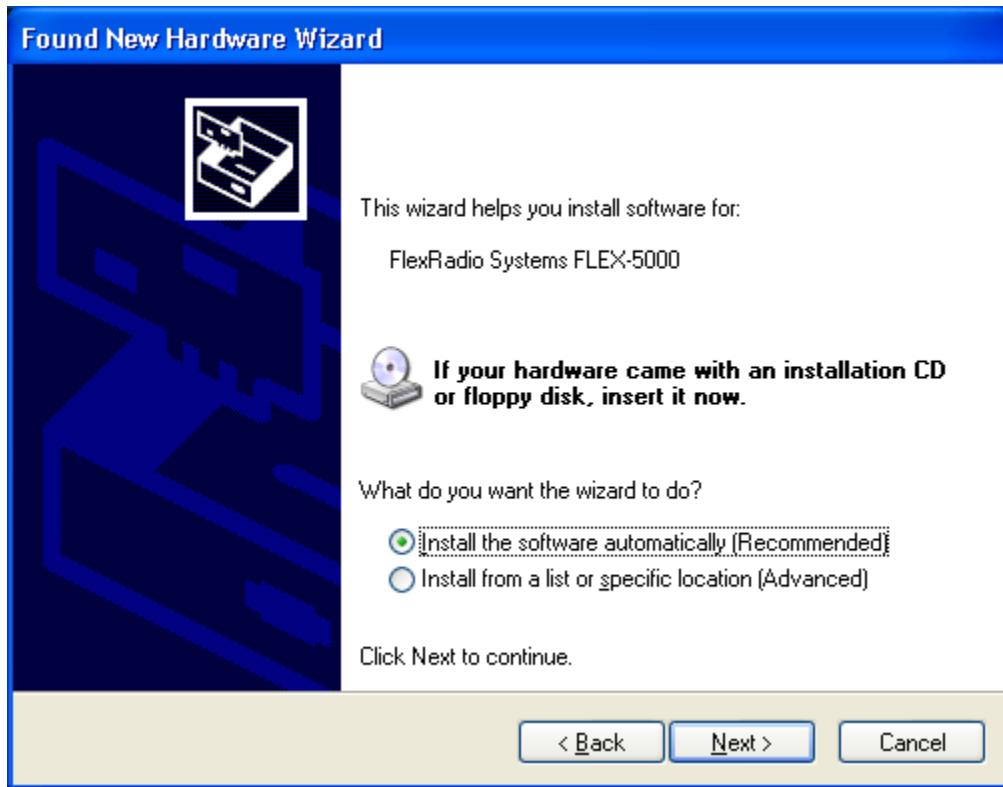
Your computer will detect the FLEX-5000 (or FLEX-MIDI as the case may be) and display the Found New Hardware Wizard Welcome screen (Figure 26).



Figure 26: Found New Hardware Wizard

Select the option **No, not this time** and click **Next** to choose how to install the driver (Figure 27).

**Note:** Figure 26 above may not show up in some systems.



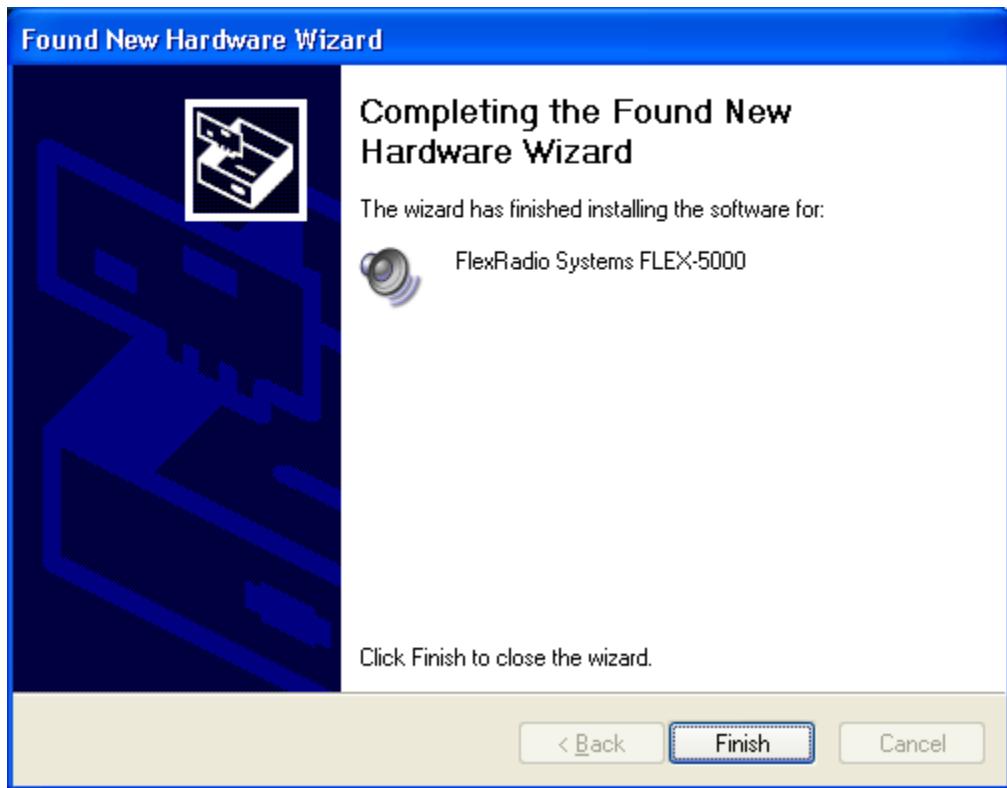
*Figure 27: Found New Hardware Wizard - Installing the Software*

The Found New Hardware Wizard will show that you are trying to install a **FlexRadio Systems FLEX-5000**. 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 28).

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



*Figure 28: Found New Hardware Wizard - Software Installation Complete*

Click **Finish** to exit the Wizard.

As previously mentioned, the Found New Hardware Wizard will again be displayed, but now for the FlexRadio MIDI. Follow the same steps as previously to install the MIDI driver. And finally, the Found New Hardware Wizard will display one more time, again for the FlexRadio MIDI. Follow the same steps as previously to install the MIDI driver. You are now ready to setup and configure PowerSDR.

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

# PowerSDR Setup & Configuration

## Setup Wizard

Power up the FLEX-5000 and start up the PowerSDR application using the shortcut 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 29 will appear.

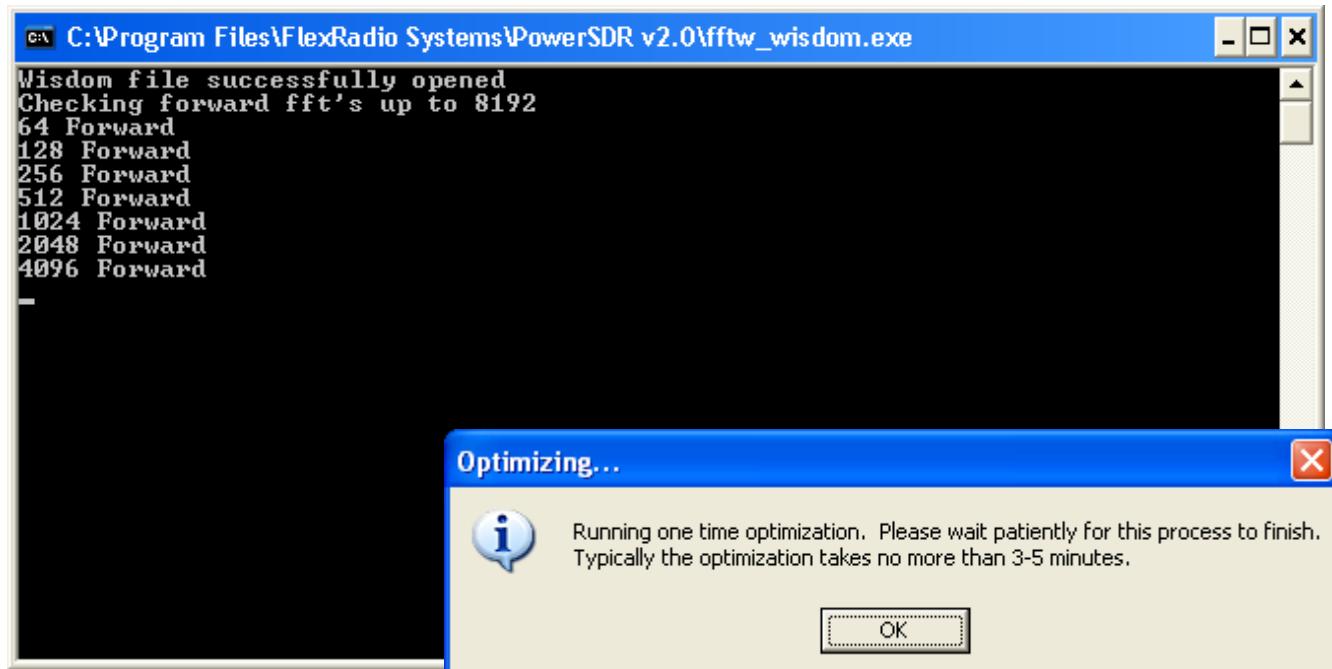


Figure 29: Optimization Routine

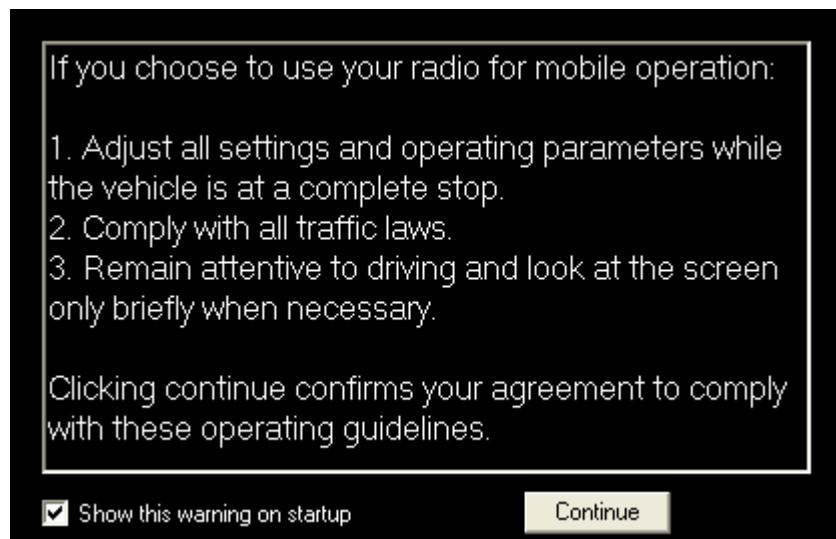
Click **OK** and let the routine run.

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

**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.n<sup>1</sup> directory. If you wish to run FFTW again, delete this file from that directory and start up PowerSDR.

PowerSDR next transfers your FLEX-5000's calibration data to your computer. This only happens once, the first time you run a new release of PowerSDR.

When the routine has completed, a brief startup sequence will follow, after which a warning regarding mobile operation appears, as shown in Figure 30.



*Figure 30: PowerSDR Setup Wizard Mobile Warning*

Read the warning and then click the **Continue** button. The PowerSDR Setup Wizard will then ask you to chose your Radio Model (Figure 31).

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

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

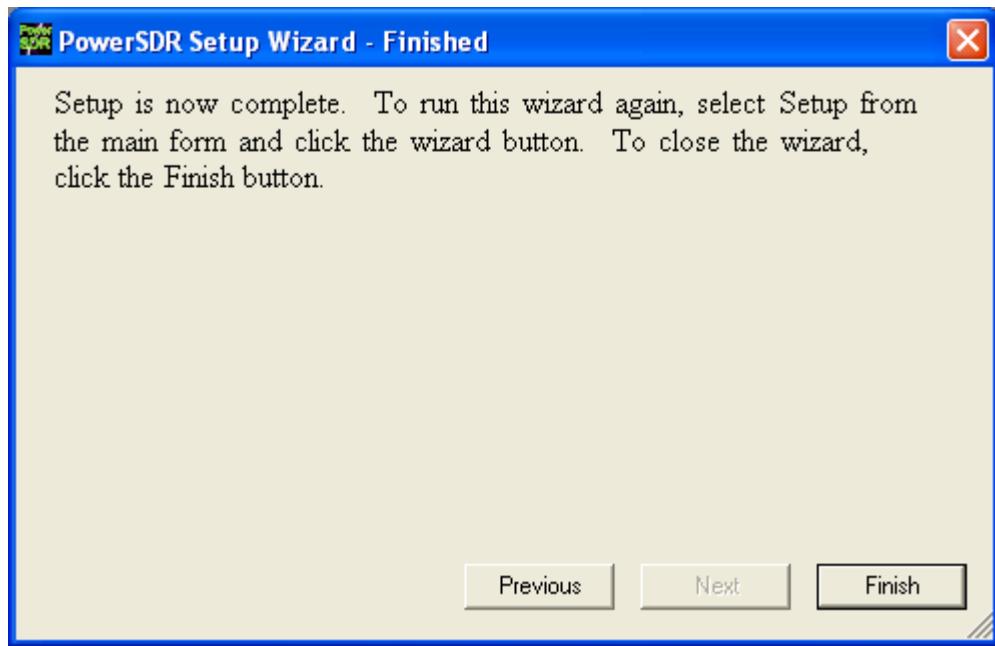


*Figure 31: PowerSDR Setup Wizard - Radio Model*

Select the FLEX-5000 radio model as shown in Figure 31. Click the **Next** button to continue to Figure 32.

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

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



*Figure 32: PowerSDR Setup Wizard – Finished*

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

**Note:** If you forgot to power up the FLEX-5000 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-5000 and restart PowerSDR.

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

## Configuration

Before operating the FLEX-5000 you will need to configure the 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.

- Note:** From time to time the FLEX-5000 firmware may need to be updated. If PowerSDR detects an incompatible version of the firmware, it will display an error message similar to that shown in Figure 33 below.



Figure 33: FLEX-5000 Firmware Version Error

Click **OK** and if a Driver Error message follows, click **OK** again. PowerSDR will start up, but the **Start** button will be grayed out. Close PowerSDR and see the **Firmware Loader** section on page 183. You also might want to search for *firmware* in our Knowledge Center at <http://kc.flex-radio.com/search.aspx>. Locate the appropriate document explaining how to upload the firmware and follow the instructions.

## 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 34. When the transfer is complete, PowerSDR will complete starting up.

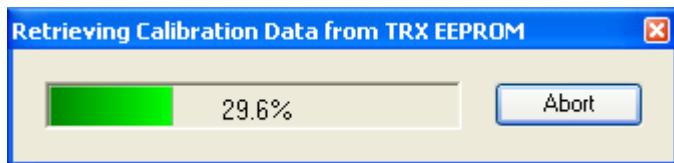


Figure 34: Calibration Retrieval Progress Indicator

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**Note:** The FLEX-5000 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-5000 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 35).

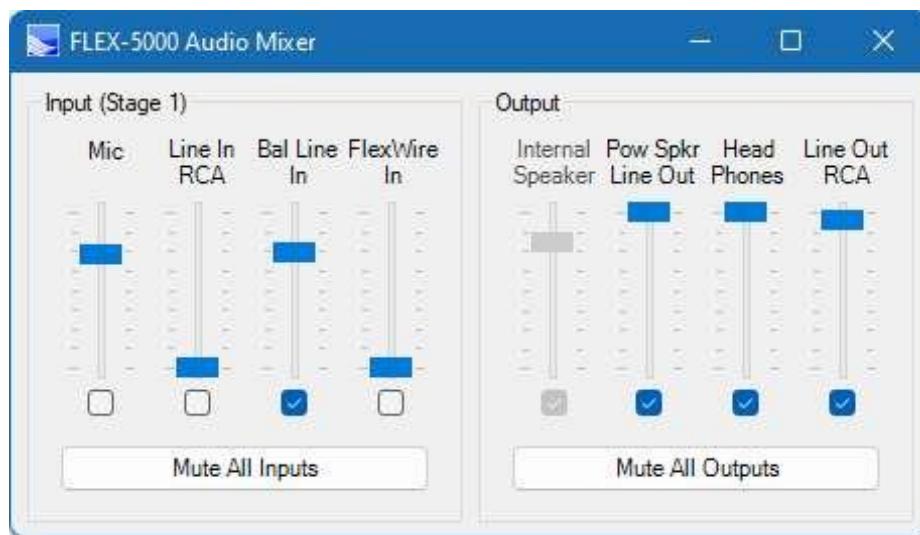


Figure 35: Audio Mixer

Select the desired **Input** and **Output** channels. Only one Input channel can be selected, but multiple Output channels can be selected. **Mic** and **Head Phones** are front panel jacks; the other channels refer to the various audio inputs and outputs on the back panel. For more detailed information see page 118).

**Note:** The Internal Speaker output is unavailable for the FLEX-5000A, which has no internal speaker.

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## Antenna Port and External Keying Lines

You will next need to configure the antenna ports such that the correct antenna is selected for each band as well as the correct keying line(s), if any. To do so, click on **Antenna** in the menu of the Front Console (Figure 36). We will only describe certain controls at the **Simple** complexity level here. For more detailed information, including **Expert** level, see page 119).

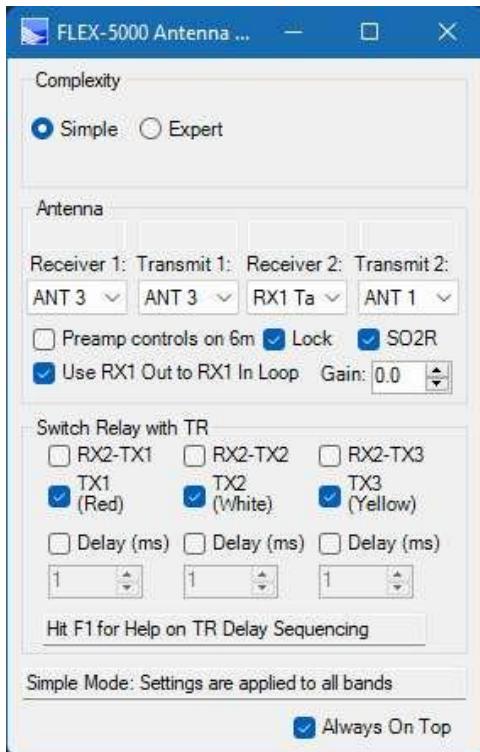


Figure 36: Antenna Form - Simple

- **Complexity: Simple** uses the same antenna port for all bands, whereas **Expert** allows you to select different antenna ports for each band. If you use only one antenna, choose **Simple**.
- **Antenna:** The following selections are possible:
  - **Receiver 1:** RX1 ANT1 (default), ANT2, ANT3 or RX1 IN, or NC
  - **Transmit 1:** RX1 ANT1 (default), ANT2, ANT3
  - **Receiver 2:** (if installed) RX2 IN (default), RX1 Tap (the same antenna port as selected for receiver 1), ANT1<sup>1</sup>, or N/C (not connected).
  - **Transmit 2:** (if installed) RX2 ANT1 (default), ANT2 or ANT3<sup>2</sup>. (Note: **SO2R** must be checked ON)

<sup>1</sup> Earlier versions of the FLEX-5000, with the HRFIO board Assembly Number (ASSY) 27 installed instead of the later HRFIO board ASSY 34, do not have ANT1 available as an option for Receiver 2. You can check which board is installed in your FLEX-5000 by opening the Setup Form – General Tab, Hardware Config Sub-Tab, in the section marked FLEX-5000 Config. The Assembly Number is shown between brackets at the end of the line beginning with RFIO (see e.g. Figure 93 on page 126). Also see the Knowledge Center articles [HRFIO Capabilities by Assembly Number](#), [How to Identify the HRFIO Assembly Number](#) and [Antenna Selection Options for the RX2](#) (a search for *HRFIO* in our Knowledge Center at <http://kc.flex-radio.com/search.aspx> will yield all these articles). If you have the earlier HRFIO ASSY 27, you can upgrade to ASSY 34. See the [Flex-Radio Systems website](#) (<http://www.flex-radio.com/>) for more information.

**WARNING! Make sure you have an antenna connected 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.**

- ❑ **Switch Relay with TR (RX1):** Select the keying line(s) you use, if any, to key your amplifier(s) or other external equipment. If you want to sequence the switching, set the appropriate **Delay** times for each keying line. This is for RX1 transmit only.
- ❑ **Switch Relay with TR (RX2):** (SO2R MUST BE CHECKED) allows you to select a different output when RX2 is Transmitting.
- ❑ **SO2R:** (if RX2 installed) Allows you to change transmit antennas between RX1 and RX2 for 2 band operation. Unchecked and RX2 transmit features will be disabled

Close the Antenna Form when you are done.

## Ready to Start Operating

You are now ready to use your FLEX-5000. 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-5000 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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<sup>2</sup> For the earlier HRFIO board ASSY 27 (see footnote 1), the 6m transmit antenna port is fixed to ANT3 and cannot be changed. Only the ANT3 port meets the -60 dBc spurious output requirement at 6m. For the later HRFIO ASSY 34, this is not the case and the 6m transmit antenna port can be assigned to any of ANT1-3, just like any other band.

# Operation

This chapter is intended to provide the user with a clear understanding of how the FLEX-5000 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 46 on page 73. 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-5000 hardware and its many connections, have installed and initialized the FLEX FireWire driver and have installed and 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-5000, 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](http://www.flex-radio.com) click *About FlexRadio* and then *Contact Us*).

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## Power-Up Procedure

To power up the FLEX-5000A

1. Connect (at a minimum) the FLEX-5000A 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-5000A power switch. After a few seconds you will hear the internal power relay click and see the LED illuminate. The FLEX-5000A will be recognized by Windows and its driver will be available for PowerSDR to use.
4. After waiting at least 30 seconds, start up PowerSDR. It will automatically recognize the FLEX-5000 driver. You are now ready to operate.

To power up the FLEX-5000C

1. Connect (at minimum) a monitor, mouse and keyboard to the FLEX-5000C and connect the FLEX-5000C to the power supply.
2. To start both the radio and the internal computer, turn on the power supply and press the FLEX-5000C power switch. After a few seconds you will hear the internal power relay click and see the LED illuminate as well as the light on the wireless keyboard controller.
  - a. Press and release the **connect** button on the wireless keyboard controller.
  - b. Press and release the **connect** button on the bottom of the keyboard. Wait at least 20 seconds before the next step.
  - c. Press and release the **connect** button on the wireless keyboard controller again.
  - d. Press and release the **connect** button on the bottom of the mouse.
  - e. Move the mouse and check for pointer motion on the display.
3. At this point you should see the Windows opening screen.
4. After waiting at least 30 seconds, start up PowerSDR. It will automatically recognize the FLEX-5000 driver. You are now ready to operate.

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## 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-5000 illuminated Power switch to 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*.

**Note:** The FLEX-5000C power switch will turn on both the transceiver and the internal computer, but only turn off the transceiver. To turn off the internal computer, click with your mouse on **Start** and then on **Turn Off Computer**, just as you would any other Windows computer.

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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. This will work for both receivers, depending on which Panadapter/Waterfall the mouse cursor is in.

### 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)**<sup>1</sup> 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.

If the second receiver (RX2) is installed and on, then the mouse wheel will tune **VFO B** only if the mouse pointer is anywhere in the RX2 Panadapter or Waterfall display.

**Note:** When the **Tune Step** equals 1 kHz, each click of the mouse wheel will first snap tune up or down to the nearest 1 kHz and then change in 1 kHz steps. E.g. if **VFO A** is tuned to say 14.000258 MHz then with the tuning rate set to 1 kHz, using the mouse wheel to tune up will first increase **VFO A** to 14.001000 MHz and then to 14.002000 MHz, and so on.

**Hint:** Holding down the Shift key while turning the mouse wheel will change **VFO A** (or for RX2 **VFO B**) at the next lower **Tune Step**.

### Mouse Wheel Hover

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

### Spectrum Click Tuning

With the RX1 display set to Spectrum, Panadapter, Waterfall or Histogram, hover with the mouse over the RX1 display and right click to cycle through yellow cross-hairs to tune **VFO A**, red cross-hairs to tune **VFO B** - or the **lower part of VFO A** if RX2 is on - (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 RX1 display and click the left mouse button. The corresponding VFO will immediately tune to the frequency of the selected signal.

<sup>1</sup> Chapter 5 on page 73 explains all the Front Console controls in detail. The identifiers between parentheses refer to the control identifiers used there.

If RX2 is installed and on, hover with the mouse over the RX2 display and right click to activate the yellow cross-hairs; right click again to turn click tuning off. With the cross-hairs visible, hover over the desired signal in the RX2 display and click the left mouse button. **VFO B** will immediately tune to the frequency of the selected signal.

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.

- 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) or (9b)** button is on to enable **0 Beat**).
- Hint 2:** If you have checked **Snap ClickTune** (Setup Form, General tab - Options sub-tab; see page 130) then spectrum click tuning will tune the VFO to the nearest discrete multiple of the Tune Step. E.g. if the Tune Step is set to 1 kHz, the VFO will only ClickTune in steps of 1 kHz.

## 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 170).
- **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

**DJ Console Mp3e2, MK2, and MP3LE** devices have a built in interface with PowerSDR (see Setup->General->User Interface->DJ Console)

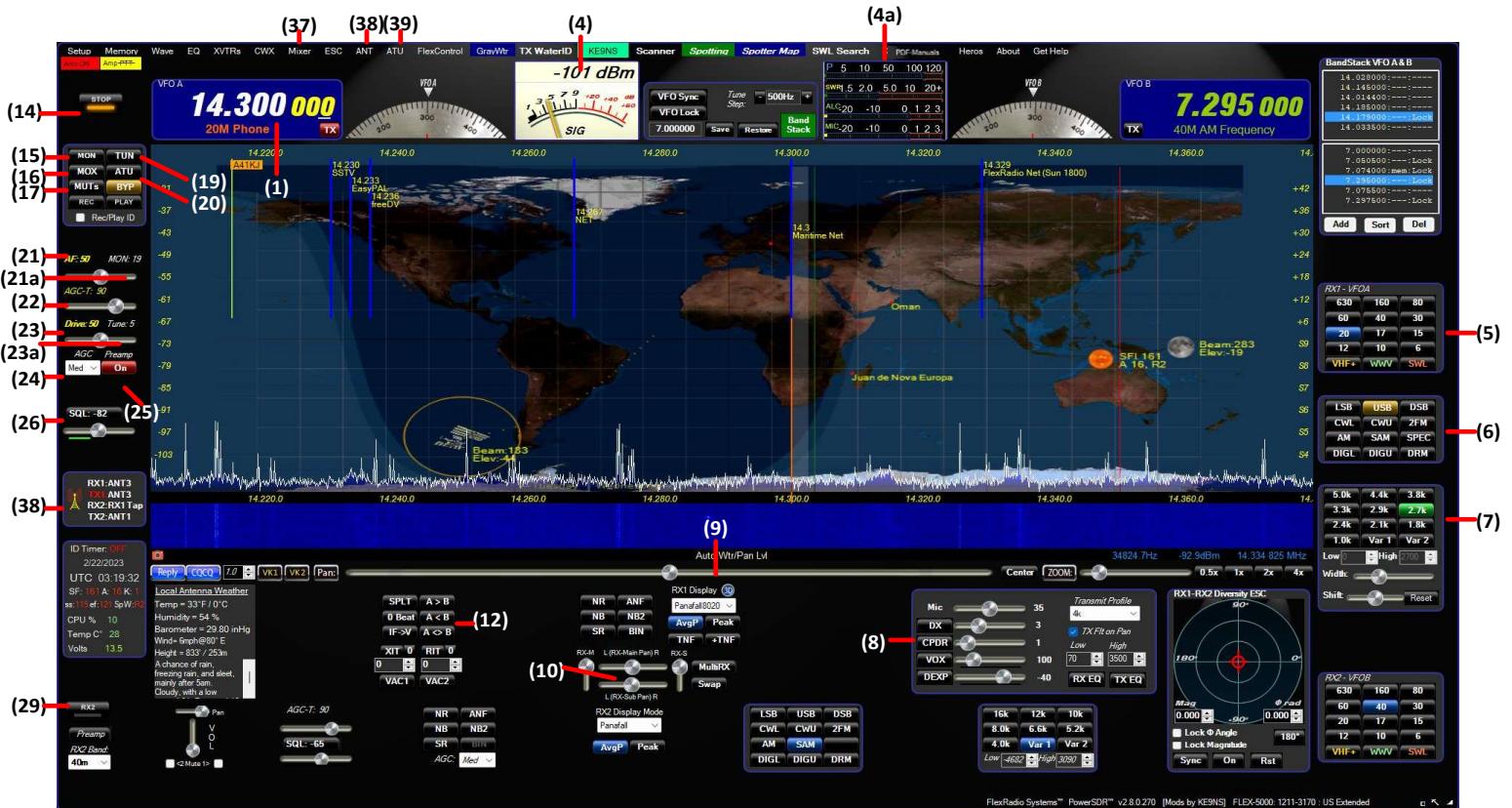
**Griffin PowerMate Knob** has a built in interface with PowerSDR (see Setup->General->User Interface->PowerMate and FlexControl)

**FlexControl Knob** has a built in interface with PowerSDR (see PowerSDR main console screen top line menu "FlexControl") (see Setup->General->User Interface->PowerMate and FlexControl)

**Contour ShuttlePro v2** has a built in interface with PowerSDR (see Setup-> 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 *ShuttlePro* on our Knowledge Center at <http://kc.flex-radio.com/search.aspx>)

# Voice Operation

The following procedure outlines how to setup quickly for voice transmission operation (SSB, AM/SAM, or FM).



**Figure 37 Front Panel Controls Used for Basic Voice Operation.**

Please use Figure 37<sup>1</sup> to identify the controls referenced in the following step-by-step instruction. For consistency we have used the same control identifiers as in Figure 46 on page 73 and for clarity we have left out any identifiers of controls not referenced.

**Note:** In this chapter, we will only describe basic operation using the main RX1 receiver.



**Figure 37a Front Panel FM Controls**

<sup>1</sup> 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 163 for more information on how to select skins).

- Follow the Power Up Procedure, described on page 52. Then click the **Start/Stop** button **(14)**. Set the following controls as specified in Table 10 below.

*Table 10: Initial Control Values for Voice Operation*

Ctrl	Value	Reference to Figure 37
VFO A	14.3 MHz	(1)
RX1 Meter	Signal	(4)
TX Meter	TX2 Combo ALC & MIC	(4a)
BAND	20 m	(5)
Mode	USB	(6)
Filter	2.7 kHz	(7)
Mic Gain	35	(8)
DX	Off	(8)
CPDR	Off	(8)
VOX	Off	(8)
DEXP	Off	(8)
RX EQ	Off	(8)
TX EQ	Off	(8)
VAC	Off	(8)
Display Mode	Panadapter	(9)
AVG	AVGpan = On	(9)
PEAK	Off	(9)
MultiRX	Off	(10)
SPLT	Off	(12)
XIT	Off	(12)
RIT	Off	(12)
MUT	Off	(17)
ATU/BYP	ATU (if applicable)	(20)
AF	50	(21)
AGC-T	90	(22)
Drive	50	(23)
AGC	Med	(24)
Preamp	On	(25)
SQL	Off	(26)
RX2	Off (if applicable)	(29)

- In the **ANT form (38)** choose **Simple** complexity level and set **RX1** to **ANT1** (see page 119 for more on the Antenna Form). Connect a 50 ohm dummy load to the ANT 1 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 (4a)** (Set TX2 meter to COMBO to see Fwd Pwr, SWR, ALC and MIC). If using the optional, integrated ATU, select **Automatic** on the **ATU Form (39)** and then click the **TUN (19)** button. See the section on the **ATU Form** on page 123 for more on how to use the ATU.

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**CAUTION:** If you are not using the internal ATU then connect a 50 ohm dummy load, or ensure that the antenna presents a 50 ohm load with a low SWR. Failing to do so may damage the FLEX-5000 output transistors.

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 (37)** (see page 118) and that your microphone is connected correctly (see pages 4 and 11 for pin-outs of the MIC connector and Balanced Line-In jack respectively). 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 136).

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 (4a)** (Set TX2 meter to COMBO to see Fwd Pwr, SWR, ALC and 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 an 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**, **VOX** and **(Noise) Downward Expander**. Generally, use either **DX** or **CPDR** to increase average power without adjusting the peaks. Check **Show Transmit 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 159).

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

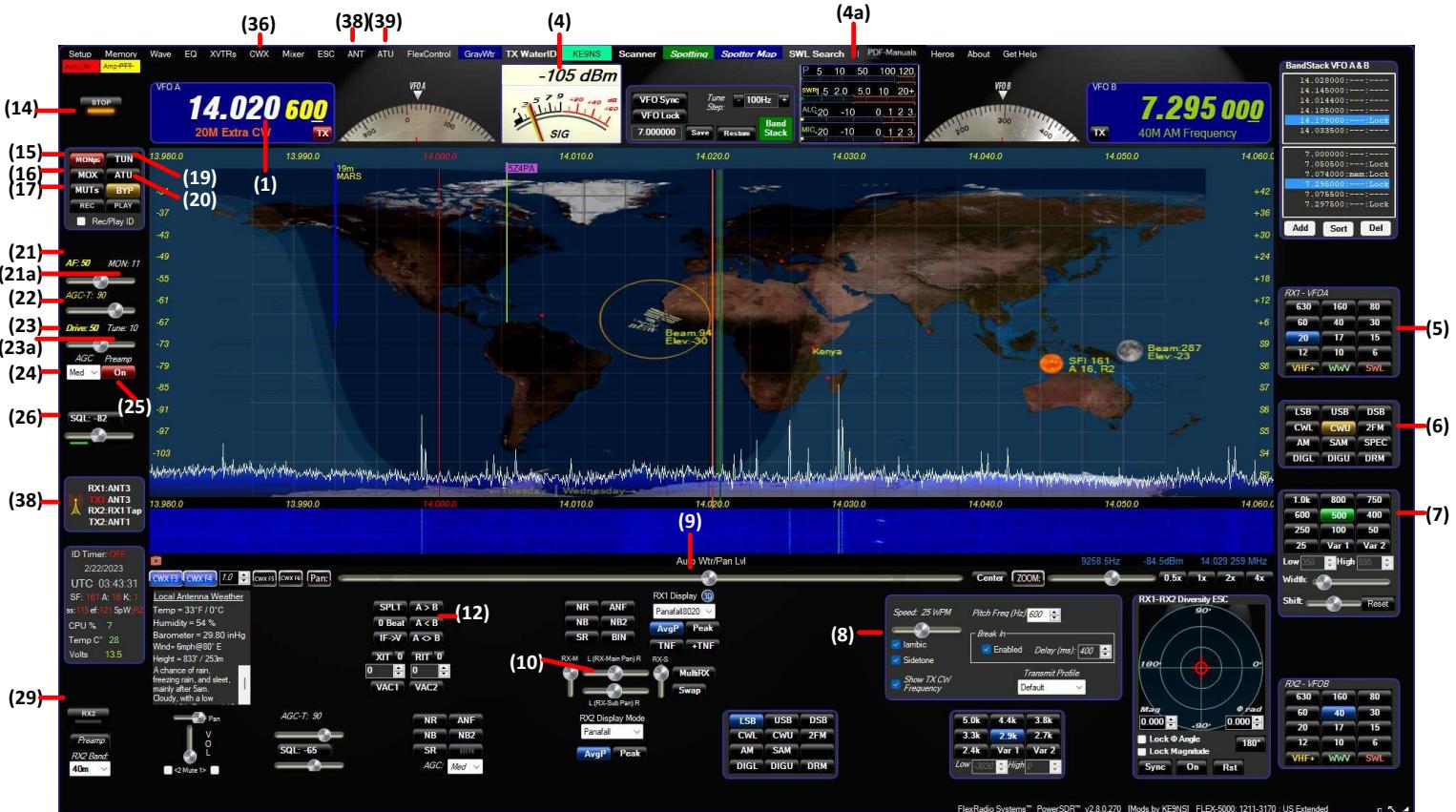
6. In order to monitor voice transmissions, enable the **MON (15)** button. **MONps** = Audio from the Transmitter (may not be available on all radios or modes). **MONpr** = Audio input to the Flex itself. You may notice a delay due to buffering in the audio/DSP system. This processing delay is largest when using large buffer sizes and low sampling rates. If you find this delay objectionable, try decreasing it by reducing the **Buffer Size** and increasing the **Sample Rate** settings on the Audio tab, Primary sub-tab (page 136) and/or DSP tab, Options sub-tab (page 145) of the Setup Form. See also the Knowledge Base article <http://kc.flex-radio.com/KnowledgebaseArticle50437.aspx> for more information on Buffers and Sample Rate and how they effect latency and filter skirts.
7. TX2 COMBO Fwd pwr **TX Meter (4a)** 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 100W in voice modes if calibrated properly even when the **Drive control (23)** is set to 100. This is also true when monitoring voice transmissions on an external watt meter.

**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 100W will average less than 10W. 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 as adding too much compression can result in high levels of distortion.

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## 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 38: Front Panel Controls Used for CW Operation**

Please use Figure 38 to identify the controls referenced in the following step-by-step instruction. For consistency we have used the same control identifiers as in Figure 46 on page 73 and for clarity we have left out any identifiers of controls not referenced.

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## Initial Settings

- Follow the Power Up Procedure, described on page 52. Then click the **Start** button (**14**). Set the following controls as specified in Table 11.

*Table 11: Initial Control Values for CW Transmission*

Ctrl	Value	Reference to Figure 38
VFO A	14.020600 MHz	(1)
RX Meter	Signal	(4)
TX Meter	TX2 Combo	(4a)
Band	20 m	(5)
Mode	CWU	(6)
Filter	500 Hz	(7)
VAC	Off	(8)
Display Mode	Panadapter	(9)
AVG	AVGpan = On	(9)
PEAK	Off	(9)
MultiRX	Off	(10)
SPLT	Off	(12)
XIT	Off	(12)
RIT	Off	(12)
MON	On	(15)
MUT	Off	(17)
ATU/BYP	ATU (if applicable)	(20)
AF	50	(21)
AGC-T	90	(22)
Drive	50	(23)
AGC	Med	(24)
Preamp	On	(25)
SQL	Off	(26)
RX2	Off (if applicable)	(29)

- In the **Antenna Form (38)** choose **Simple** complexity level and set **RX1** to **ANT1** (see page 119 for more on the Antenna Form). Connect a 50 ohm dummy load to the ANT 1 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 (4a)** (Set TX2 to COMBO). If using the optional, integrated ATU, select **Automatic** on the **ATU Form (39)** and then click the **TUN (19)** button. See the section on the **ATU Form** on page 123 for more on how to use the ATU.

**CAUTION:** If you are not using the internal ATU then connect a 50 ohm dummy load, or ensure that the antenna presents a 50 ohm load with a low SWR. Failing to do so may damage the FLEX5000 output transistors.

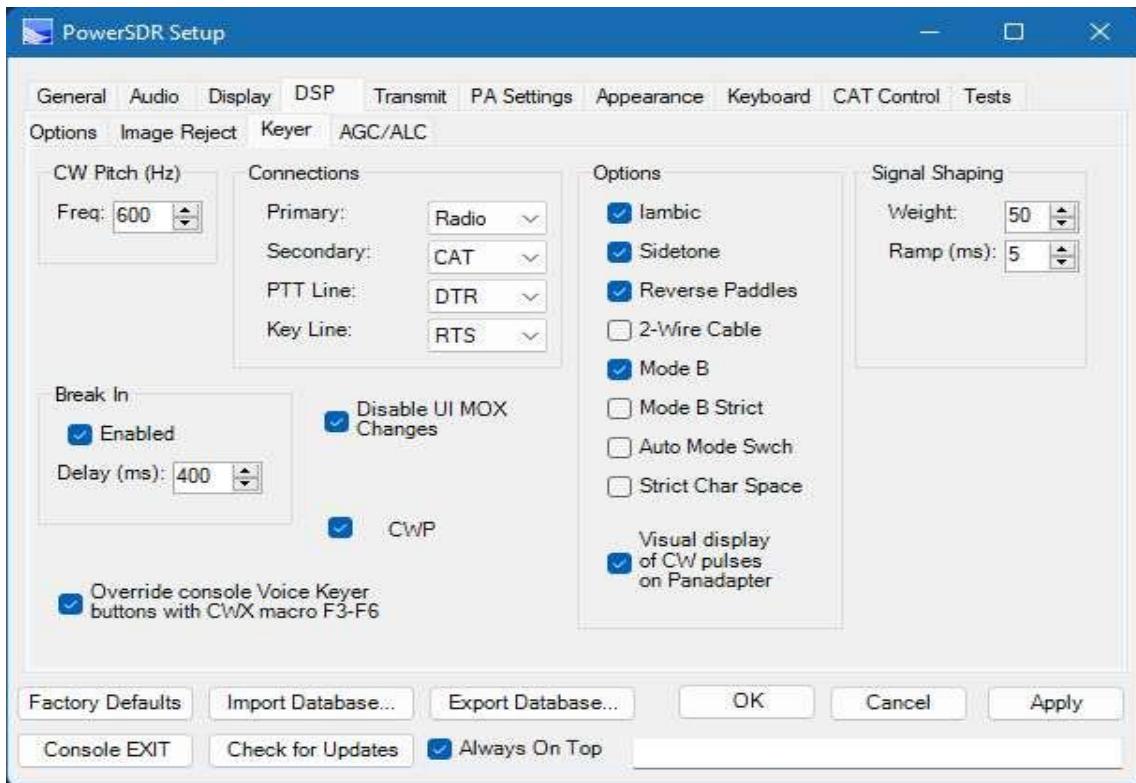
**Hint:** There is a trade-off to be made of minimum latency versus sharpest (narrowest) filters. Both are driven by the buffer (DSP and Audio) settings and the sample rate setting. For optimal CW performance, you may need to use either the 48 kHz or 96 kHz sample rates, where the former will give the narrowest filters. Next you need to set your audio buffer as low as your computer system will tolerate. The DSP buffer setting should then be set as high as possible, without introducing disturbing latency. See also the Knowledge Base article <http://kc.flex-radio.com/KnowledgebaseArticle50437.aspx> for a more detailed explanation of Buffers and Sample Rate.

**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-> DSP -> Keyer shown in Figure 39 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 39: Setup-> DSP-> Keyer**

1. Connect your paddles or keyer to the Key jack on the back panel (see page 9) and on the Keyer Sub-Tab in the **Connections** section, set **Primary** to **Radio** (see Figure 39 above).
- 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 **2-Wire Cable**; leave unchecked if the connector has a tip, ring and shield. Check **Disable MOX UI Lockout** to prevent all controls from being locked out during Transmit.
2. Check **CWP** to allow the use of the CWX panel without being in CW mode. Check **Override console Voice keyer buttons with CWX Macro F3-F6** to allow you to hide CWX panel but use the voice keyer buttons or F3-F6 keys to send CWX macros whenever in CW mode. Check **Visual display of CW pulses on Panadapter** to allow display of Transmit CW on the panadapter.
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 153 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.

- You are now ready to begin a QSO. If a 50 ohm dummy load was connected, connect an 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

- Connect your paddles or keyer to the Key jack on the back panel (see page 9) and set the **Primary Connection** to **Radio** (see Figure 39 above)
- 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 (8)** 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.
- 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 153 for more detail).
- 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 (4A)** set TX2 to **COMBO** that there is forward power.
- You are now ready to begin a QSO. If a 50 ohm dummy load was connected, connect an 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, click on **CWX (36)** on the Front Console menu to open the CWX Form shown Figure 40 below. (Refer to the CWX Form section on page 113 for more detail on how to use this form).

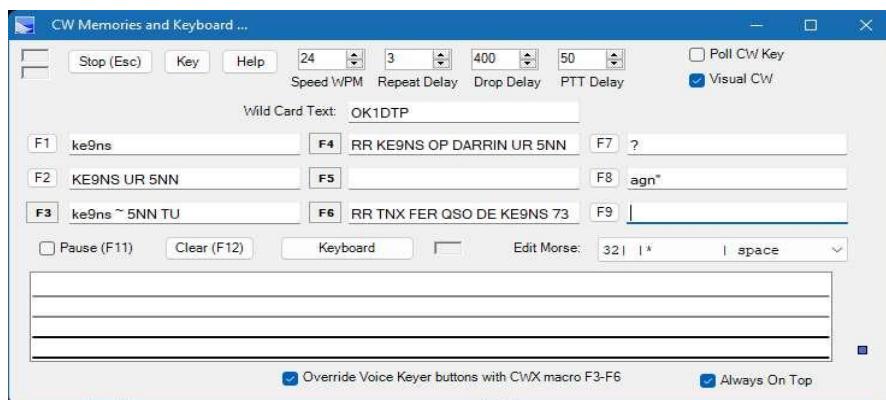


Figure 40: CWX Form

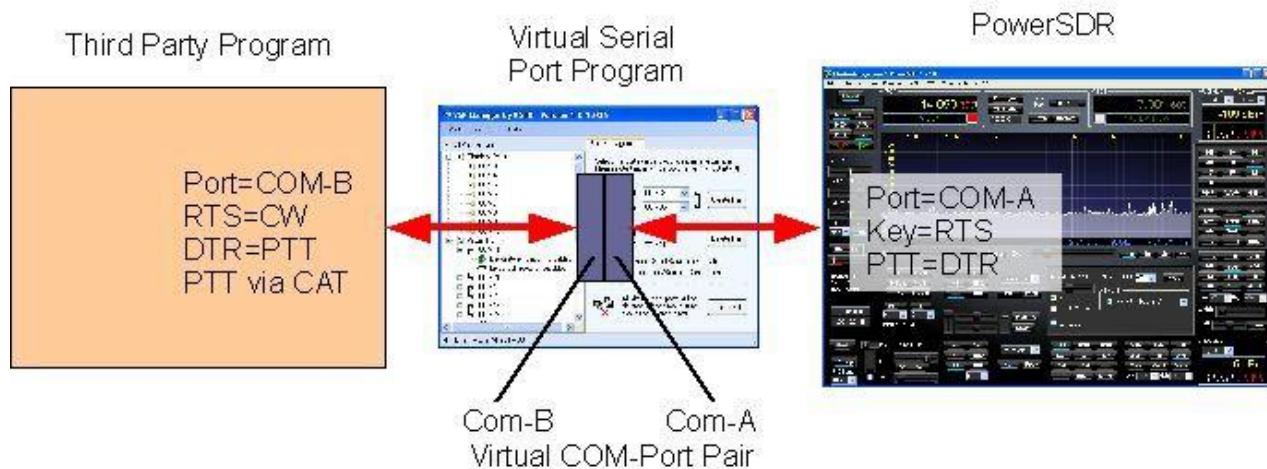
- Click on one of the numbered buttons to start transmitting the corresponding CW sequence. Verify with the **TX Meter (4)** set to **Fwd Pwr** that there is forward power.

2. You are now ready to begin a QSO. If a 50 ohm dummy load was connected, connect an 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

If the third party software and PowerSDR are running on the same computer, it also requires the computer to have two virtual serial ports (2 ends of the same virtual cable)

A virtual serial port pair can be created, as shown in Figure 41. There are various programs that can be used to create such a virtual serial port pair, such as "vspMgr" or "Com0Com". 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.

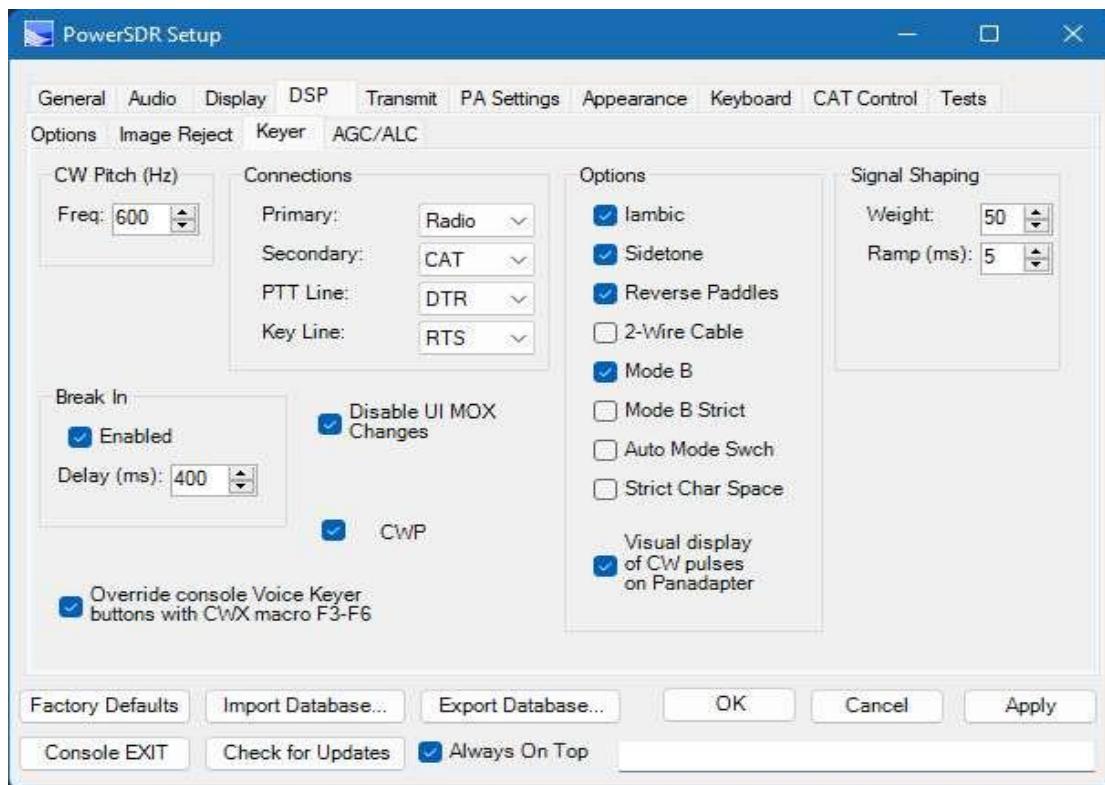


**Figure 41: Diagram Illustrating Connections Between PowerSDR and Third Party Program**

In the following we will assume that a virtual serial port pair COM6/COM26 has been created. (In other words COM-A = COM26 and COM-B = COM6). Try using VspMgr to create these COM port pairs.

1. In PowerSDR open first the **Setup-> CAT Control** tab, select *COM26* as the **Cat Control** port for PowerSDR to connect to and check **Enable CAT** (see page 171).
2. Next, in PowerSDR open the **Setup-> DSP-> Keyer** shown in Figure 42 below to access the Internal Keyer controls.

<sup>1</sup> 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 42: Setup-> DSP-> Keyer**

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.
4. 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 Kenwood®<sup>1</sup> 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. Right Click on the **KeyCatShortCut** item at the top of PowerSDR console screen to open up the CAT command PDF).
5. You are now ready to begin a QSO. If a 50 ohm dummy load was connected, connect an 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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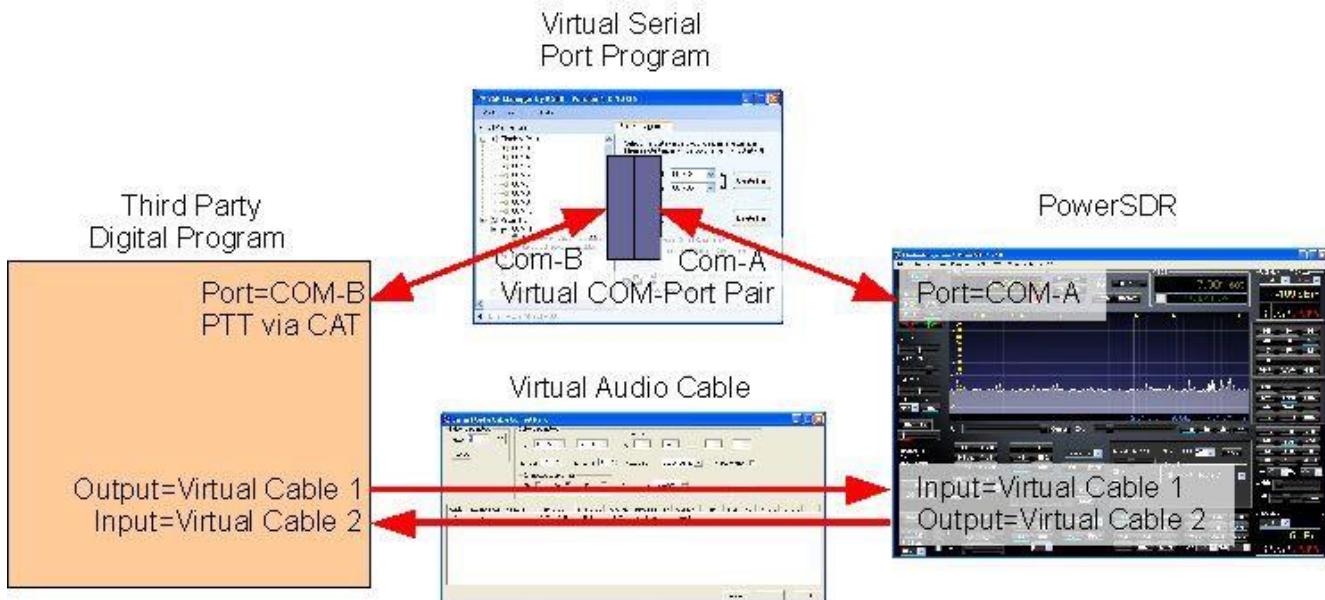
<sup>1</sup> Kenwood is a registered trademark of Kenwood Corporation

## Digital Operation

External Digital devices may require real physical audio cables and real COM serial port connections back to your PC, which in turn are routed to PowerSDR by selecting the VAC1 or VAC2 features.

For modern digital devices and modes in which the entire digital operation resides in a 3<sup>rd</sup> party PC program, we can connect these programs back to PowerSDR using use another 3<sup>rd</sup> party program called Virtual Audio Cable (VAC) to create virtual digital audio connections, that present themselves to programs just like a real audio cable. Search for "VB-Cable" or "VoiceMeeter" for a free Virtual Audio Cables.

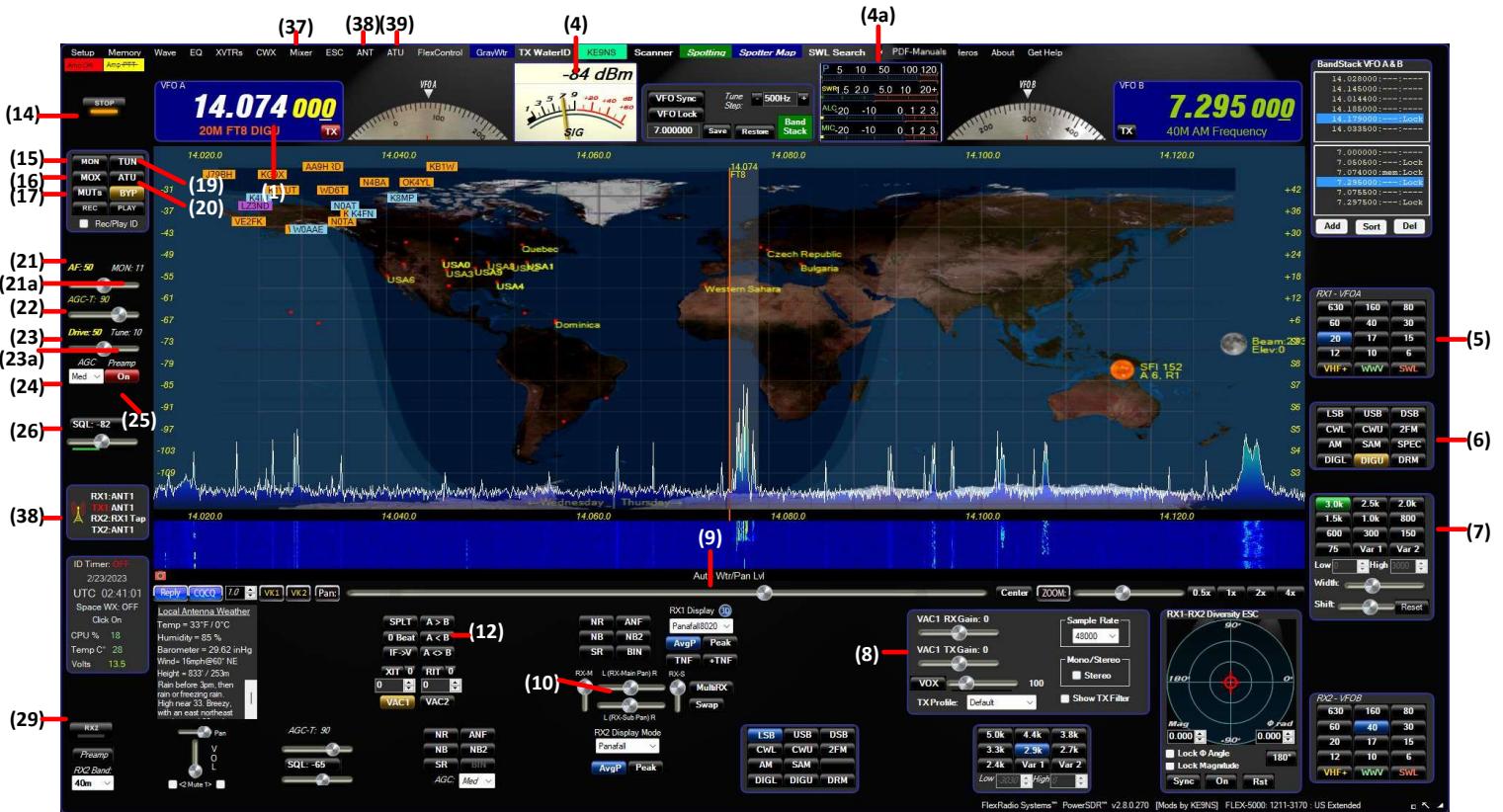
Likewise, for the serial port interconnection, there are several programs that can be used to create a virtual null-modem serial port pair. This is described in the previous section (see Third Party CW Program on page 65). Figure 43 below illustrates these virtual connections.



**Figure 43: 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 COM6/COM26. (In other words COM-A = COM26 and COM-B = COM6).

<sup>1</sup> 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 44: Front Panel Controls Used for Basic Digital Mode Operation**

Please use Figure 44 to identify the controls referenced in the following step-by-step instruction. For consistency we have used the same control identifiers as in Figure 46 on page 73 and for clarity we have left out any identifiers of controls not referenced.

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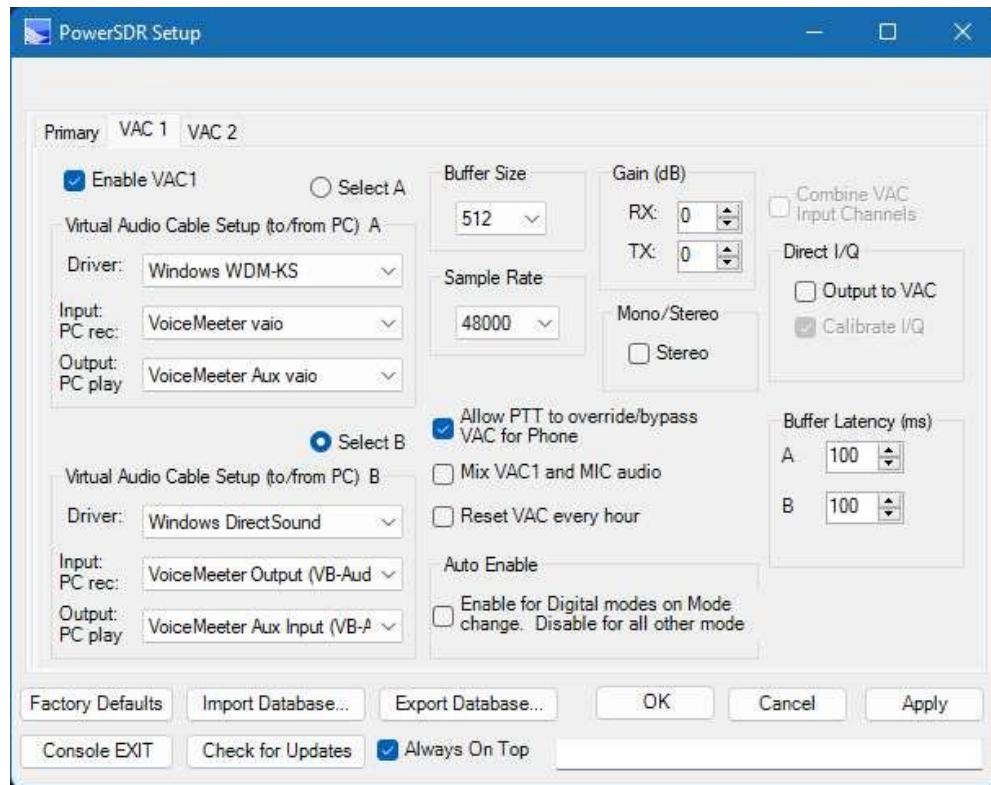
- Follow the Power Up Procedure, described on page 52. Then click the **Start** button (**14**). Set the following controls as specified in Table 12.

*Table 12: Initial Control Values for Digital Mode Operation*

Ctrl	Value	Reference to Figure 44
VFO A	14.074 MHz	(1)
RX Meter	Signal	(4)
TX Meter	TX2 COMBO	(4a)
BAND	20 m	(5)
Mode	DIGU	(6)
Filter	Around 3kHz	(7)
VAC1	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)
ATU/BYP	ATU (if applicable)	(20)
AF	50	(21)
AGC-T	70	(22)
Drive	50	(23)
AGC	Med	(24)
Preamp	On	(25)
SQL	Off	(26)
RX2	Off (if applicable)	(29)

- In PowerSDR open the **Setup-> Audio-> VAC1** (see Figure 45 below). Check **Enable VAC1**, Select a *Virtual Cable* (like **VoiceMeeter Output**) as the **Input**, and a *Virtual Cable* (like **VoiceMeeter Aux input**) 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 44 above). You can now use **VOX** to PTT the radio. This prevents audio from becoming out of sync after hours of continuous operation or Check **Reset VAC every hour**.
- If you want your digital mode software to control PowerSDR, then in the **Setup -> CAT Control**, select **COM26** as the **Cat Control** port for PowerSDR to connect to and check **Enable CAT** (see page 172).

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**Figure 45: Setup -> Audio -> VAC1**

4. Start up your digital mode program, select a **Virtual Cable** (like **VoiceMeeter Aux Output**) for its **Input**, and a **Virtual Cable** (like **VoiceMeeter Input**) for its output. Use the **RX Gain (8)** control to adjust the audio level going to your digital mode program (instead of the **AF (21)**) 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 (38)** choose **Simple** complexity level and set **RX1** to **ANT1** (see page 119 for more on the Antenna Form). Connect a 50 ohm dummy load to the ANT 1 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 (4a)** (Set to **Combo**). If using the optional, integrated ATU, select **Automatic** on the **ATU Form (39)** and then click the **TUN (19)** button. See the section on the **ATU Form** on page 123 for more on how to use the ATU.

**CAUTION:** If you are not using the internal ATU then connect a 50 ohm dummy load, or ensure that the antenna presents a 50 ohm load with a low SWR. Failing to do so may damage the FLEX-5000 output transistors.

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 (4a)** to **Combo** or **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 an 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 130). 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-> General-> Options**.

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 171). These offsets can be modified on the **Setup-> CAT Control**.

**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.

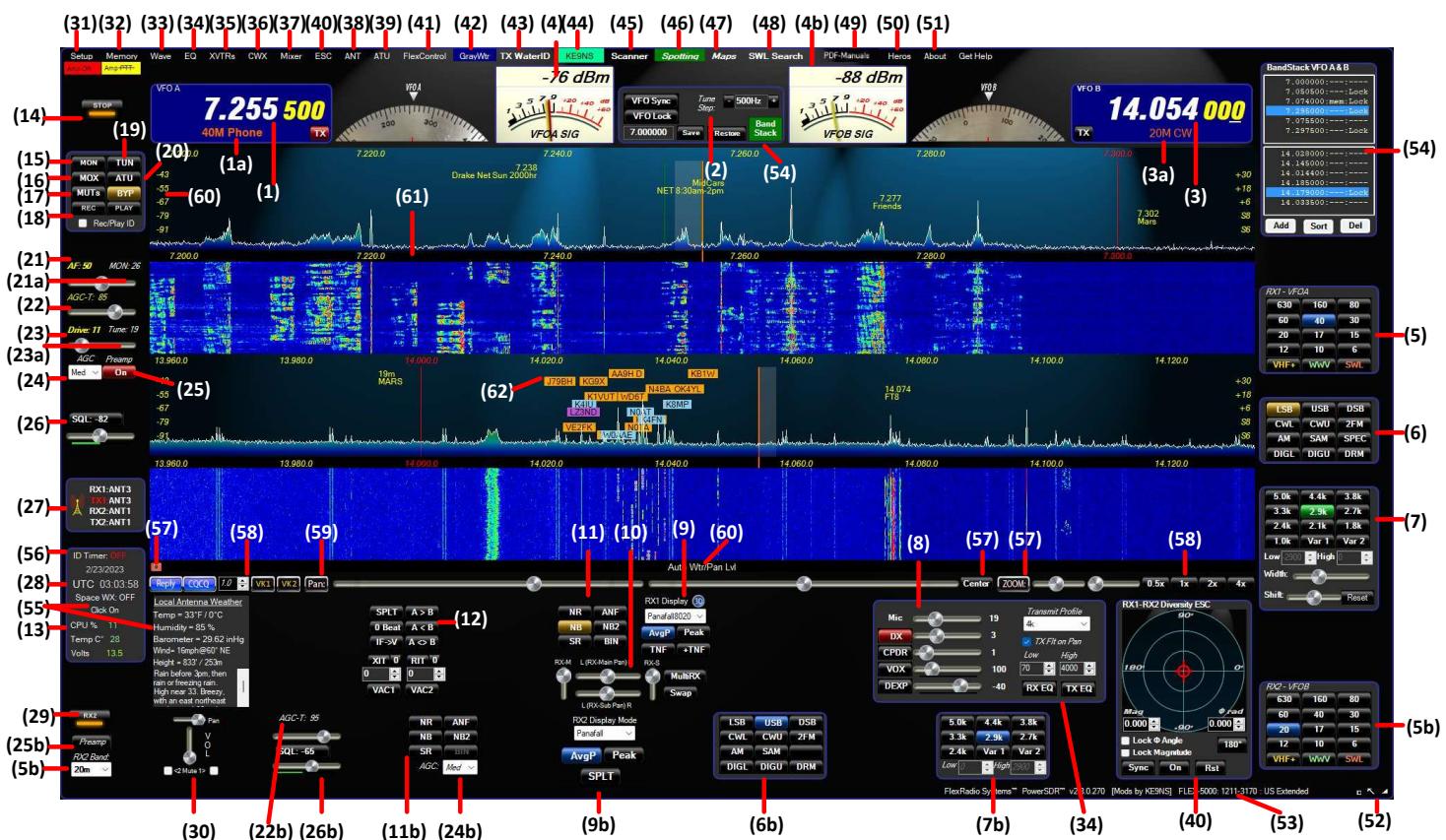
**Hint 2:** Please check our Knowledge Center (<http://kc.flex-radio.com/search.aspx>) for more articles on how to use PowerSDR with various digital mode programs.

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## **Chapter**

5

# Front Console



**Figure 46: PowerSDR 2.0 Front Console**

### Note 1:

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.

### Note 2:

The lower part of the font console will only be visible if you have the second receiver (RX2) installed.

**Note 3:** Corresponding main and second receiver control identifiers have corresponding numbers, with the latter appended by the letter b.

**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

RX2	Split	MultiRX	VFO A Appearance	
Off <sup>1</sup>	-	-	VFO A <b>14.179 000</b> 20M Ext/Adv Phone	VFO B <b>7.295 000</b> TX
On	Off	Off	VFO A <b>14.179 000</b> 20M Ext/Adv Phone	VFO B <b>7.295 000</b> 40M AM Frequency
On	On	-	VFO A <b>14.179 000</b> 14.189000 TX	VFO B <b>7.295 000</b> 40M AM Frequency
On	Off	On	VFO A <b>7.295 000</b> 7.296000 TX	VFO B <b>14.179 000</b> 20M Ext/Adv Phone

Figure 47: VFO A and VFO B (with RX2 present and ON)

VFO A is the main tuning VFO for the primary receiver RX1 and the transmitter. It consists of a frequency and a band description (related to the selected frequency). VFO A (and VFO B see below) act slightly differently, depending on whether the secondary receiver RX2 is on or not:

- When RX2 is **off** (or not installed), VFO A is the the main tuning VFO and VFO B tunes the primary receiver's secondary (split transmit or multiRX) 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)

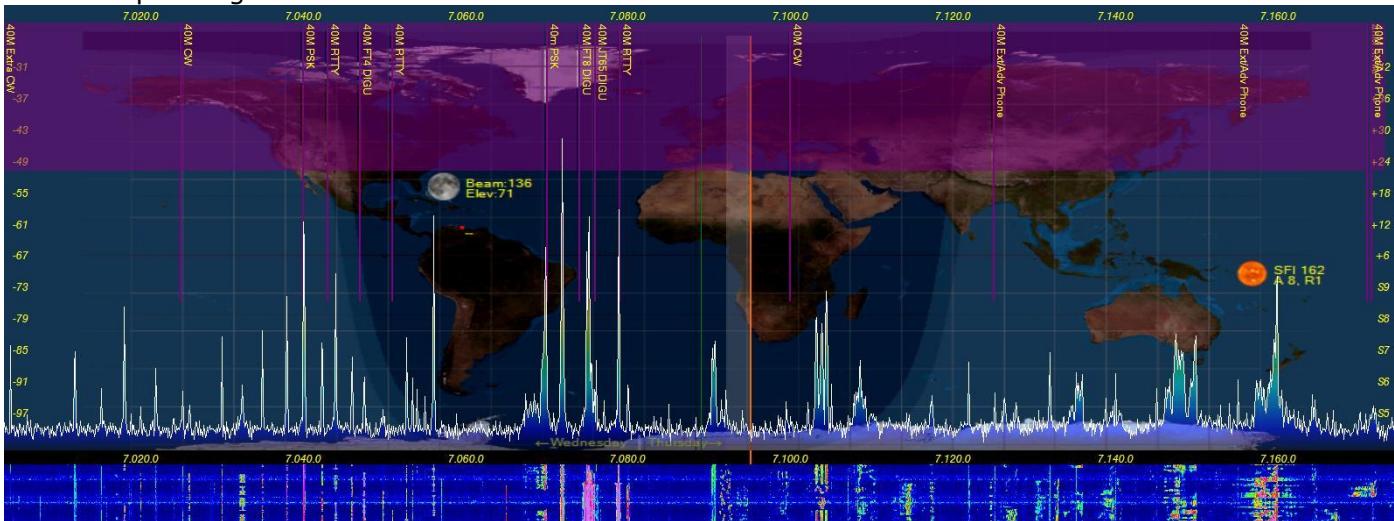
**Note:** Split and MultiRX are only available for the primary receiver RX1.

<sup>1</sup> **RX2 Off** means that either the second receiver is not installed or it is installed, but switched off.

- When RX2 is **on**, VFO A is exclusively dedicated to RX1 (and VFO B to RX2). As can be seen in Figure 47 above, in this case the RX1 split transmit or multiRX frequency is shown as a sub-frequency in the lower section of the display, where otherwise the band text would be.<sup>1</sup>
  - Clicking on the **TX** indicator in VFO A or VFO B will respectively switch the transmit frequency to either the RX1 (VFO A) or RX2 (VFO B) frequency.
  - If **Split** is on, the RX1 transmit frequency is the VFO A sub-frequency, displayed in red.
  - **RX2 Split** button will appear (see 3a VFOB for details). Split can be active on both RX1 VFOA and RX2 VFOB at the same time (manually selecting which VFO to be TX enabled)

The upper frequency area of the VFO is a Text Box and may be edited as such (click and drag highlighting, etc). The same holds for the lower area, when it displays a frequency instead of a band description. The upper area may also be changed by entering a numeric character (without any mouse interaction). You can enter Frequency in khz (i.e. 7125 = 7.125 mhz). An underline indicates the digit that will be tuned when hovering over the frequency display. See the Tuning Methods on page 54 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 Band Text information below the frequency gives general information about the FCC Amateur bands as well as the Short Wave Radio bands and WWV. **Right Click on the Band Text will Toggle Band Text to appear in the Panadapter area displaying the defined area described in the Band Text.** 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.



**Figure 47a: Right Click on Band Text under VFOA or B to Toggle BandText**

## (2) Tuning Controls



*Figure 48: Tuning Controls*

**VFO Sync** keeps VFO B synchronized to VFO A. This can be especially useful when using both RX1 and RX2 for diversity reception.

**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. Check **Setup-> General-> Options-> VFO Lock A/B**. Now **Right Click to Toggle between VFOA, VFOB or Both Locked**.

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 with the tune step for each click, while rotating the wheel toward you will decrease the frequency. You can change the Tune Step by clicking the **-** or **+** buttons, clicking the mouse wheel button, or using Ctrl + Left/Right Arrow.  
Tune Step values are also remembered by Mode (CW vs SSB)

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.

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<sup>1</sup> The band text returns by turning RX2 off, or leaving RX2 on, but turning split and/or multiRX off.

### (3) VFO B

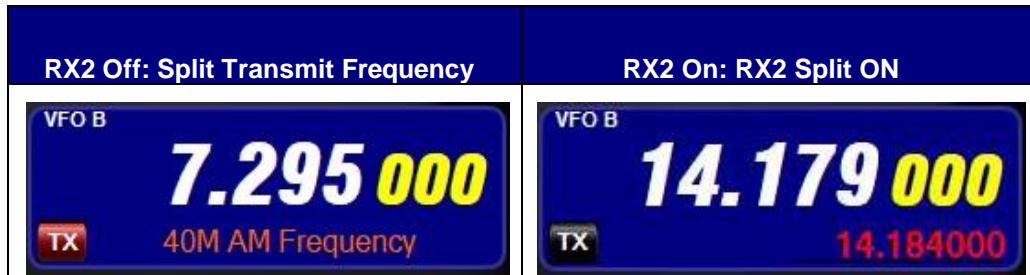


Figure 49: VFO B

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

- ❑ Without RX2 installed or with RX2 installed but **Off**:
  - VFO B displays in red the transmit frequency when operating split (**SPLT** is **On**).
  - VFO B displays in yellow the second receive channel frequency when activating the multi receive function (**MultiRX** is **On**).
  - Otherwise, it can be viewed as a storage container to copy VFO data to and from VFO A (see the VFO Controls section on page 95).
- ❑ With **RX2 installed and On**, VFO B tunes RX2 exclusively. **RX2 Split** button will appear. In this case the RX1 split or multi RX frequencies are displayed in the lower section of VFO A (see above).
  - The red TX indicator identifies the transmit frequency. Clicking on the TX indicator of VFO A or VFO B will change the transmit frequency to either RX1 (VFO A) or RX2 (VFO B).

### (4 and 4b) Multimeters

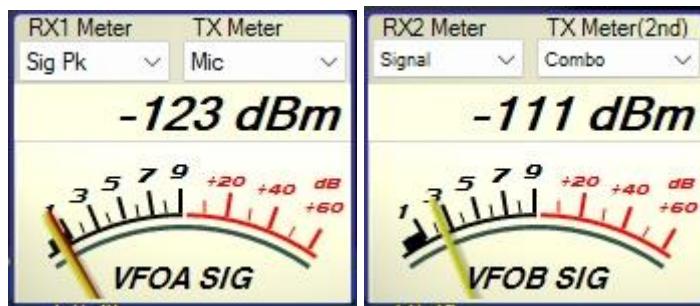


Figure 50: Primary (left) and RX2 (right) Multimeters

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 50 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 168).



Figure 50a: Alternate Multimeter faces

**Left Click** on the RX1 Meter cycles through all available meter faces. Right Clicking will open up Setup-> Appearance-> Meter. This is where you can select the look of the meter. The Last meter face is called “Combo” and can only be selected for TX2 Meter

**Right Click** on the digital dBm value area will toggle the Meter RX/TX selection menu OFF/ON. Setup-> Appearance-> Meter-> **Meters On Top** (just like Figure 46)

## RX1 and RX2 Meters

- ❑ **Signal (Signal Level):** Calculates the true RMS power in dBm of the current signal within the passband, as measured at the selected FLEX-5000 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 selected FLEX-5000 antenna port.
- ❑ **Sig Pk (Signal with Peak hold):** Analog meters show Avg needle along with a Red Peak hold needle
- ❑ **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.
- ❑ **ADC2 L (Analog To Digital RX2 Left):** If the second receiver RX2 is installed, calculates the level in dBFS (decibel full scale) of the Left input from the internal I/Q ADC for RX2. If RX2 is not installed, displays -200.
- ❑ **ADC2 R (Analog To Digital RX2 Right):** If the second receiver RX2 is installed, calculates the level in dBFS (decibel full scale) of the Right input from the internal I/Q ADC for RX2. If RX2 is not installed, displays -200.
- ❑ **Off:** Used for debugging purposes or to save CPU cycles on slower machines.

## TX Meters

- ❑ **Fwd Pwr (Forward Power):** Reads out forward power minus reflected power in Watts as measured by the internal ADC on the PA. The meter shows average power.

**Note:** In SSB, the typical male voice peak to average ratio is 14 dB. This means that a typical voice without the **DX** and/or **CPDR** enabled will only read 4-10W on an average meter when peaking at 100W.

- ❑ **Ref Pwr (Reflected Power):** Reads out reflected power as measured by the internal ADC on the PA.
- ❑ **SWR (Standing Wave Ratio):** Reads out the standing wave ratio as calculated from the measured forward and reflected power. (Only available with TUN on)
- ❑ **Mic: (This works in RX and TX modes.)** 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.
- ❑ **Combo: (RX2-TX2 meter only)** Shows FWD Power, SWR, ALC and live MIC all at the same time. All fields have a peak hold indicator.
- ❑ **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 on page 145)

## (5 and 5b) Band Selection & Band Stacking Memories



Figure 51: Primary (left) and RX2 (right) 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. This is used to quickly identify which band you are in (see Figure 51). Outside of your countries HF “TURF” ham band will jump into the nearest SWL band, and lastly VHF/UHF bands.

Secondly, clicking on one of the Band Selection buttons will change the frequency, mode and filter to the one last used on that band for RX1. At this stage, the same is not true for RX2, when selecting a band from the RX2 band drop down list.

The third role is a feature called Band Stacking Memories (RX1 only). 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.

**BandStack Window:** Click on the “Band Stack” button (See figure 51a). With the BandStack window active, click the Add, Sort, or Del (Delete button). Right click on bandstack memory to “Lock” it from being overridden. **Left Click** on any band stack memory will jump to this memory (VFOA on top and VFOB on bottom). If Meters on top, BandStack window appears top right (see Fig 46). **Right Click** on “Band Stack” button for Floating Band Stack Window.



Figure 51a: Click on BandStack button (turns Green) to enable BandStack window

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 and cannot be changed. And BandStack window displays "Lock"

The **VHF+** button (RX1 only) will swap between the typical HF bands and any configured transverter bands (see the description of the XVTRs Form on page 111). The VHF band buttons work in the same way, but for the frequencies within the transverter frequency range.

## (6 and 6b) Mode Selection



**Figure 52: Mode Selection**

The Mode Selection controls allow you to change the selected demodulation routine. Changing 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 54 below) as well as display the appropriate mode specific controls on the front console (see page 82). Following is a list of the available modes:

- ❑ **LSB:** Lower Side Band. Right Click SPLT toggles a +/- 5khz split
- ❑ **USB:** Upper Side Band. Right Click SPLT toggles a +/- 5khz split
- ❑ **DSB:** Double Side Band
- ❑ **CWL:** CW Lower Side Band. Right Click SPLT toggles a +/- 1khz split
- ❑ **CWU:** CW Upper Side Band. Right Click SPLT toggles a +/- 1khz split
- ❑ **FM:** Frequency Modulation. Right Click for RX/TX: nar 2khz (2FM), 5khz (5FM), wide 20khz (WFM)
- ❑ **AM:** Amplitude Modulation. Right Click for TX: standard DSB-AM, LSB-AM (H3E), USB-AM(H3E)
- ❑ **SAM:** Synchronous (PLL) AM. Right Click for TX: standard DSB-AM, LSB-AM (H3E), USB-AM(H3E)
- ❑ **SPEC (RX1 only):** Spectrum mode (DC IF, max bandwidth determined by the selected sampling rate)
- ❑ **DIGL:** Digital Lower Side Band (Enables VAC if VAC Auto Enable is engaged, see page 139)

- ❑ **DIGU:** Digital Upper Side Band (Enables VAC if VAC Auto Enable is engaged, see page 139)
- ❑ **DRM:** Digital Radio Mondiale (requires licensed external demodulator software not available from FlexRadio Systems; Enables VAC if VAC Auto Enable is engaged, see page 139)

Hotkeys are available in the Setup-Form, Keyboard Tab to cycle through the various modes using the keyboard (see page 170).

## (7 and 7b) Filter Controls



Figure 53: Primary (left) and RX2 (right) Filter Controls

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

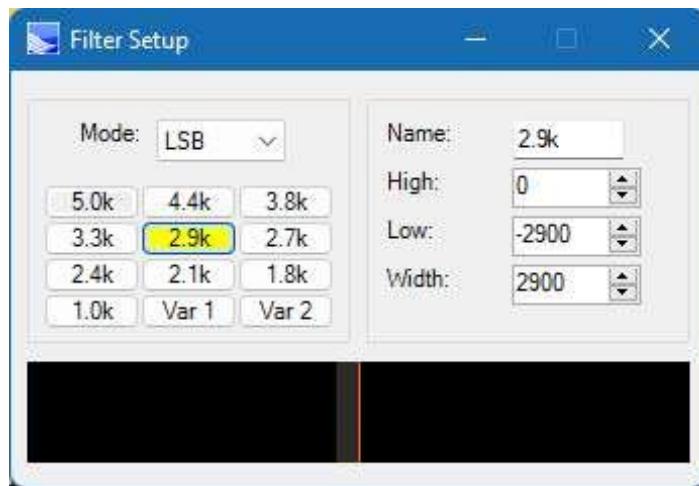
## Labeled Filter Buttons

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 (RX1 only) 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																																				
RX1	<table border="1"> <tr><td>1.0k</td><td>800</td><td>750</td></tr> <tr><td>600</td><td>500</td><td>400</td></tr> <tr><td>250</td><td>100</td><td>50</td></tr> <tr><td>25</td><td>Var 1</td><td>Var 2</td></tr> </table>	1.0k	800	750	600	500	400	250	100	50	25	Var 1	Var 2	<table border="1"> <tr><td>5.0k</td><td>4.4k</td><td>3.8k</td></tr> <tr><td>3.3k</td><td>2.9k</td><td>2.7k</td></tr> <tr><td>2.4k</td><td>2.1k</td><td>1.8k</td></tr> <tr><td>1.0k</td><td>Var 1</td><td>Var 2</td></tr> </table>	5.0k	4.4k	3.8k	3.3k	2.9k	2.7k	2.4k	2.1k	1.8k	1.0k	Var 1	Var 2	<table border="1"> <tr><td>16k</td><td>12k</td><td>10k</td></tr> <tr><td>8.0k</td><td>6.6k</td><td>5.2k</td></tr> <tr><td>4.0k</td><td>3.1k</td><td>2.9k</td></tr> <tr><td>2.4k</td><td>Var 1</td><td>Var 2</td></tr> </table>	16k	12k	10k	8.0k	6.6k	5.2k	4.0k	3.1k	2.9k	2.4k	Var 1	Var 2
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600	500	400																																					
250	100	50																																					
25	Var 1	Var 2																																					
5.0k	4.4k	3.8k																																					
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8.0k	6.6k	5.2k																																					
4.0k	3.1k	2.9k																																					
2.4k	Var 1	Var 2																																					
RX2	<table border="1"> <tr><td>1.0k</td><td>800</td><td>750</td></tr> <tr><td>600</td><td>500</td><td>400</td></tr> <tr><td>250</td><td>Var 1</td><td>Var 2</td></tr> </table>	1.0k	800	750	600	500	400	250	Var 1	Var 2	<table border="1"> <tr><td>5.0k</td><td>4.4k</td><td>3.8k</td></tr> <tr><td>3.3k</td><td>2.9k</td><td>2.7k</td></tr> <tr><td>2.4k</td><td>Var 1</td><td>Var 2</td></tr> </table>	5.0k	4.4k	3.8k	3.3k	2.9k	2.7k	2.4k	Var 1	Var 2	<table border="1"> <tr><td>16k</td><td>12k</td><td>10k</td></tr> <tr><td>8.0k</td><td>6.6k</td><td>5.2k</td></tr> <tr><td>4.0k</td><td>Var 1</td><td>Var 2</td></tr> </table>	16k	12k	10k	8.0k	6.6k	5.2k	4.0k	Var 1	Var 2									
1.0k	800	750																																					
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16k	12k	10k																																					
8.0k	6.6k	5.2k																																					
4.0k	Var 1	Var 2																																					

Figure 54: Default Mode Dependent Filters

Each of the 10 (7 for RX2) 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 55.



*Figure 55: 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 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** and for RX1 also with **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 133).

- **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 133).
  - 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 95)
- **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 band 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 170) to change the filters using the keyboard.

## (8) Mode Specific Controls

This section of the front console displays key controls specific to the selected modulation 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 158, where a more detailed description may also be found)



Figure 56: Mode Specific Controls - Phone

- **Mic:** adjusts the software microphone gain. This is a simple multiplier applied to the input samples when in 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 77 above)

- ❑ **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. Works well in SSB to raise avg talk power (set to 3) when used with the Setup->DSP->AGC/ALC-> **Leveler** set fast: 5,1,125,170 and **ALC** fast=1,20,170
- ❑ **CPDR:** click to enable the Compander and adjust its level with the slider. Works well in AM with Leveler turned OFF, and ALC OFF 1,1,10
- ❑ **VOX:** click to enable the VOX and adjust its level with the slider. See also the Setup Form-Transmit Tab (page 161). When enabled, 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 not activate the transmitter; the red part the portion that will. VOX should be adjusted such that ambient noise will not activate the transmitter, but a normal voice will. Works with VAC as well.
- ❑ **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 160 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, irrespective of whether VOX is engaged.

- ❑ **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 158)
- ❑ **Show TX Filter:** when checked, the band edges of the transmit filter, set on the Setup Form-Transmit Tab (page 159) 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 (or VFO A sub-frequency when RX2 is on). Additionally, it will give you a quick visual impression of whether your transmit filter needs to be adjusted or not.
- ❑ **RX EQ:** activates the receive equalizer (three-band or ten-band). See also the Equalizer form described on page 109.
- ❑ **TX EQ:** activates the transmit equalizer (three-band or ten-band). See also the Equalizer form described on page 109.
- ❑ **VAC:** activates *Virtual Audio Cable* (see <https://vb-audio.com/Cable/>), a third party program, VB-CABLE or VoiceMeeter Banana, used 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 138. VAC is not automatically enabled for phone modes, even if **Auto Enable** has been checked on the VAC Sub-Tab.

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## CW Controls

The CW controls, shown in Figure 57 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 153, where you can also find a more detailed description).



*Figure 57: 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 154)
- ❑ **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 (or the VFOA sub-frequency when RX2 is on).
- ❑ **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.
- ❑ **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 155. When checked, disables the CWX "Drop Delay"
- ❑ **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 158)

## 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 138, where you can also find a more detailed description).

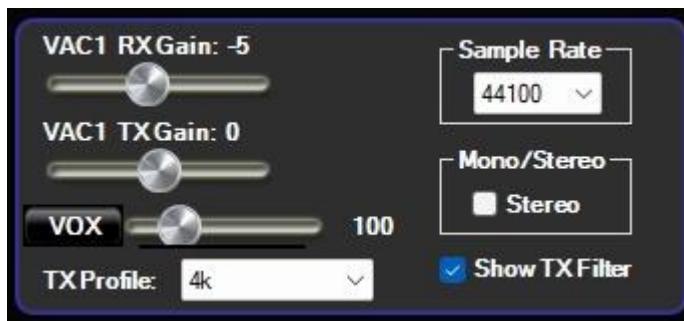


Figure 58: Mode Specific Controls - Digital

- **VAC:** activates *Virtual Audio Cable* ([see \*https://vb-audio.com/Cable/\*](https://vb-audio.com/Cable/)), a third party program, VB-CABLE or VoiceMeeter Banana, used 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 138. If **Auto Enable** (page 139) has been checked on the VAC Sub-Tab, then VAC will automatically be enabled when either DIGL, DIGU or DRM is selected.
- **VOX:** click to enable the VOX and adjust its level with the slider. See also the Setup Form- Transmit Tab (page 161). When enabled, 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 not activate the transmitter; the red part the portion that will. VOX should be adjusted such that ambient noise will not activate the transmitter, but a normal voice will. Works with VAC as well.
- **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).
- **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 158)
- **Show TX Filter:** when checked, the band edges of the transmit filter, set on the Setup Form-Transmit Tab (page 159) 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 (or VFO A sub-frequency when RX2 is on). Additionally, it will give you a quick visual impression of whether your transmit filter needs to be adjusted or not.

## (9 and 9b) Display Controls

The main display controls, shown in Figure 59 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 for RX1 (9) and RX2 (9b) respectively.



*Figure 59: Display Controls*

### Screen Controls

The screen controls adjust the view of the Panadapter, Panafall, or Waterfall display, they are not functional for any of the other display types.

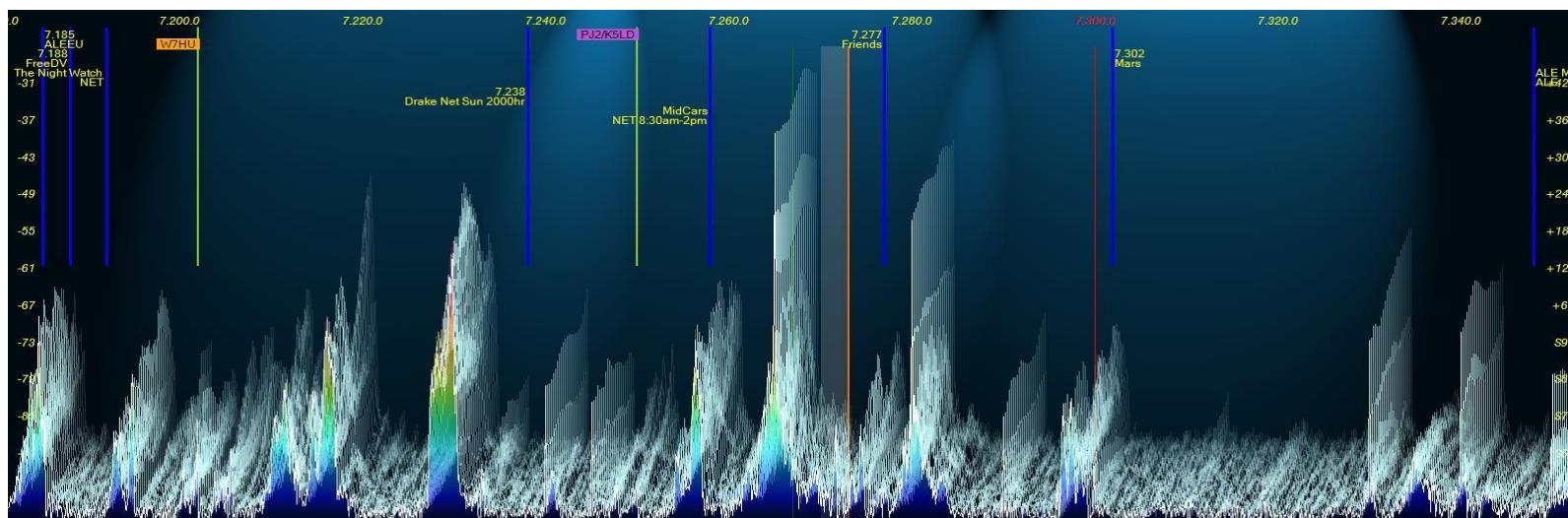
- **Pan (button):** **Left Click** (turns RED) toggles between Standard operation, and PAN mode, where the Panadapter is stationary and the Bandpass moves around the screen as VFO frequency changes. If you scroll off the screen, the entire Panadapter moves to put the Bandpass in the center. **Right Click** to Reset I.F. back to default values. NOTE: PAN mode disrupts the IQ output for VAC.
- **Pan (Sliders):** adjust the slider to pan the Panadapter or Waterfall display from left to right. Click on. **Center** to quickly center the display. **RX2** gets its own slider
- **Zoom (button):** **Hold mouse** over button (while PowerSDR in Focus) to show Zoom level. **Left Click** (turns RED) to Enlarge signals. **Right Click** (turns Orange) to Zoom in on Bandpass and toggle between showing Frequency or Frequency offset.
- **Zoom (Sliders):** Adjust slider to manually change the Zoom level. NOTE: The maximum frequency span of the Panadapter or Waterfall is dependent on the audio sample rate setting. **RX2** gets its own slider.
- **0.5x, 1x, 2x, 4x:** **Left Click:** on any button zooms VFOA, **Wheel Click:** Zooms VFOB. **Right Click:** zooms 100x, 10x, 20x, 40x for VFOA only (this assumes Setup->Display->Hi-Res PanaFall checked ON for 100x mode)

Video of Pan feature (also referred to as CTUN): <https://youtu.be/JZcbTVARFTA>

## 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 boxes for RX1 and RX2 respectively. 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 142).

- AVG (Average):** click to view time-averaged signals. Toggle between **AvgP** (Pan only) and **AvgB** (both Pan and water). 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 141). **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.



- 3D:** click to change Panadapter display to 3D style display (turns Red). Display will have more depth if in Panadapter and not Panafall mode, but will work in both. Adjust the 3D effect from Setup->Appearance->General-> 3D x offset, y offset, and z offset. This is for RX1 only.

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## Display Type Descriptions

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

For RX1 there are six frequency domain display types (Spectrum, Panadapter, Waterfall, Histogram, Panafall™ and Panascope™) and three time domain display types (Scope, Phase and Phase2). Panafall and Panascope are only available when RX2 is off (or not installed). For RX2 the choice is limited to either Panadapter or Waterfall. Various colors used in the display (text, data line, etc) are customizable using the Setup Form-Appearance Tab, Display Sub-Tab (page 165).

We will now first discuss the display types for RX1 only, followed by the combination of RX1 and RX2.

### Spectrum



Figure 60: 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).

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## PanaFall

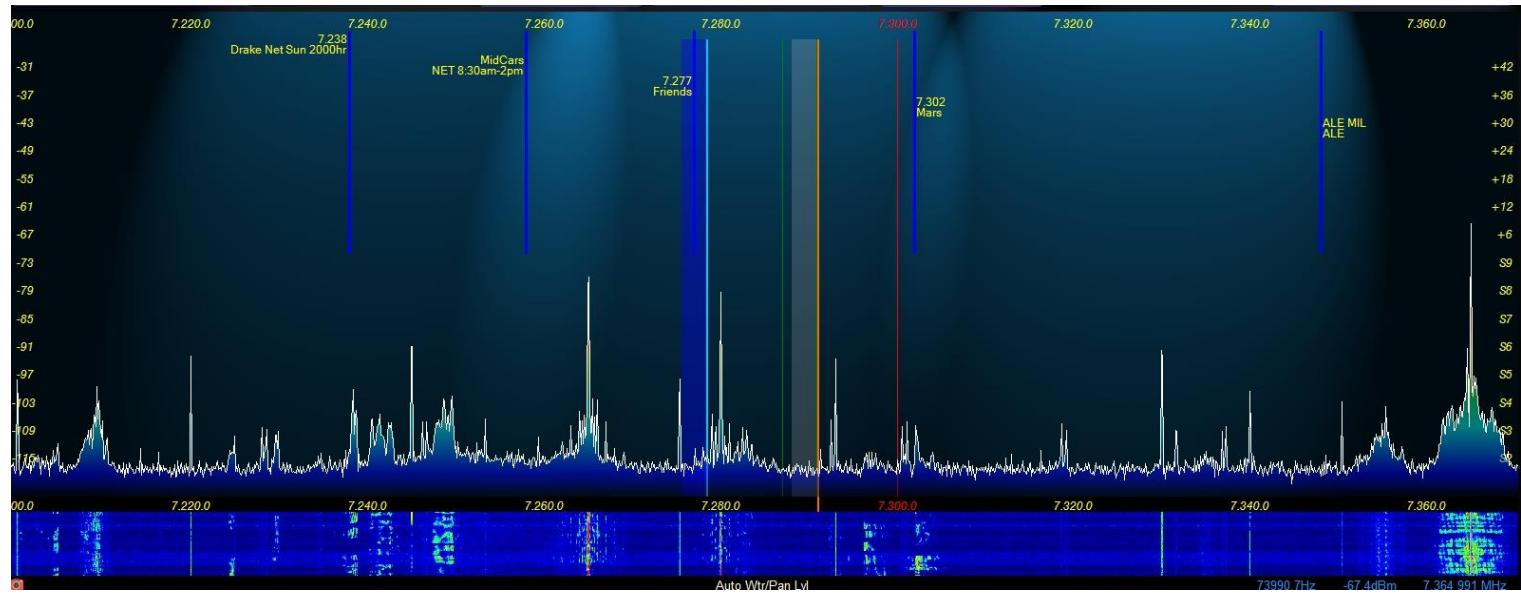


Figure 61 PanaFall Display. Panadapter mode would be just the upper half.

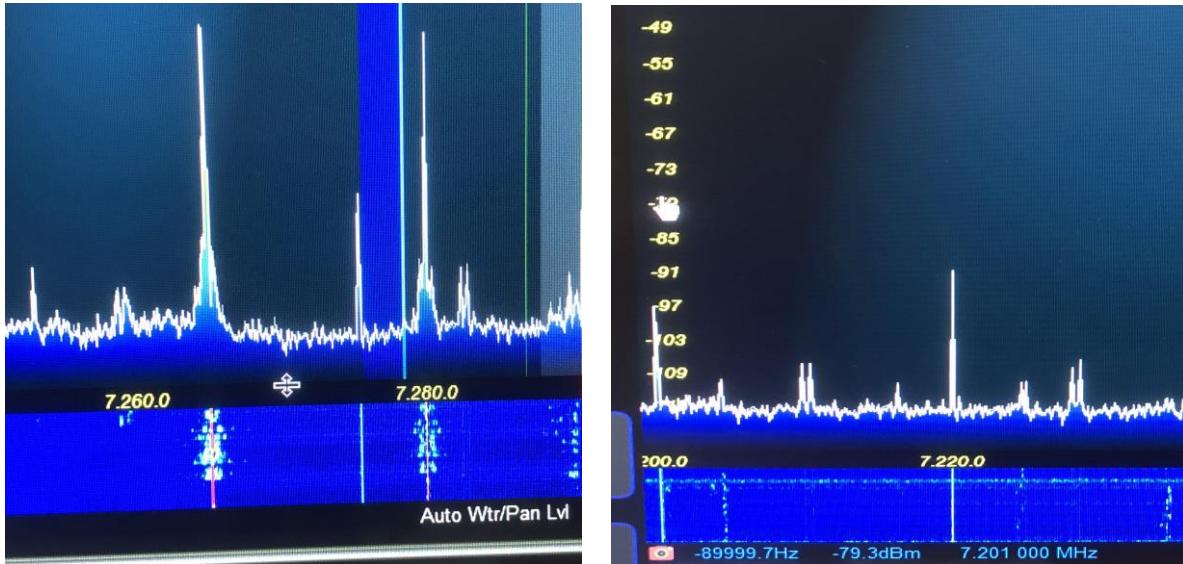


Figure 61a: Grab bar between Pan and Water to change ratio. Figure 61b: Grab hand to raise/lower Pan floor

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

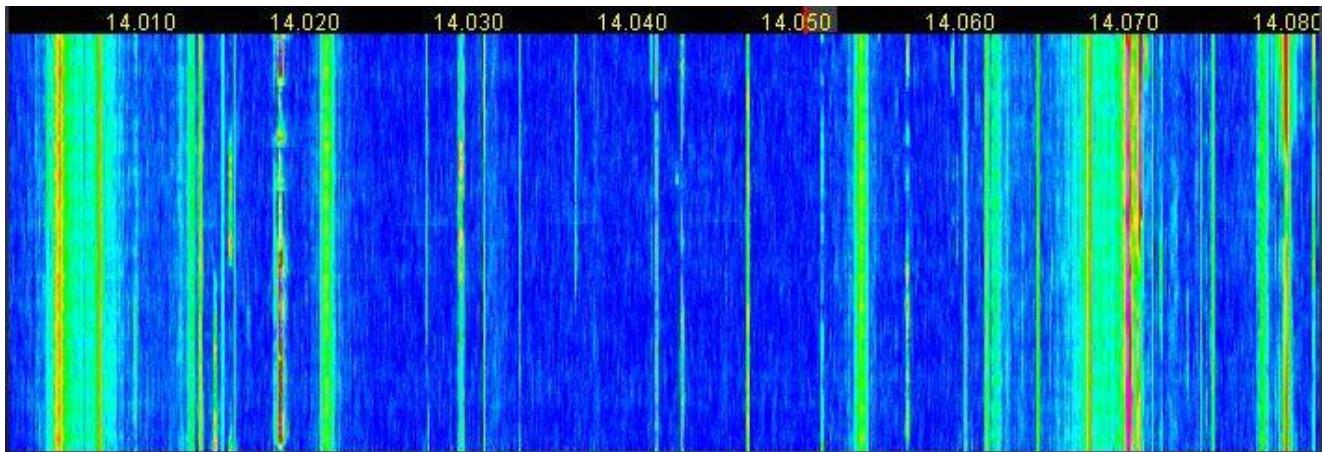
- The maximum display width is a function of the selected sampling rate, no matter what filter bandwidth is selected.
- The selected filter is displayed as an overlay to help the user visualize the filter. Shown are the main RX filter (gray, VFO-A), the MultiRX filter (blue, VFO-B) and the TX filter edges (yellow vertical lines). The color and transparency of all the filter overlays can be changed independently using the Setup Form-Appearance Tab, Display Sub-Tab (page 165).
- 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.
- In **PanaFall** mode, you can Grab the divide between Pan and Water and pull it up or down to change the ratio of Pan to Water. You can also Grab the dBm (on the left side) and pull it up or down to raise or lower the level of the noise floor.
- **RX2** can also use PanaFall mode. It will always appear below RX1

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 (as determined by the sampling rate). 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).

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## Waterfall



*Figure 62: Waterfall Display*

The Waterfall Display shows a scrolling view of activity within the receiver's passband (as determined by the sampling rate). 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 143 for more details.)

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## Histogram

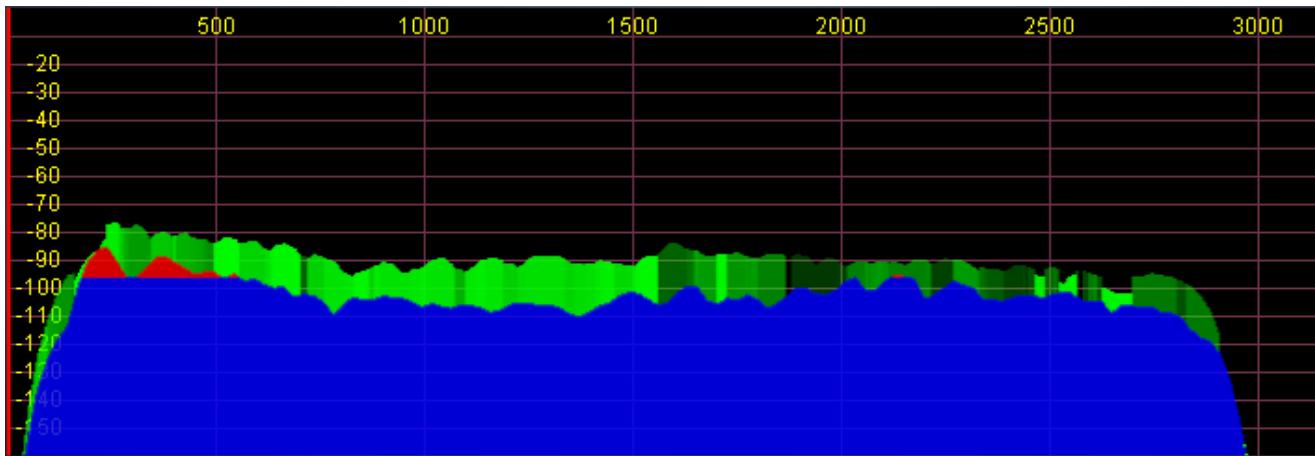


Figure 63: Histogram Display Mode

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

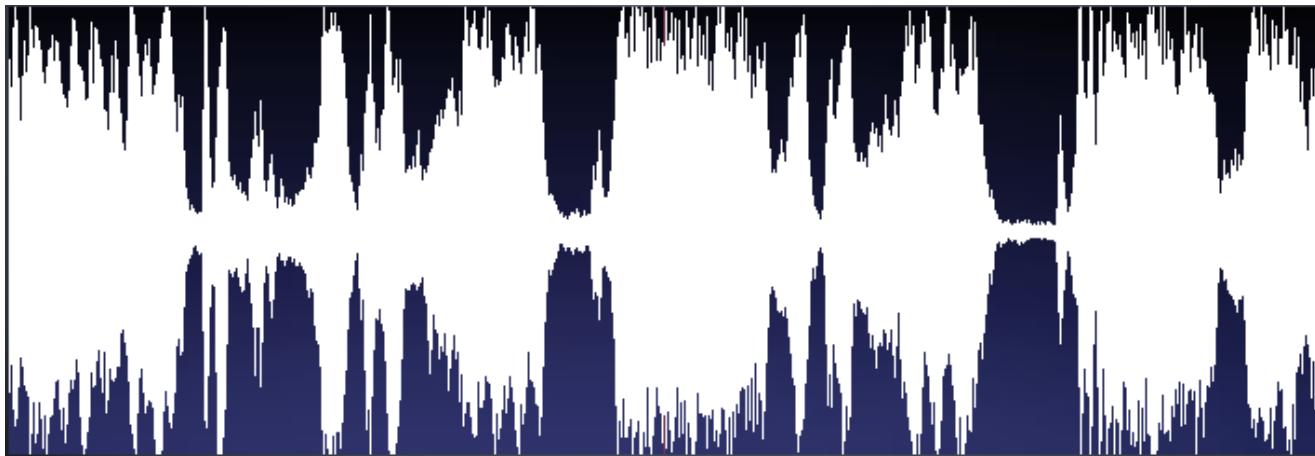
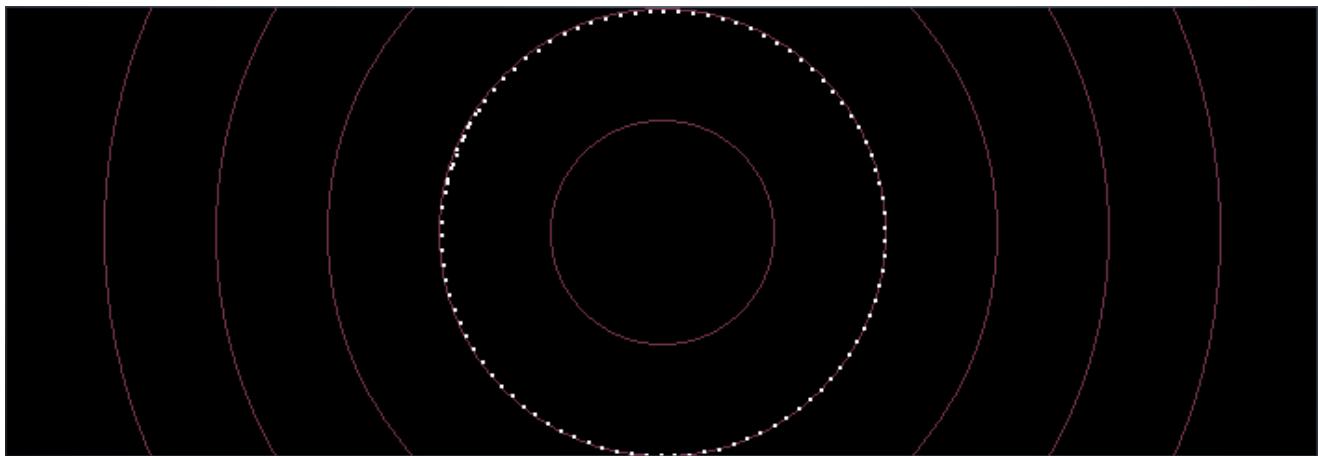


Figure 64: Scope Display

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 82) or equalization (page 109). The time base can be adjusted on the Setup Form- Display Tab (see page 141). In **AM mode**, a **AM Negative Modulation > 100%** Red Warning will appear when the Carrier collapses due to excessive Negative audio Peak above 100%.

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## Phase



*Figure 65: 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.

## PanadAPTER

This display is just the PanadAPTER displays described above. This can be used for both RX1 and RX2.

## PanasCOPE

This display is a combination of the PanadAPTER and the Scope displays described above. It is only available when the second receiver RX2 is off.

## 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.

## RX2 Display

With RX2 installed and on, the RX2 available display types are Panafall, PanadAPTER and Waterfall. The screen then shows the RX1 display type above the RX2 display type, as illustrated in Figure 66.

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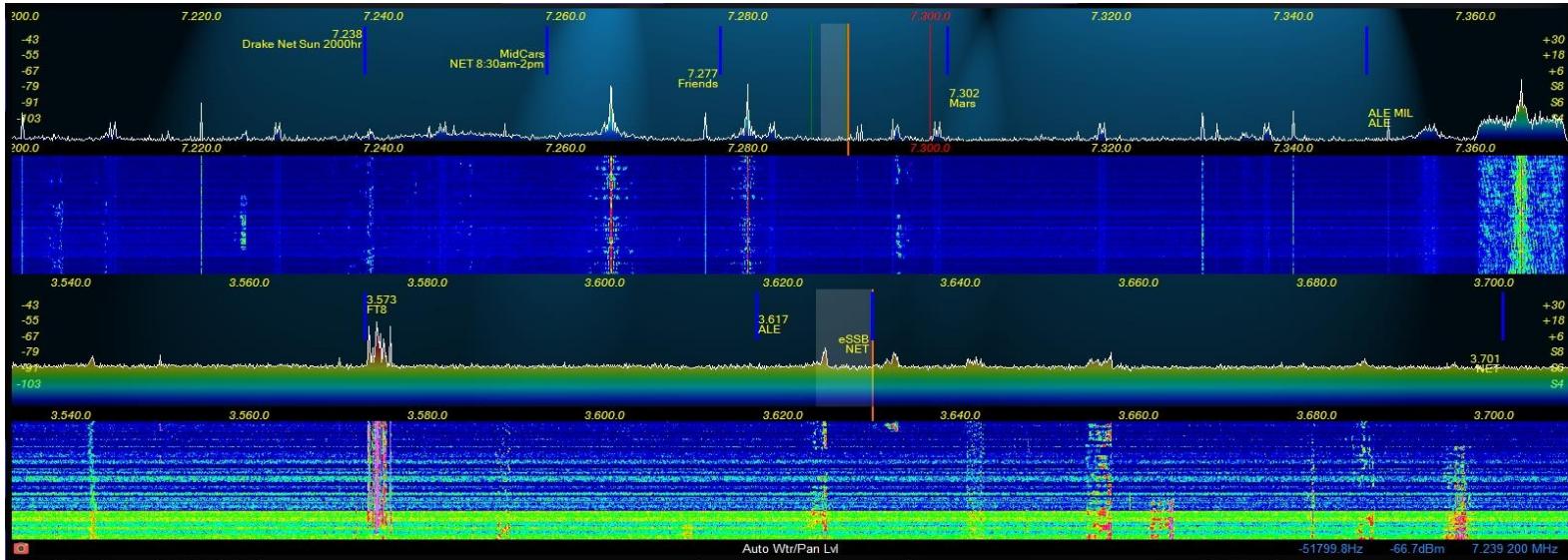


Figure 66: Combined RX1 and RX2 PanaFall

### 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 67 below, 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. When RX1 and RX2 displays are both showing, the cursor position read-out relates to the respective display the cursor is in, either the RX1 (upper) or RX2 (lower) display.

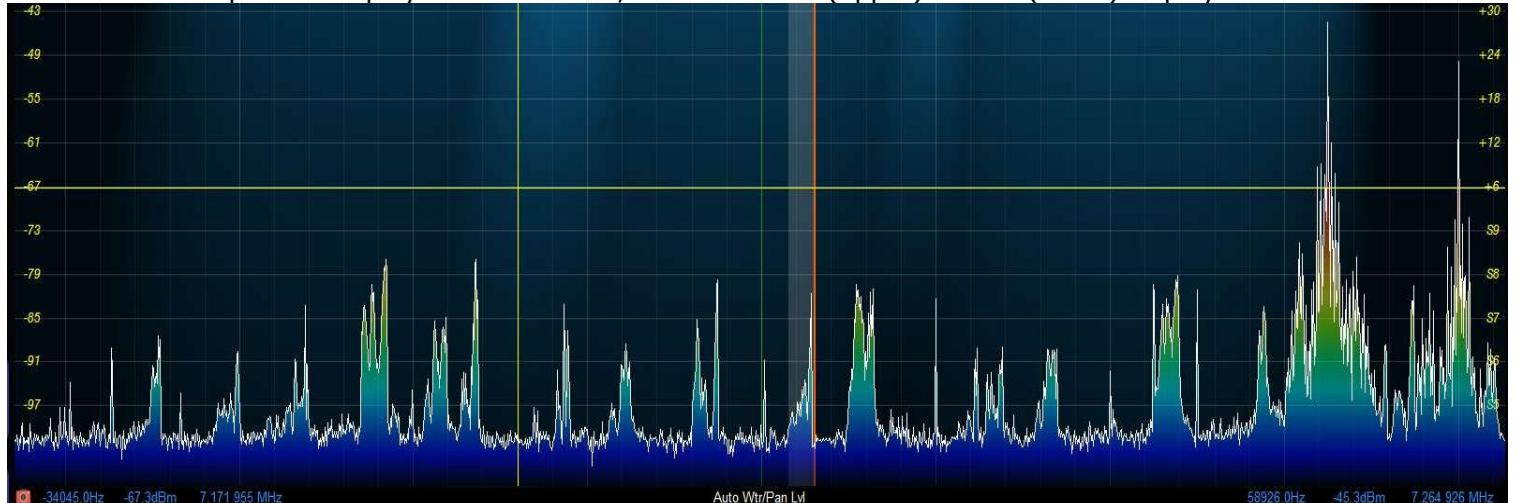


Figure 67: Cursor and Peak Position Information

- 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 67 above).
- Together with the **AVG** control they allow easy measurement of signals on the display. For example, in Figure 67 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 (and for RX2 VFO B) to the frequency indicated by the cursor position data (or if Snap ClickTune is on, see page 130), to the nearest multiple of the Tune Step). The red crosshairs tune VFO B if RX2 is off (or not installed), or the lower section of VFO A (see page 74). 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 for RX1 only 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. Right Click on **MultiRX** to reset back to VFOA. See Setup->Display->"MultiRX auto Reset", and "Split TX Listen"(XFC).



*Figure 68: MultiRX Controls*

Click **MultiRX** to enable the second receive channel. The second receive channel will be tuned to the frequency shown in either VFO B if RX2 is off (or not installed), or in the lower section of VFO A if RX2 is on (see page 74). 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 1:** 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.

**Hint 2:** With the second receiver RX2 installed and on, you can also use these controls to adjust the volume L/R position of RX1 and RX2 independently. To do so, deactivate **MultiRX** and activate **RX2**. The left vertical slider will then adjust the RX1 volume only and the right slider RX2 volume only. Use the 2 horizontal sliders to position RX1 and RX2 independently anywhere in the L/R audio spectrum.

Although you can manipulate the RX2 audio separately with the **RX2 Audio Controls** (see Figure 75 on page 100), you can only manipulate the RX1 audio independently using the MultiRX controls.

**Hint 3:** If you activate **MultiRX** and **RX2** simultaneously, these vertical sliders will effect both the RX2 audio and the second RX1 channel audio simultaneously. You can then also use the **RX2 Audio Controls** to adjust RX2's audio independently (see Figure 75 on page 100).

## (11 and 11b) DSP Controls



Figure 69: 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 145); **SR** (Spur Reduction) is described in the Setup Form-General Tab, Options Sub-Tab (page 129).

- **NR (DSP Noise Reduction):** Activates the DSP Noise Reduction algorithm (see page 145).
- **ANF (Automatic Notch Filter):** Activates the Automatic Notch Filter algorithm (see page 146).
- **NB (Impulse Noise Blanker):** Activates the Noise Blanker algorithm (see page 148).
- **NB2 (Mean Rank Noise Blanker):** Activates the Mean Rank Noise Blanker algorithm (see page 148).
- **SR (Spur Reduction):** Activates the Spur Reduction algorithm (see page 129).
- **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. As you tune across CW signals, they will seem to move in space. 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 **FM**, **AM** or **SAM**.

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## (12) VFO Controls



*Figure 70: VFO Controls*

These controls are only available for the main receiver RX1.

- ❑ **SPLT (Split):** Enables Split operation using VFO B (or the lower section of VFO A if RX2 is on, see page 74) for the transmit frequency. The frequency displayed in VFO B (or lower part of VFO A) will turn red to indicate that it is the transmit frequency. **Right Click** in **SSB** to toggle a +/- 5khz split, in **CW** to toggle a +/- 1khz split.
- ❑ **0 Beat:** Centers the signal peak within the RX1 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** and shifts it back to baseband. Useful when chasing a signal with the Filter **Shift** control (see also page 81).
- ❑ **A >B:** Transfers the contents of VFO **A** to VFO **B** (frequency, mode, and filter). If RX2 is on, this tunes RX2 to the same frequency RX1 is on.
- ❑ **A< B:** Transfers the contents of VFO **B** to VFO **A** (frequency, mode, and filter). If RX2 is on, this tunes RX1 to the same frequency RX2 is on.
- ❑ **A<>B:** Swaps the contents of VFO **A** and **B** (frequency, mode, and filter). If RX2 is on, this swaps the frequencies RX1 and RX2 are tuned to.
- ❑ **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 **SPLT** activated, XIT modifies the VFO B (or lower part of VFO A if RX2 is on) 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 %, Temp, Volts

This displays the 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. You need at least a 4 core or better CPU. Left Click on **Temp** to toggle between F and C and OFF. OFF will turn **Volts** off as well.

## (14) Start/Stop Button

Click **Start** to activate PowerSDR, click **Stop** to deactivate it (see Figure 71).



Figure 71: Power Button States

**Note:** Please see also the Power-Up/Down procedures described on page 52 for information on best practices.

## (15) MON “Monitor” (MONps and MONpr)

When in **MONps** is enabled, the transmitted audio is monitored through the receiver's speakers. When in **MONpr** is enabled, the audio coming into the Flex radio is monitored through the receiver's speakers. The **MONps** 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 **MONps** feature will allow you to hear the effects of MIC gain, TX equalization, compression and compansion and to adjust them in real time. MONpr feature allows all mode usage and the ability to hear yourself when using over-the-ear headphones. Click on the **(21a) MON:** (turns yellow) used to adjust the monitor volume. Click on **(21) AF:** (turns yellow) used to adjust receiver 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 **(19) TUN** button description on page 97.

**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” (MUT and MUTs)

This button Mutes the speaker audio. (If RX2 is installed and on, it will mute both RX1 and RX2.). Right Click on **MUT** to toggle **MUTs**. **MUTs** will mute only the external speakers BUT leave the headphones ON

## (18) REC (record) and PLAY (play)

The **Record** and **Play** buttons offer a quick and easy way to record and play back a signal on the main receiver RX1. Click **REC** to start recording a RX signal, and click **REC** again to stop recording. Once recorded, the signal can be played back by PTT or MOX of the radio into Transmit and clicking **PLAY**. All recordings are saved as both **WAV** and **MP3**. The last recording will be played. Right Click **PLAY** to manually go back and select older WAV files, or hit CANCEL to go back to the latest file.

- Note 1:** **Wave**->“QuickAudio Save Folder” and “QuickAudio Create MP3” will save WAV recordings by date and time into folder: **%appdata%\FlexRadio Systems\PowerSDR v2.8.0\QuickAudio**. MP3 copies go in **\QuickAudioMP3** folders respectively.
- Note 2:** The **REC** and **PLAY** buttons are the same as the **Quick Rec** and **Quick Play** buttons on the **Wave Form** (see page 107).

Video on Audio Recording: <https://youtu.be/PIhqNuMiyjw>

## (19) TUN “Tune” (TUN and TUNp)

- Without the automatic antenna tuner (ATU), **TUN** transmits a continuous (CW) carrier at the level set with the **Tune Power** control (default 10W) on the Setup Form-Transmit Tab (page 158) and outputs a tone at the CW Pitch. This power is shown on the **Drive** control while **TUN** is activated. Any changes to the **Drive** control while **TUN** is active are saved when the **TUN** button is turned off. This feature is used to simplify the antenna tuning process for proper load matching. See **(23a) Tune**: (turns Yellow) allows the Tune level to be set. Right Click on **TUN** to toggle **TUNp** (tune pulse) See Setup->Transmit->Tune->Pulsar (pulse/sec and duty). **TUNp** disables the ATU as the ATU will be unable to properly detect SWR when pulsing.
- With the ATU, **TUN** activates the ATU tuning function. When the ATU is in Bypass, the **TUN** function operates just as if the ATU were not present.

- Note:** The **TUN** button will stay enabled after a tune cycle with the ATU set to Memory or Full. The button will become deselected when the ATU is bypassed, whether it be due to tuning to another band or manually selecting Bypass in the **ATU** Form (see page 123).

## (20) ATU and BYP

Click **ATU** to activate the Antenna Tuning Unit (ATU) and place it in Semi-Automatic mode. Click **BYP** to bypass the ATU. See also the description of the ATU Form on page 123.

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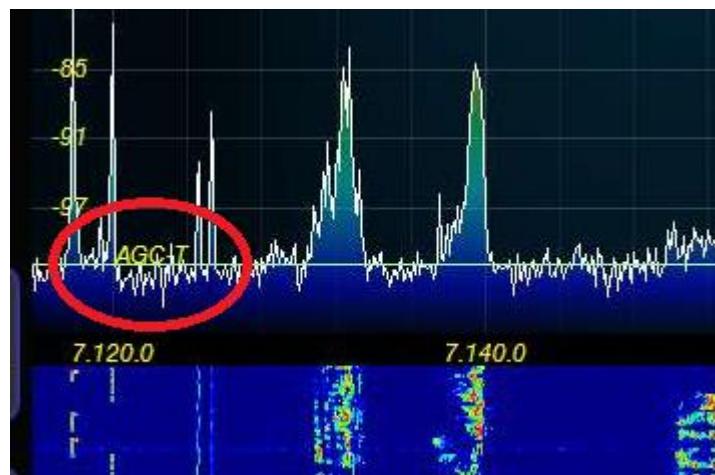
## (21) AF (Audio Frequency Gain)

This control sets the audio gain. If RX2 is installed and on, it sets the combined audio gains of RX1 and RX2. To adjust the RX1 audio level independently, use the MultiRX controls (see page 93), or the RX2 Audio Controls (see Figure 75 on page 100).

The AF gain may also be adjusted by pressing the + (plus) and - (minus) keys on the numeric keypad. For best performance of the FLEX-5000A, or FLEX-5000C when using an external speaker, 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.

## (22 rx1 and 22b rx2) AGC-T (AGC Threshold)

These controls set the *threshold (maximum gain)* of the AGC for RX1 and RX2 respectively. It is the same control as the **AGC Max Gain**, which can be found on the Setup Form-DSP Tab, AGC/ALC Sub-Tab (page 156). The operational use of the AGC control is essentially the same as that of an RF gain control found in more traditional receivers. **Right Click on AGC-T: text** to toggle the **Green AGC-T line** on the Panadapter. Then use your mouse to grab the AGC-T text touching the Green line to Pull up/down. The Green line should represent the noise level you hear. You should hear only signals at and above the line. If you need to adjust this see Setup->Display->AGC-T line Adj.



**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.

## (23) Drive: (TX Power Output) and (23a) Tune:(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. See Setup->Transmit->Drive Max to set a maximum drive level. Also Setup->transmit->Save Drive per band and per Mode.

Click on **Tune:** (turns yellow) to change over to TUNE power level (see Setup->Transmit->Drive)

**Note:**

Right Click on Drive: text (turns Dark) will lock the drive power level.

While great care is taken to ensure accuracy and that selecting a **Drive** value will give approximately that amount when using the 100W 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).

## (24 rx1 and 24b rx2) AGC (Automatic Gain Control)

These controls set, for each receiver RX1 and RX2 respectively, the Automatic Gain to one of the following settings: Fixd (Fixed or off), Long, Slow, Med (Medium), Fast, or Custom. The Custom setting enables the controls on the Setup Form-DSP Tab, AGC/ALC Sub-Tab (page 156), where also a more expansive explanation of the AGC can be found.

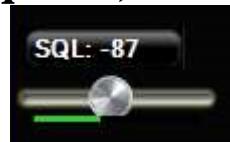
## (25 rx1 and 25b rx2) Preamp

This control switches the 15 dB preamp on or off. For the HF frequencies best results are achieved with the preamp on for the upper bands and off for the lower.

**Note:**

The preamp is unavailable for the 160m band to avoid interference from the broadcast bands. However, you can either insert a dedicated preamp using the RX1 Out/In receive loop (see page 7), or connect one at a receive only antenna and configure the appropriate antenna selection with the Antenna Form (see page 119).

## (26 rx1 and 26b rx2) SQL (Squelch)



*Figure 72: 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 (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.

## (27) Antenna Selection Display



*Figure 73: Antenna Selection Display*

The antenna selection display can be a helpful reminder of which antenna ports are selected for the main receiver RX1, the transmitter TX and the secondary receiver RX2. These ports are selected using the Antenna Form, described on page 120). Antenna will turn bright RED when transmitting. **Click on ANT1, ANT2, ANT3 to open up the ANT selection window.**

## (28) Date/Time Display



*Figure 74: 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*. **See (13),(55),(56) for other features.**

## (29) RX2 On/Off

If RX2 is installed, this button will turn RX2 on or off.



## (30) RX2 Audio Controls



*Figure 75: RX2 Audio Controls*

These controls allow you to adjust the audio of the second receiver RX2, if installed.

- **Pan:** Move left or right to position RX2 anywhere in the left-right audio spectrum.
- **Vol:** Adjusts the RX2 audio volume relative to the total RX1 + RX2 audio gain. The latter is controlled with the **AF** slider (see above).
- **<2 MUTE 1>:** Mutes the RX2 or RX1 receiver's audio.

## (31) 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 125 for more detailed information.

## (32) – (51) Operating Forms

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

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## Operating Forms (Windows)

This chapter describes each of the so-called operating forms (Windows). 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 76). 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 124)



Figure 76: Operating Form Identifiers

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## (32) Memory Form (recording scheduler)

Click the **Memory** menu to save and recall information such as TX/RX frequency, mode, filter and various other settings like repeater functions, scanner, and recording scheduler

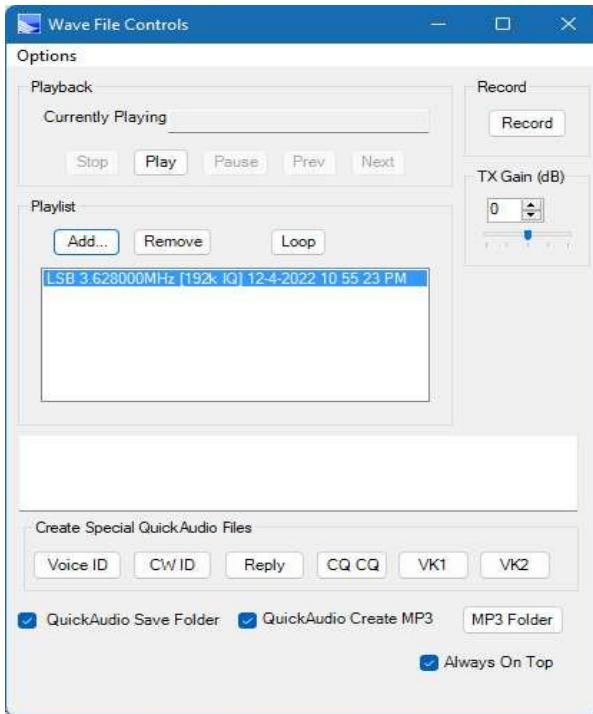
The screenshot shows the 'Memory Interface' window. The main area is a data grid displaying memory entries. Each entry includes columns for Group, Name, RX Freq, DSP Mode, Schedule Start, Duration, Recording, Weekly, Monthly, and Comments. To the right of the grid is a detailed table with columns for Scan, Tune Step, RPTR, RPTR Offset, CTCSS, CTCSS Freq, Deviation, Power, Split, TX Freq, RX Filter, RX Filter Low, RX Filter High, AGC Mode, and AGC T. Below the main grid is a scheduling interface with fields for Start Date, Start Time, Duration, Frequency (mhz), Group, and Name. It also includes buttons for Add, Copy, Delete, Select, Always On Top, Close after selection, and Open Rec Folder. A note at the bottom explains the highlighting and linking features.

**Figure 78: Memory Channel Form**

Memory form (window) with data from all previously stored memory locations. 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.

- **Delete:** Click the Delete button to remove a memory from the database. A prompt will be shown to prevent unintended loss of memories.
- Send a Memory to **VFOA** by **Left Clicking** on a Memory (left Margin).
- Send a Memory to **VFOB** by **Wheel Clicking** on a Memory (left margin).
- The **Group** column allows you to group into similar memory types (i.e. Repeater, Net, SWL, Broadcast, etc). The **(45) Scanner** allows you to recall memories by Group name for easy scanning.
- The **Name** column allows for a more specific definition of the type of memory.
- Both the **Group** and **Name** will be displayed on the Panadapter when the **(46) Spotter** "memories to Pan" box is checked.
- Add: To add a new Memory directly from the Panadapter, setup the radio controls the way you like them on the frequency you want to add, and hit **ALT+M**, OR go to the Memory form and hit **Add**.
- **MP3 recording** can be scheduled by first selecting the memory you want (highlight it), select the Start Date and time, duration of recording, and weekly or monthly.
- Add a URL hyperlink to the Comment of a memory. **Right Click to Open the URL** in your default web browser.

## (33) Wave Form



*Figure 79: Wave Form*

The Wave form (window) allows the user to Record and Playback either the post-processed audio (see page 108) of the current station, or up to 192 kHz bandwidth (as determined by the audio sample rate setting) of pre-processed IF (IQ) "audio" (see page 108) from the FLEX-5000.

**NOTE:**

If you record 192 kHz of pre-processed bandwidth, and play it back with PowerSDR set to *Receive*, you will see all the signals within that bandwidth and be able to tune them, filter them etc, as if you were actually receiving those signals live. In order to do this, you must first go to Setup->General->DDS->Expert->Yes->IF = 0hz. Make the IQ Recording. When you play it back use the MultiRX sub receiver to move around to hear all the recorded signals.

If on the other hand you record "post-processed" audio (your bandpass only), and play it back with PowerSDR set to *Transmit* you will be transmitting the audio you received and recorded.

### 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 an open file dialog 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 the %APPDATA% folder, the exact location of which depends on your operating system (see the notes under **REC and Play** (on page 97).

## 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).

## QuickAudio

- ❑ **Voice ID**: Used to Record your voice to ID for your station when using the ID Timer. Click, state your Call sign into your MIC, Click again to end recording.
- ❑ **CW ID**: Used to Record a CW ID for your station when using the ID Timer. Put the Radio into CW mode, use CWX macro to send your Call sign. Click, play macro, click to end recording
- ❑ **Reply**: Used to Record a voice ID for the Reply button. Click, state your Callsign into the MIC, Click to end recording.
- ❑ **CQCQ**: Used to Record a voice CQ for the CQCQ button. Click, speak your CQ into the MIC, Click to end recording.
- ❑ **VK1**: Used to Record a voice message for the VK1 button. Click, state your message into the MIC, Click to end recording.
- ❑ **VK2**: Used to Record a voice message for the VK1 button. Click, state your message into the MIC, Click to end recording.
- ❑ **QuickAudio Save Folder**: Console REC / PLAY will save all quick audio WAV recordings by time/date, mode, freq in a QuickAudio folder (%userprofile%\AppData\Roaming\FlexRadio Systems\PowerSDR v2.8.0\QuickAudio).
- ❑ **QuickAudio Create MP3**: Console REC / PLAY will save all quick audio MP3 recordings by time/date, mode, freq in a QuickAudioMP3 folder (%userprofile%\AppData\Roaming\FlexRadio Systems\PowerSDR v2.8.0\QuickAudioMP3).
- ❑ **MP3 Folder**: Quick access to your MP3s for listening on your PC or emailing to others.

## Record Options

Click **Options** at the top of the Wave Form (see Figure 79) to open the following form:



*Figure 80: 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. The bandwidth is determined by the Sample Rate you set in Setup->Audio->Primary. This is useful for playing back through PowerSDR at a later time (e.g. for demonstration purposes).
- **Post-Processed Audio** will record only the Bandpass (filtered, AGC'd) audio as you hear it coming out of the speaker. This is useful for playing back the received audio through a typical WAV and MP3 file player

### 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, compounded, 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.

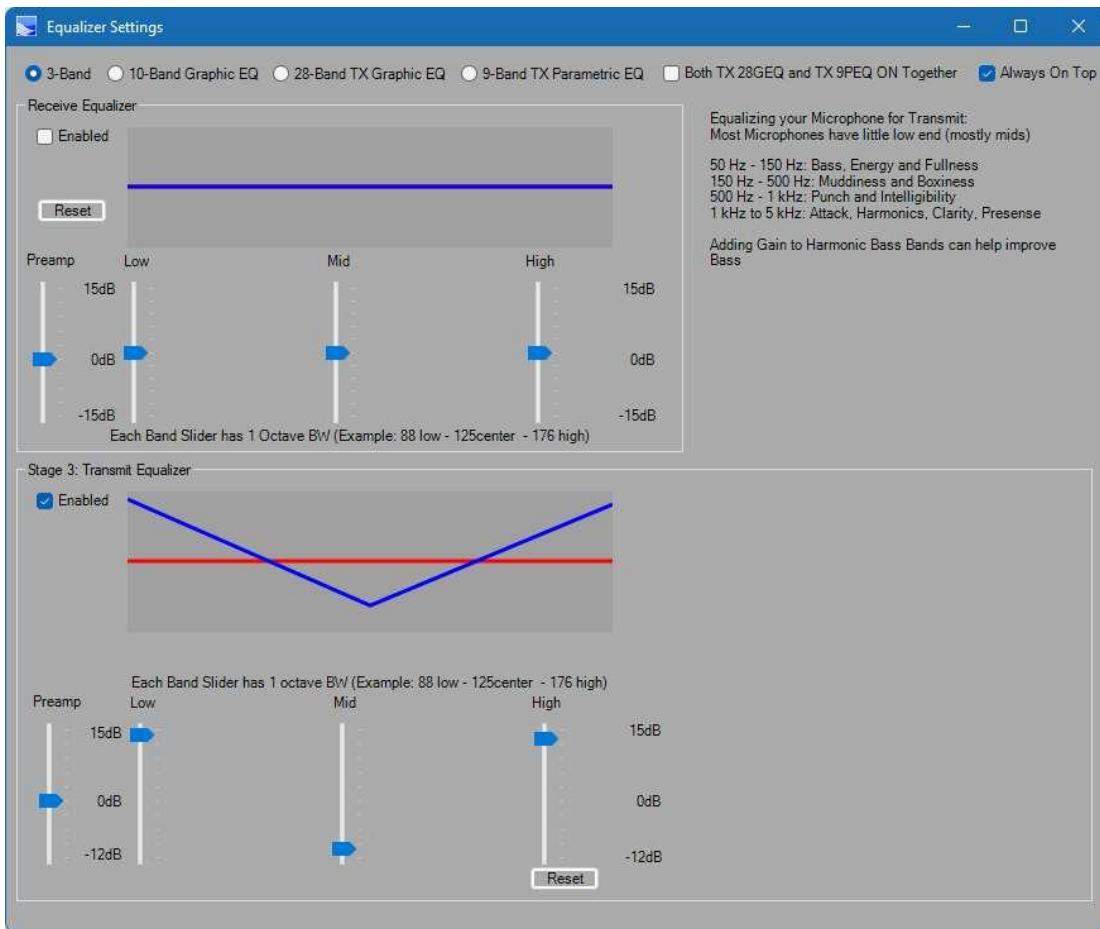
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## (34) EQ “Equalizer Form”

There are 5 equalizers available: a 3-band GEQ, 10-band GEQ, 28-band GEQ, and a 9-band PEQ. 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 82).

### 3-Band Equalizer

*Figure 81: Three-Band Equalizer Form (RX and TX)*

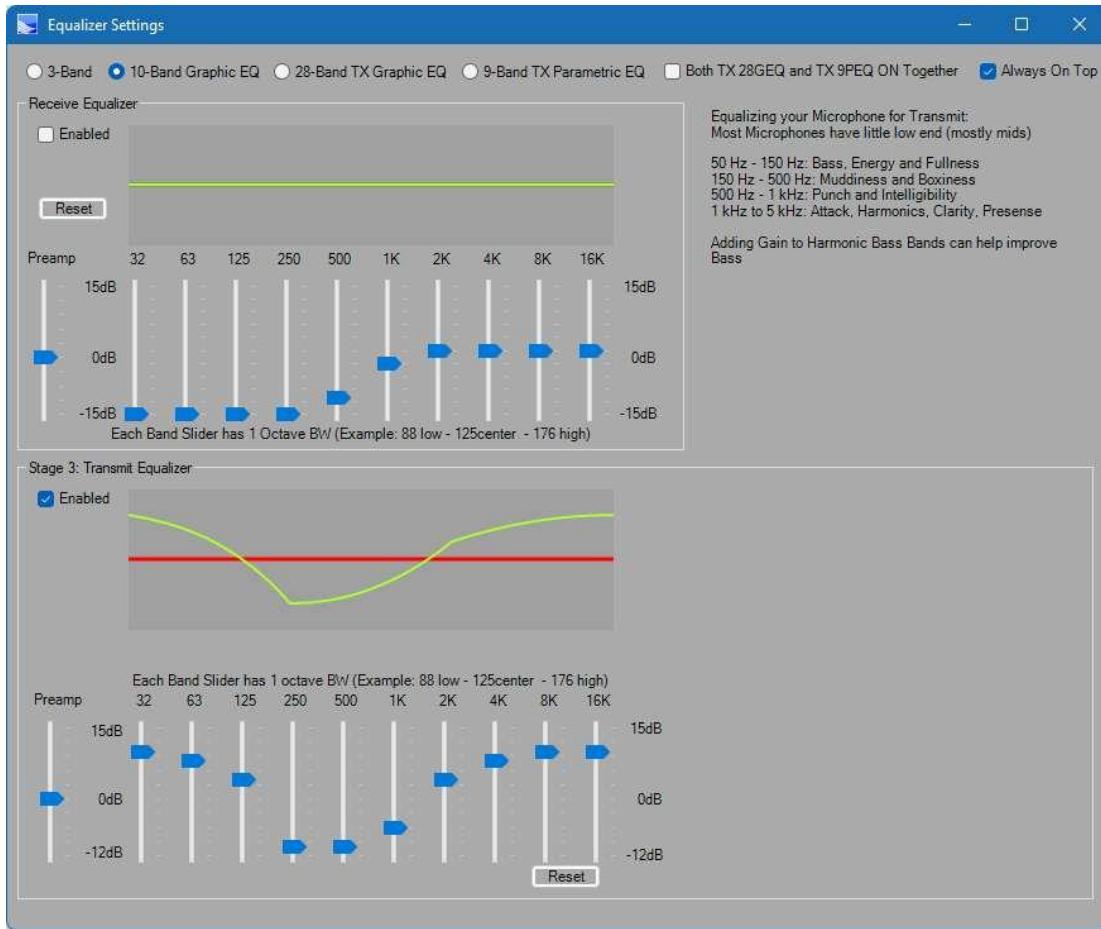


In most situations the 3-Band Equalizer will suffice. The receive and/or transmit audio can be modified by adjusting the gain for the **Low**, **Mid** and **High** audio bands. The **Preamp** applies gain across the whole audio spectrum. Easily compare the audio with and without the equalizer using the **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 Graphic Equalizer

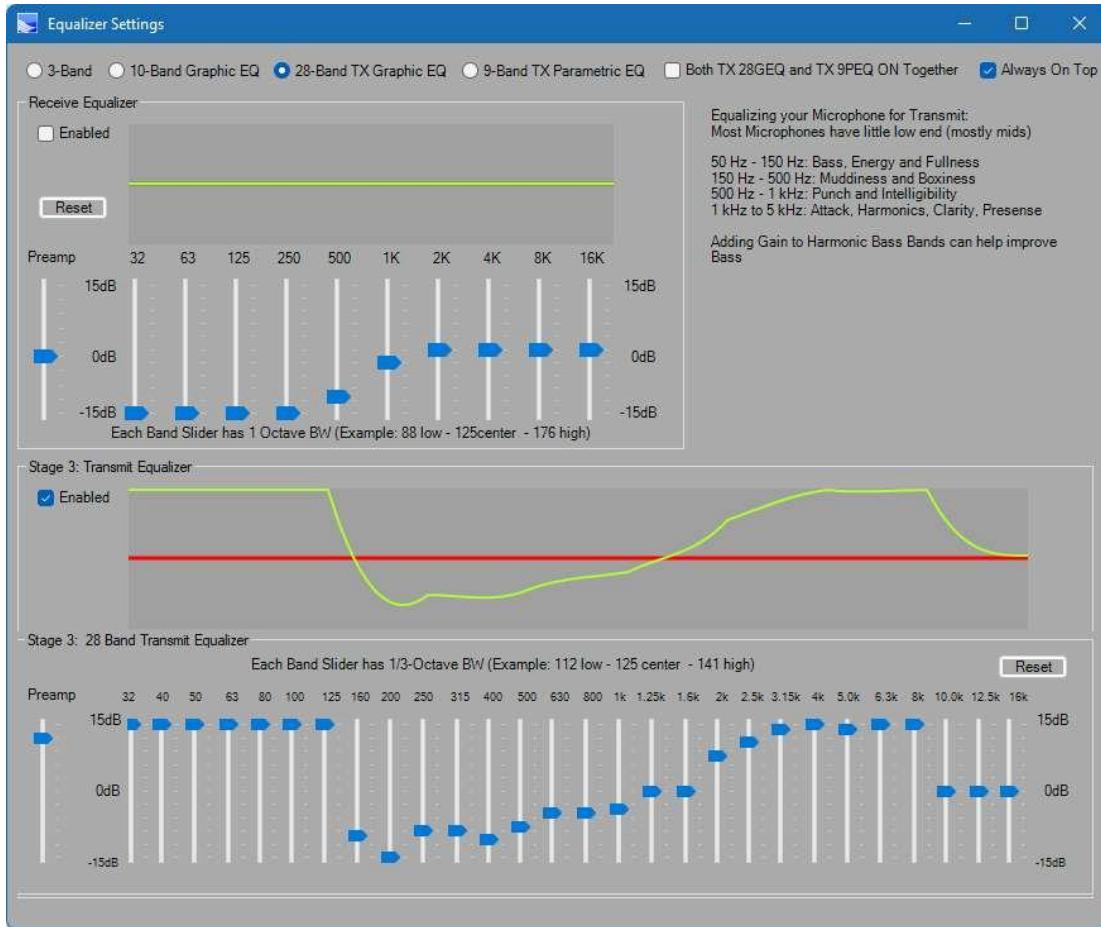
*Figure 82: Ten-Band Equalizer Form (RX and TX)*



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.

## 28-Band Graphic Equalizer

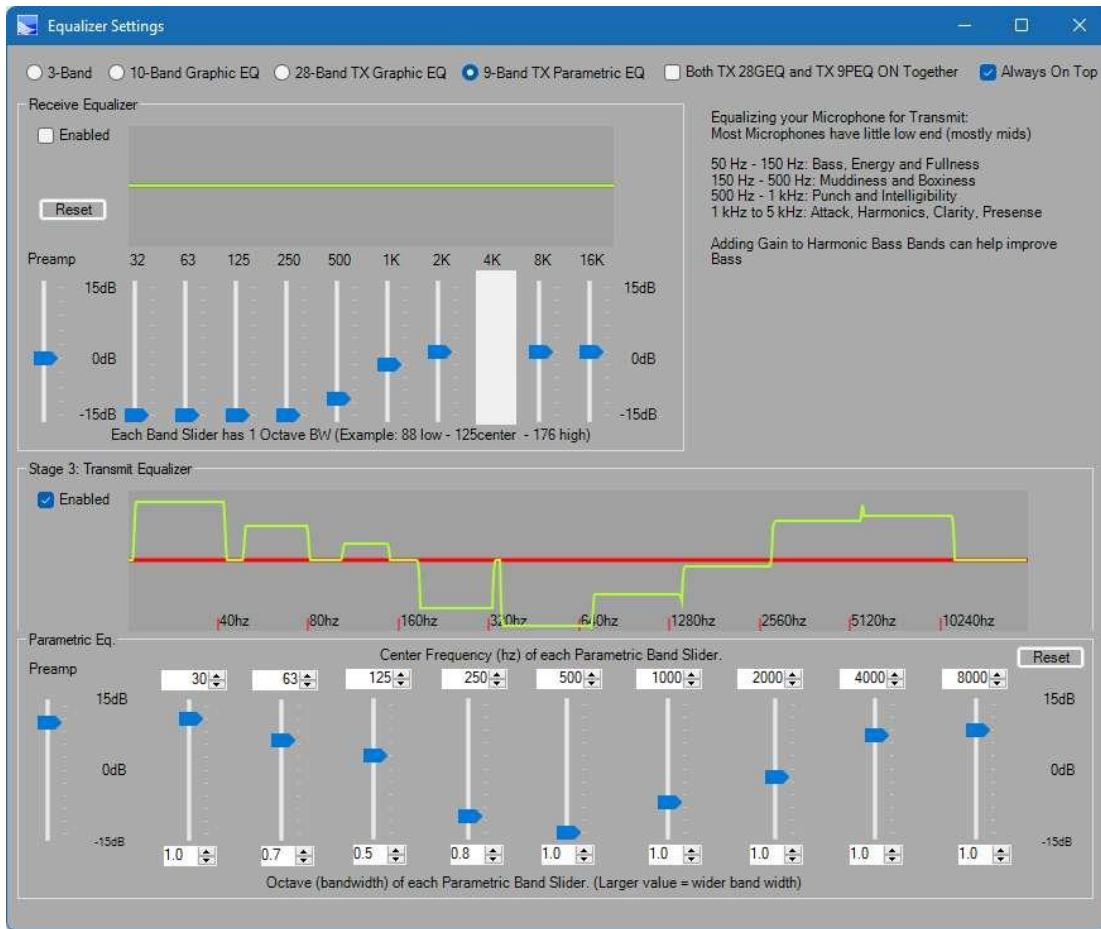
*Figure 82a: 28-Band Equalizer Form (TX only)*



The 28-Band Equalizer offers an even finer degree of audio frequency control.

## 9-Band Parametric Equalizer

Figure 82b: 9-Band PEQ Form (TX only)



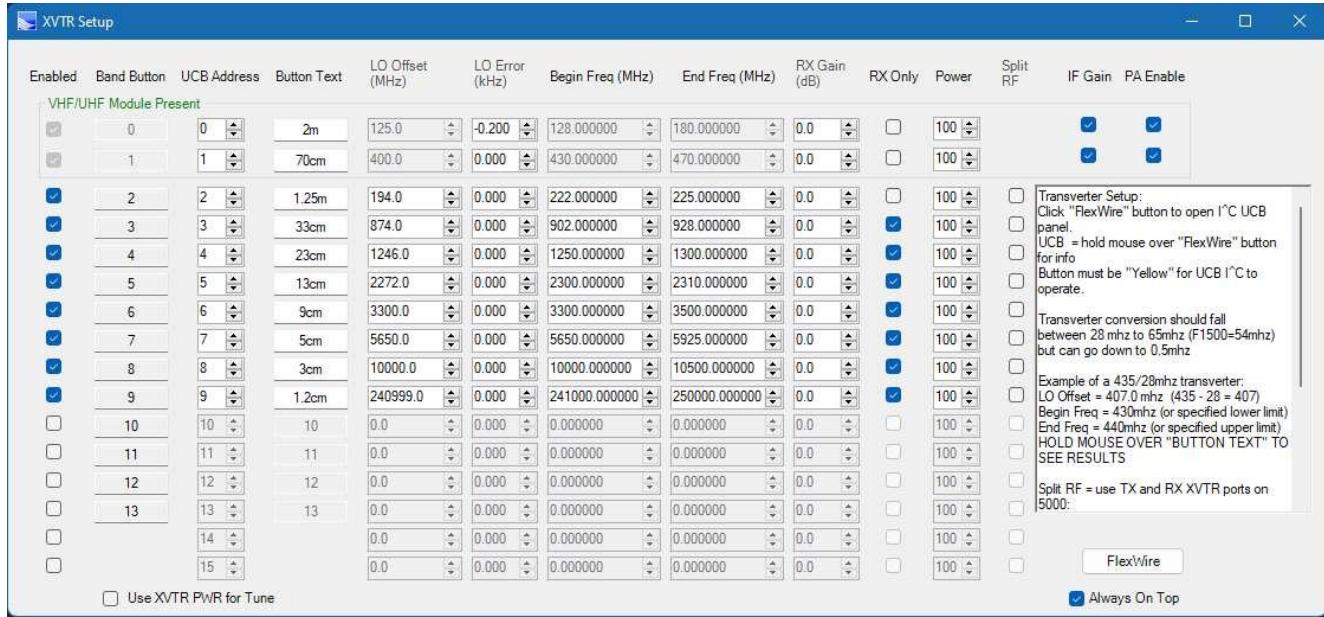
The 9-Band Equalizer offers a different strategy of audio frequency control. By controlling frequency, gain, and octave (how wide the gain), in 9 bands.

You can also combine the 28 Band GEQ with the 9-Band PEG together.

**Note: You cannot add or boost a frequency if the MIC does not have that frequency range. If your MIC outputs only 300hz to 3khz, depending on how sharp the cut-off, you may be unable to boost anything below 300hz or above 3khz. Use a full-range audio mic when eq'ing.**

## (35) XVTRs Form

Figure 83: XVTR Setup Form



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

VU5K (2m & 70cm optional module) occupies the first 2 transverter spot automatically.

- ❑ **Enabled:** Enables that particular Band Button on the front console with the options selected.
- ❑ **Band Button: (5 and 5b) VHF** Band button to use for the particular transverter that is being configured. 0=upper left 16=lower right of 16 buttons
- ❑ **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 for the transverter.
- ❑ **End Frequency (MHz):** The upper frequency bound for the transverter.
- ❑ **RX Gain (dB):** Amount of gain to apply to the incoming signals to compensate for gain within the transverter.

- 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.
- Split RF:** Check if the transverter you are using for this band uses separate connectors for transmit and receive RF. In this case connect your transverter to the Back Panel **XVTX/COM** port for transmit RF and the **XVRX** port for the receive RF. Otherwise, connect it to the **XVTX/COM** port only.
- 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 158) will be used.

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## (36) CWX Form

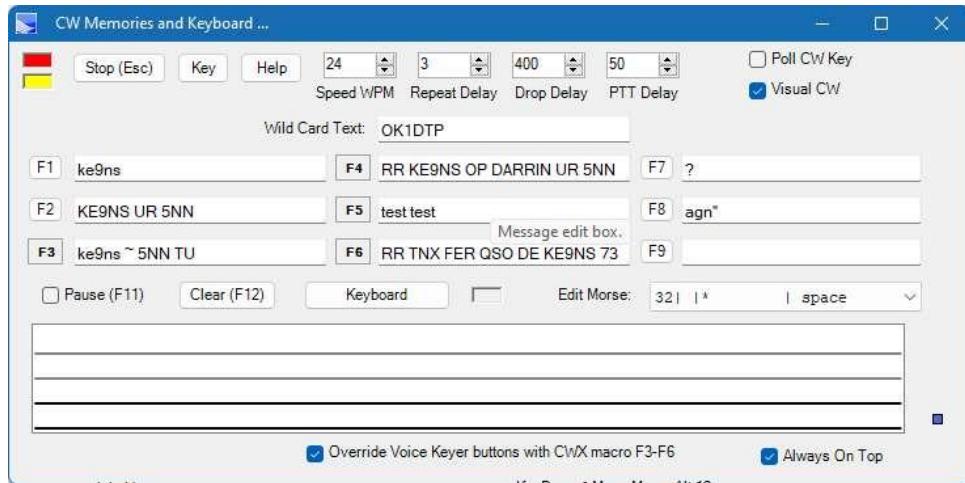


Figure 84: CWX Form

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 Front Console menu opens this form. The radio must be in either **CWL** or **CWU** mode for transmission to take place.

### 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 hitting 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.
- ❑ **Help:** Clicking this button will cause a small help screen to be displayed. You can leave the help screen 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 by 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.
- ❑ **Repeat Delay:** This control specifies the amount of time in Seconds that the keyer will wait when a parentheses character “ ” is encountered in a macro text.
- ❑ **Drop Delay:** This control specifies the amount of time in mSec that the semi-break in keying will wait before dropping the transmitter when there is no keying occurring. If **break in** is enabled from the Console CW panel, this Drop delay is disabled and the **break in** is used.
- ❑ **PTT Delay:** This control allows you to set the time delay in mSec 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.
- Poll CW Key:** Tapping of the CW key will stop a macro and allow you to immediately use your key.
- Visual CW:** Panadapter and Waterfall will show dots and dashes. Normally its blank.
- Override Voice Keyer Buttons with CWX macro F3-F6:** Check to allow CWX macros from the main PowerSDR console screen (**58) Voice Keyer buttons**, and F3-F6 keys will function when the main Console screen is in focus. Hitting the FN button or the Voice Keyer button now will Start/Stop the CW immediately.
- F1-F9 Marcos:** Hitting F1 through F9 when CWX panel is in Focus will play that CWX Macro (memories)

### **CWX Memories**

There are nine CWX memories. 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 hitting 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.

NOTE: If the Override Voice Keyer checkbox is Checked, hitting a voice keyer button, or its designated function key F3-F6, will also Stop the CW transmission.

## Special Characters

There are several predefined characters that provide non-Morse code functionality or to send familiar combinations like AR and SK (see Table 13 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 parentheses character " may be placed at the end of a message. When " is encountered, the keyer will stop 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 13.

*Table 13: 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 116). Characters that are undefined have no dots and dashes and are simply sent as a space.

## 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.
    - Hitting **Alt 1** to **Alt 9** or right clicking on the message number button will cause the numbered message memory to be copied into the unsent area just as if you

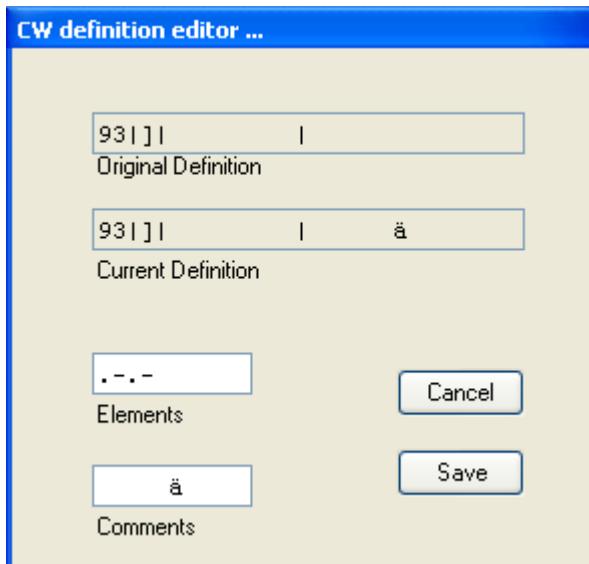
had typed it.

- The *or ditto* character is ignored in the keyboard mode.
  
- Clicking **Clear(F12)** (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 (F11):** Checking this box or hitting the **F11** key will cause keyboard buffer sending to pause.
  
- **Clear (F12):** Clicking this button or hitting the **F12** 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.

### **Morse Definition Editor (see figure 84: 32 space)**

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.



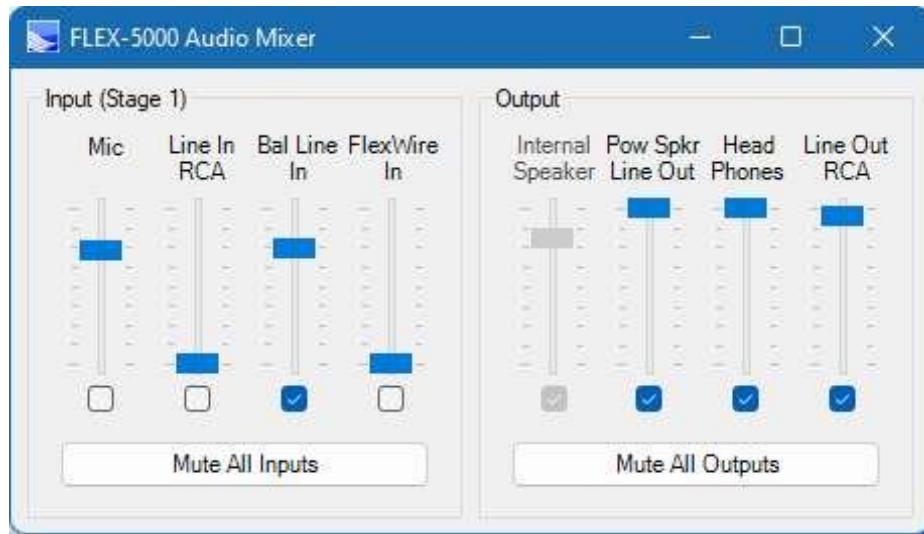
*Figure 86: CW Definition Editor*

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, **Record (○)** and **Play (▷)** on page 97).
- ❑ 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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## (37) Mixer



*Figure 87: Audio Mixer Form*

The Mixer controls the audio lines into and out of the FLEX-5000. In essence it is no different than the usual Windows sound card mixer.

### Input

The FLEX-5000 has four possible sources of input audio. These are the **MIC** connector on the Front Panel and on the Back Panel the **Line-In RCA** connector, the **Balanced Line In** ¼" TRS connector and the **FlexWire In** (pin 2 of the FlexWire connector). 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 three or four possible audio outputs depending on your radio model. These are the **Internal Speaker** (not available on the FLEX-5000A), the Front Panel **Headphones** connector and on the Back Panel the **Powered Speaker** and **Line Out RCA** connectors. The latter also adjusts the FlexWire AF out (pin 9). 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.

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

## (38) Antenna

The Antenna Selection Form offers two levels of complexity:

- Simple** uses the same antenna ports and keying lines for all bands. Different antennas can be selected for each receiver and the transmitter, but they will remain the same for all bands. This is the recommended setting if you use only one antenna.
- Expert** allows you to customize antenna ports and keying lines for each band.
- SO2R** allows transmit from VFOA or VFOB on different antennas and different Key lines.

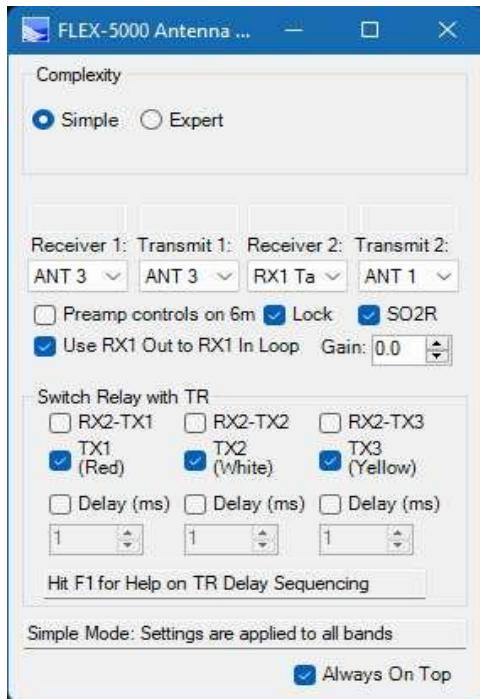
**WARNING! Make sure you have an antenna connected to the Transmit antenna port you selected. Failing to do so may damage your radio and void your warranty.**

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

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

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

## Antenna Complexity (Simple):



*Figure 88: Antenna Selection Form - Simple*

These selections apply to all bands in Simple mode. The following selections are possible:

- Receiver 1:** ANT1 (default), ANT2, ANT3, RX1 IN or N/C
- Transmit 1:** ANT1 (default), ANT2 or ANT3<sup>2</sup>.
- Receiver 2 (RX2 Optional):** N/C (not connected), RX2 IN, RX1 TAP (default) or ANT1<sup>1</sup>
- Transmit2 (SO2R on):** ANT1 (default), ANT2 or ANT3<sup>2</sup>.
- Use RX1 Out to RX1 In Loop:** If either ANT1, ANT2 or ANT3 is selected for Receiver 1, then this option becomes available to enable the insertion of external signal enhancing devices such as preamps, filters and preselectors, without requiring complicated switching mechanisms to avoid transmitting through them. Check to direct the signal on the selected antenna port to RX1 OUT and connect Receiver 1 to RX1 IN.

<sup>1</sup> Earlier versions of the FLEX-5000, with the HRFIO board Assembly Number (ASSY) 27 installed instead of the later HRFIO board ASSY 34, do not have ANT1 available as an option for Receiver 2. You can check which board is installed in your FLEX-5000 by opening the Setup Form – General Tab, Hardware Config Sub-Tab, in the section marked FLEX-5000 Config. The Assembly Number is shown between brackets at the end of the line beginning with RFIO (see e.g. Figure 93 on page 126). Also see the Knowledge Center articles [HRFIO Capabilities by Assembly Number](#), [How to Identify the HRFIO Assembly Number](#) and [Antenna Selection Options for the RX2](#) (or search for *HRFIO* in our Knowledge Center at <http://kc.flex-radio.com/search.aspx>). If you have the earlier HRFIO ASSY 27, you can upgrade to ASSY 34. See the [Flex-Radio Systems website](#) ([www.flex-radio.com](http://www.flex-radio.com)) for more information.

<sup>2</sup> For the earlier RFIO board ASSY 27 (see above), the 6m transmit antenna port is fixed to ANT3 and cannot be changed. Only the ANT3 port meets the -60 dBc spurious output requirement at 6m. For the later HRFIO ASSY 34, this is not the case and the 6m transmit antenna port can be assigned to any of ANT1-3, just like any other band.

- Enable Preamp controls on 6m:** Check to enable the preamp to be turned off on 6m. Doing so will display a warning that the user accepts full responsibility for inserting an external preamp to maintain CE compliance.
- Lock:** Check to lock the antenna selections for Receiver 1 to Transmit. Any change you make in one will be followed by the other.
- SO2R: (Only if you have RX2)** Check to enable Transmit 2: option. This allows separate Transmit and Receive antenna for both RX1 and RX2
- Gain:** Enter the gain (in dB) of any device you connect to the RX1 Out to RX1 In Loop.
- Switch Relay with TR:** Select the keying line(s) you use, if any, to key your amplifier(s) or other external equipment.
  - For each, check **Delay** to delay the switching of that keying line by the amount of time set in milliseconds. This enables sequential switching of the three keying lines to account for relay switching times and the like. Especially when using transverters, this can be useful.
  - If you have RX2 option and **SO2R enabled, RX2-TX1, TX2, TX3** checkbox's will appear for amplifier selection for VFOB RX2 transmitter.

## Antenna Complexity (Expert)

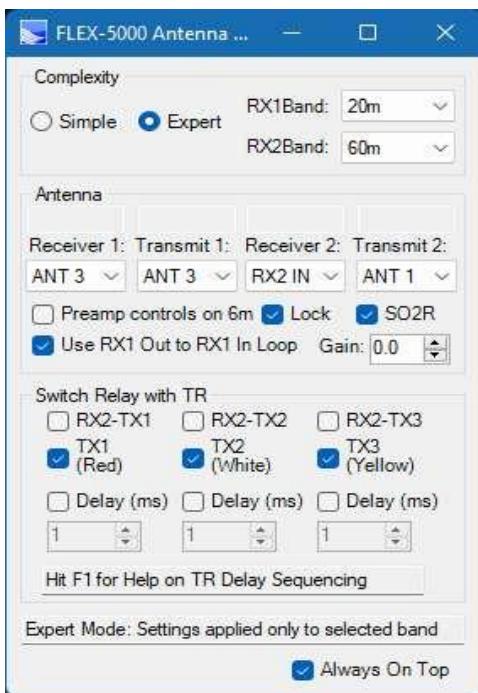


Figure 89: Antenna Selection Form - Expert

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. This also allows for RX2 band selection (RX2 Option). 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.

## Delay Sequencing using Switch Relay with TR

Activating TX1, TX2 and TX3 together can generate a complex RX to TX to RX delay sequence for external devices as follows.

Flex-1500 and Flex-3000 the TR delay operation:

- 1) PTT ON: Radio goes into TX but no Output.
- 2) After the DELAY, the TX (PA) ON and TX Out Jack activates.
- 3) PTT OFF: Radio back into Receive and TX OUT jack shuts OFF immediately

Flex-5000 you have 3 TX OUT & Delay Jacks to allow Sequential Switching:

Each TX OUT jack (1,2,3) works like the Flex-1500/3000 when used individually.

But when you use TX1 and TX2 at the same time,  
the Delay on TX2 comes after the Delay on TX1 (TX3 will start after the first 2 delays)

For the Flex-5000:

But there are effects beyond the simple Sequential Delays:

1) If you use the RCA TX3 (Enable it with no delay) to key your amp, and enable TX1 and set the TX1 delay: The Amp keys up, and the Flex delays transmit line. Then when you unkey the AMP and FLEX unkey with no delay.

2) If you use the RCA TX1 to key your amp and select just the TX1 delay, then the Amp keys up immediately and the Flex delays transmit. Then when you unkey, the Flex goes into RX and the Amp delays release.

When using all 3 TX1,TX2, TX3 the following occurs in this sequence:

PTT ON:

**>>>Flex5000 Receiver turns OFF<<<**

RCA TX1 output ON (no delay)

Wait TX1 Delay time

RCA TX2 output ON

Wait TX2 Delay time

RCA TX3 output ON

Wait TX3 Delay time

**>>>Flex5000 RF OUTPUT ON <<<**

PTT OFF:

**>>>Flex5000 RF OUTPUT OFF<<<**

**>>>Flex5000 Receiver turns ON<<<** (but you will not hear anything until the AMP unkeys)

Wait TX3 Delay time

RCA TX3 output OFF

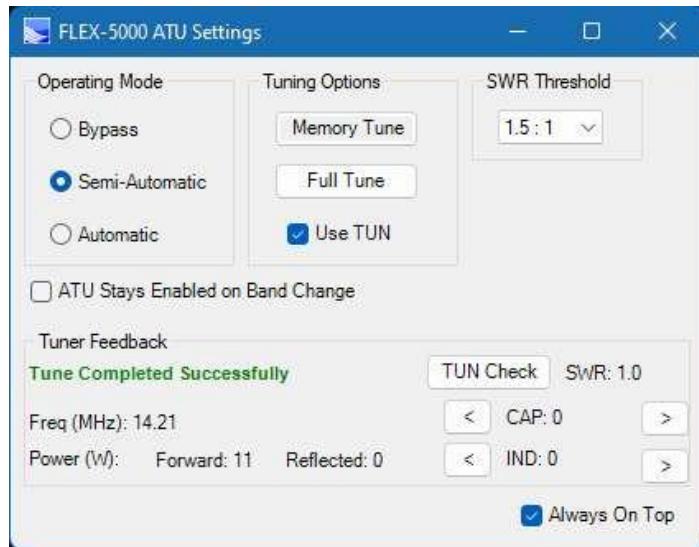
Wait TX2 Delay time

RCA TX2 output OFF

Wait TX1 Delay time

RCA TX1 output OFF

## (39) ATU



*Figure 90: ATU Settings Form*

The ATU Settings form enables you to control the internal, optional ATU. If you do not have an ATU installed, this form will not be available to you. **ATU is bypassed if you right click on TUN button to select TUNp (Pulse tune)**

### Operating Mode

- ❑ **Bypass:** Bypasses the internal ATU. When selected the **Tuning Options** become unavailable.
- ❑ **Semi-Automatic:** Requires clicking either **Memory Tune** or **Full Tune** to find a match.
- ❑ **Automatic:** Will automatically tune when RF is detected. You do not need to click either **Memory Tune** or **Full Tune**. Once selected, you can close the form. The ATU will now continuously monitor the SWR and retune as required.

**Note:** When set to **Automatic** it is possible that the ATU frequently retunes. If this is the case you can either try to select a higher **SWR Threshold** or select **Semi-Automatic** instead.

### Tuning Options

- ❑ **Memory Tune:** When clicked the ATU will perform a tuning cycle by first checking its memory for a match. If no match can be found, a **Full Tune** is performed. This is the fastest tuning option. While tuning is in progress, the button will be highlighted in yellow.
- ❑ **Full Tune:** When clicked, the ATU performs a tuning cycle ignoring its internal memory, which may take longer than **Memory Tune**. While tuning is in progress, the button will be highlighted in yellow.
- ❑ **Use TUN:** Check to transmit a carrier at the power level set by the **Tune Power** control on the Setup Form-Transmit Tab (see page 158). The ATU will use this carrier when either **Memory Tune** or **Full Tune** is selected.

## SWR Threshold

Sets the maximum SWR allowable for a match. This is measured at the input to the ATU. Setting a higher threshold may result in finding a faster match. Setting a lower threshold may result in taking longer to find a match and even risk finding no match at all.

## Tuner Feedback

Result of the tuning cycle. The possible messages are:

- ❑ **Tune Completed Successfully:** A match was found. The ATU will also display the detected Frequency of the input signal and the resulting SWR, Forward and Reflected Power, all measured at the input to the ATU.
- ❑ **Failed Tune – RF Carrier Lost:** ATU was attempting to tune, but the Input signal disappeared before a match could be found
- ❑ **Failed Tune – Unable to Bring the SWR Down to the Threshold:** No match could be found below the set **SWR Threshold**. If possible, try raising the threshold.
- ❑ **Failed tune – No RF Detected:** No input signal was detected while the ATU was attempting to tune.
- ❑ **TUN Check:** simulates hitting the TUN button for just 2 seconds to take an SWR reading from the Tuners SWR bridge (not the Flex radios SWR bridge).
- ❑ **< CAP >:** Click on the < > arrows to change the Capacitance setting. This simulates TUN for 1 second to check SWR from Tuners SWR bridge. Capacitance range is displayed 0-127
- ❑ **< IND >:** Click on the < > arrows to change the Inductance setting. This simulates TUN for 1 second to check SWR from Tuners SWR bridge. Inductor range is displayed 0-127

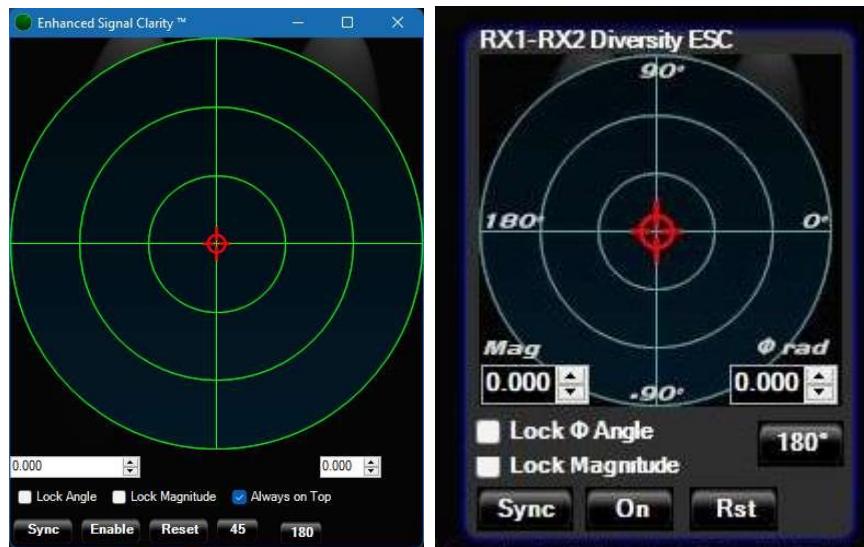
## Voltage and Temperature Information



Figure 91: Info Form

Click on the Temp to alternate its value between Celsius and Fahrenheit and OFF. Either value may be displayed against a Green, yellow or red background indicating increasing levels of criticality.

## (40) ESC Enhanced Signal Clarity (i.e. Diversity reception)



*ESC Form (left: standard free floating original window)  
(right: New ESC integrated into console screen)*

### See Setup->General->RX2-> **ESC Integrated into Console screen:**

Enhanced signal Clarity Controls screen is placed directly into the PowerSDR console (if the Console screen has enough room to display it). When OFF, ESC has its own floating Window.

If you have a Flex-5000 with the 2<sup>nd</sup> receiver option (RX2), you can use the ESC feature for Diversity reception. When turned "On" or "Enable", allows you to vary the phase and signal of the 2<sup>nd</sup> antenna with respect to the 1<sup>st</sup> antenna. Doing so allows you to reduce external noise "interference" by creating a **NULL** with signals being 180deg out of phase, in the direction of the noise source, OR **increase Signal strength** by matching the phase of both antennas, causing signals to add in a particular direction.

This requires 2 antennas with some "distance" (separation) apart. Both antennas need work be capable of operating on the band you are using. Adjust the "**Red Bullseye**" around the circle to achieve either noise NULL, or signal increase.

NOTE: Setting the phase to XXXdeg does not mean the received signals are XXXdeg out of phase, it means the 2 receivers (RX1 and RX2) are XXXdeg out of phase with each other.

- ❑ **SYNC:** Clicking this button will force RX2 parameters to match RX1. Sync button will appear RED only as long as the Parameters match. Once you alter any parameter (Mode, Freq, Filter), Sync will turn OFF.
- ❑ **Enable:** Activate RX2, and SYNC, and ESC is now active (you will see RX2 appear). ESC is active as long as the SYNC is Red.
- ❑ **ON:** Activate RX2, Sync, and ESC is now active (you will NOT see RX2 appear, but it is ON as long as the SYNC is Red)
- ❑ **RST:** Sets Phase & Mag back to 0 offset, and the 2 receivers (RX1 and RX2) are phase and magnitude matched to be identical.
- ❑ **45, 180:** Rotate Phase by RX2 45 or 180deg

## (40) An Explanation of Diversity Reception Techniques for the FLEX-5000

Diversity reception is a set of techniques using *multiple receivers connected to separate antennas* for improving the intelligibility of received signals by improving the signal to noise ratio and mitigating signal fading and drop outs. Below are descriptions of several diversity reception techniques that can be employed using the FLEX-5000 and the RX2 (second independent receiver).

These techniques can be used in combination for increasing levels of signal reception enhancement. Below are three different combinations of diversity reception techniques that are possible with the FLEX-5000 and the RX2.

- Stereo or Dual Diversity Reception - **Good**
- Stereo/Dual Diversity + Antenna or Space Diversity Reception - **Better**
- Stereo/Dual Diversity + Antenna/Space Diversity + Polarization Diversity Reception - **BEST!**

### Stereo or Dual (Receiver) Diversity Reception

To accomplish stereo or dual diversity reception, it requires two receivers that are *frequency and phased locked* on the same signal outputting the demodulated signal to two discrete audio channels. Optimally both receivers need to be virtually identical in

hardware and configuration (demodulation mode, filter characteristics, preamp, AGC setting, etc) in order to create a sense of "stereo spatial depth" for the listener. Humans are very good at localizing sounds and quickly estimating their direction and distance because we have two ears that allow for multi-path reception of audio frequencies. The end result is by being able to hear stereophonically, our brains can use this information to extract intelligibility from weak and noisy signals.

When experimenting with diversity reception, establishing the ability to achieve stereo or dual diversity is the prerequisite for being able to utilize all of the other diversity reception techniques listed in this article.

Stereo or dual diversity is easily accomplished with the FLEX-5000 with the optional RX2 (second independent receiver). The RX2

is identical to the primary receiver (RX1) and using SDR software their local oscillators can be frequency and phase locked to enable stereo or dual diversity reception.

### Space or Antenna Diversity Reception

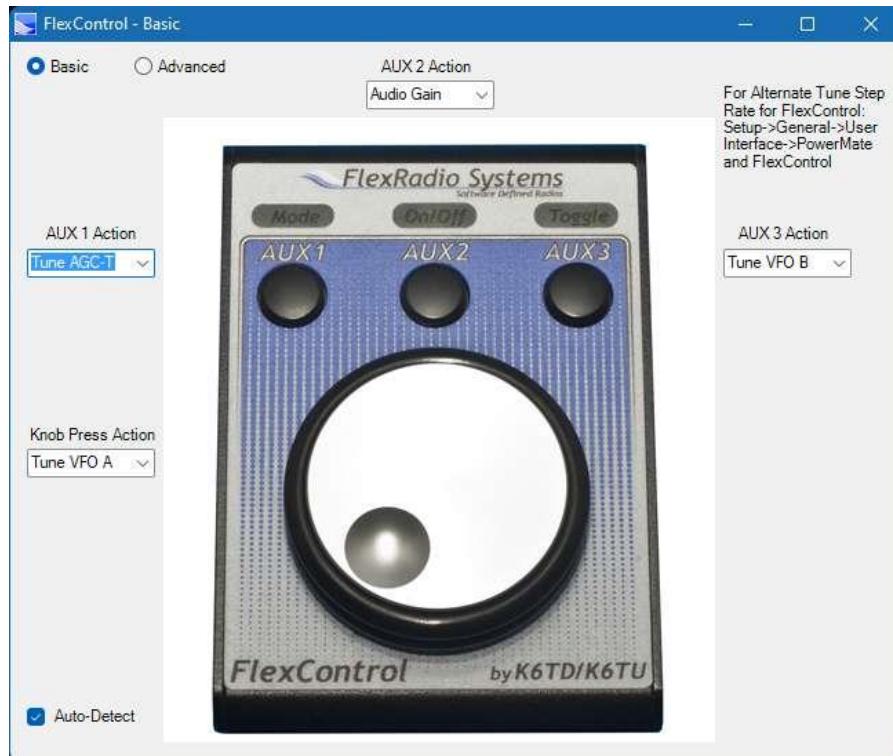
Space or antenna diversity is accomplished by simultaneously receiving on two or more antennas *separated in distance by several wavelengths* of the received signal. Even though it may be difficult to have two antennas separated in distance by multiple wavelengths on the longer wavelength frequencies (hundreds of meters), good results can be achieved when the antennas are separated in distances as small as a quarter wavelength ( $1/2 \lambda$ ). This diversity reception techniques is used to mitigate the effects of ionospheric multi-path fading, shadowing and signal drop-outs (path loss) which serves to enhance the overall signal-to-noise ratio and readability of received signals.

A transmitted radio signal can be reflected along multiple paths before finally being received. Each of these "bounces" or reflections can introduce phase shifts, time delays and signal strength attenuation that can destructively interfere with one another at the receiving antenna. Antenna or space diversity is especially effective at mitigating these multi-path situations. This is due in part because multiple antennas afford a receiver multiple reception points in 3-D space of the same signal. Each antenna will experience a different interference environment. Thus, if one antenna is experiencing a deep fade, it is likely that another has a sufficient signal for adequate reception. It should be noted that unidirectional antennas are best suited for this purpose since directional antennas receive only a fraction of all scattered RF energy.

### Polarization Diversity Reception

As noted with stereo or antenna diversity, signals reaching the multiple receiving antennas will not necessarily be in-phase with one another, therefore they will have different degrees of polarization from vertical to horizontal. It is well known that receiving vertically polarized signals with a horizontally polarized antenna (and visa versa) will result in a lower signal strength. In a linearly polarized system, a misalignment of polarization of 45 degrees will degrade the signal up to 3 dB and if misaligned 90 degrees the attenuation can be 20 dB or more! This is a significant amount of signal loss. You can minimize these polarization losses by *using two antennas that are of different polarization*. Therefore polarization diversity is the technique of simultaneously receiving on horizontally and vertically polarized antennas. If one of your antennas is a vertical loop (fed to have vertical polarization) or a multi-band vertical antenna and the other one a dipole, vertical loop (fed for horizontal polarization), horizontal loop or a broad beam width yagi it will increase the statistical probability that a selective fade will only affect one, but not both receiver systems.

## (41) FlexControl (usb tuning Knob)

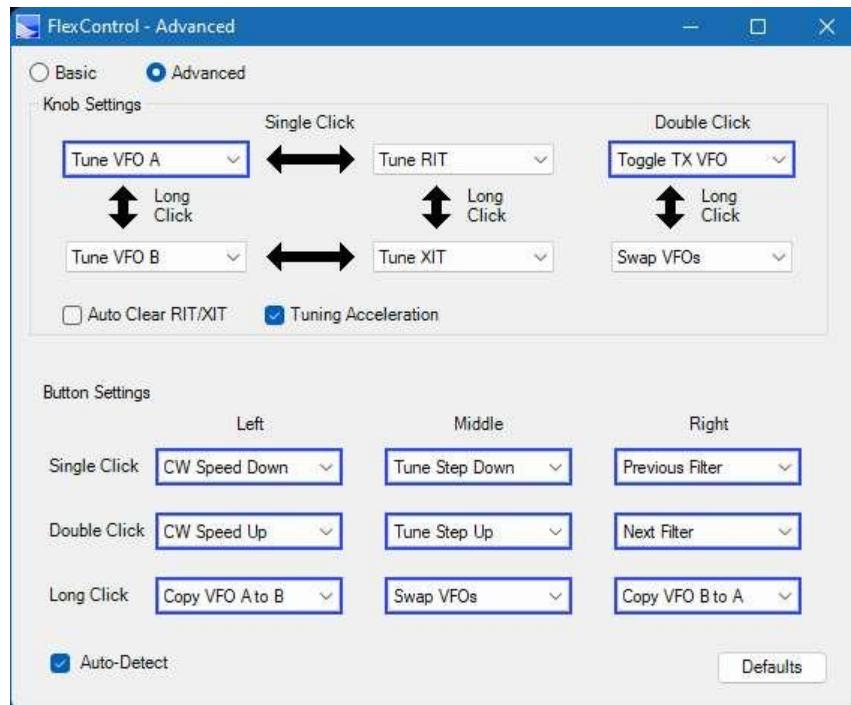


*FlexControl Basic form*

**Also see Setup->General->User Interface->PowerMate and FlexControl:**

- ❑ **Alt1-2 Tune Step for FlexControl:** Clicking this box will allow the FlexControl Knob to use the Alt#1 and Alt#2 alternate Tune Steps instead of the main console "Tune Step". This overrides the built in FlexControl Knob Press action.
- ❑ **Alt#1:** - xxx + frequency
- ❑ **Alt#2:** - xxx + frequency (push down on knob to toggle this)

## (41) FlexControl (usb tuning Knob)



*FlexControl Advanced form*

## (42) Waterfall (GrayWtr / ColorWtr)

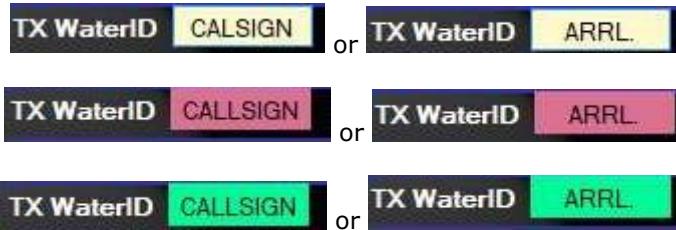
You can instantly convert the Waterfall from Color to Grayscale



**Left Click:** Toggle between Color Waterfall, and Grayscale Waterfall.

**Right Click:** Toggle between Panadapter Fill OFF, Color Fill, and Gradient Fill.  
(see Setup->Appearance->Display)

## (43-44)TX WaterID (Waterfall Text and Picture transmission)



*Figure 95: Water ID Top White: Type in Text(left) or Picture(right),  
Middle RED: image being created,  
Bottom GREEN: image ready to transmit.*

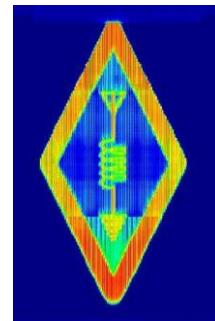
### To sent a Text Image:

- Step 1: Set your Radio mode and Transmit Filter bandwidth
- Step 2: Move mouse over the Callsign box (make sure the mouse pointer does not leave the box)
- Step 3: Type in the Text you want (like **KE9NS** for example) to transmit in the Waterfall (box should be White)
- Step 4: Move the mouse out of the callsign box. (box should turn Red)
- Step 5: Wait for Box to turn Green.
- Step 6: Click on "TX WaterID" to transmit



### To sent a Picture or Photo Image:

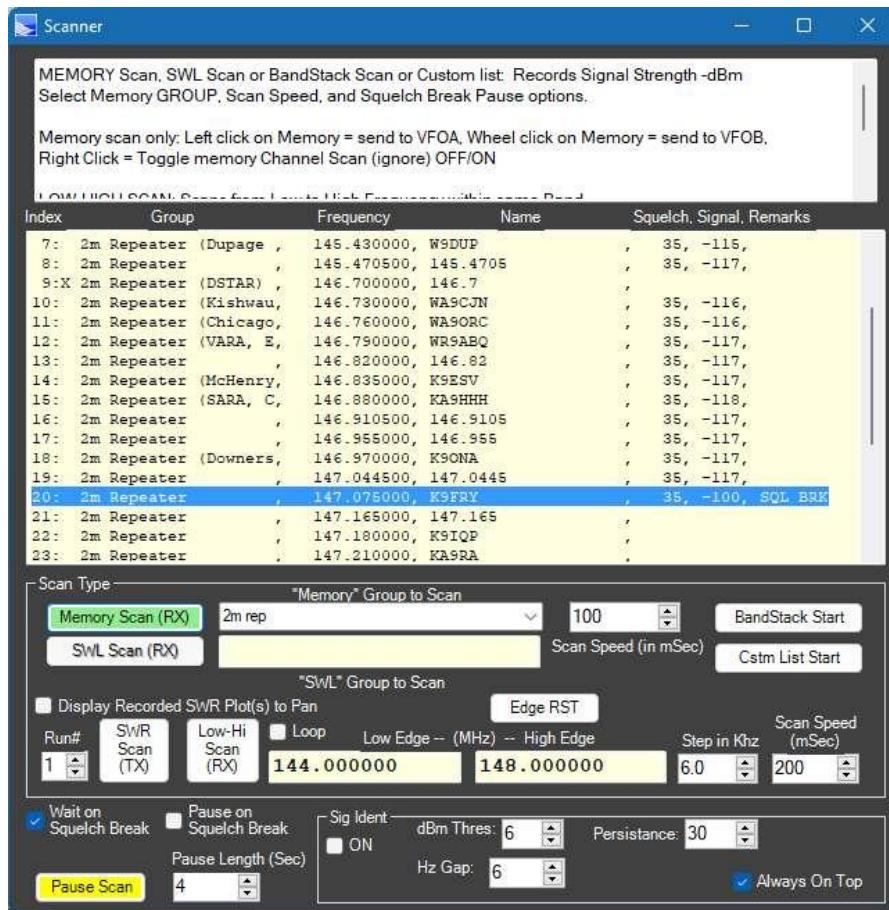
- Step 1: Create an 24bit .BMP image file. Resize any picture or photo down to 200 x 200 or 400 x 400 and save as a 24bit BMP image file. (in this example it's the ARRL logo image)
- Step 2: Set your Radio mode and Transmit Filter bandwidth
- Step 3: Move mouse over the Callsign box (make sure the mouse pointer does not leave the box)
- Step 4: Type in the image file you want (with a . at the end of the name like **ARRL.**) to transmit in the Waterfall (box should be White)
- Step 5: Move the mouse out of the callsign box. (box should turn Red)
- Step 6: Wait for Box to turn Green.
- Step 7: Click on "TX WaterID" to transmit.



NOTE: **Right Click over the CALLSIGN box** will open up the folder where image files must be stored.

NOTE: Any change to Mode or Filter will require you to move your mouse over the Callsign box to generate an image update

## (45)Scanner(Memory, SWL)



*Scanner form:*

**Left Click** on any listing shown to set VFOA to that frequency and mode.

**Right Click** on any listing to toggle "X" which bypasses that listing from being scanned.

**Mouse Wheel Click** on any listing to set VFOB to that frequency and mode.

**Blue Line** indicates current VFO

- ❑ **Memory Scan(RX):** Start Scanning from the "Memory" Group to Scan box. (**Green** when active)
- ❑ **SWL Scan(RX):** Start Scanning the SWL group to scan box. (**Green** when active)
- ❑ **"Memory" Group to Scan (box):** Type in full or partial text for the GROUP column in the Memory listing.
- ❑ **Scan Speed:** How fast the scanner will run
- ❑ **"SWL" list to Scan (box):** Type in the full or partial text for the "SWL Search" list (example: Habana, or BBC)
- ❑ **BandStack Start:** Use the current band BandStack as the list to scan
- ❑ **Cstm List Start:** Left Click to open the folder containing the custom scan list (and example file)

## (45)Scanner(Freq, SWR)



Showing the SWR scan results when "Display Recording SWR Plot(s) to Pan" is checked

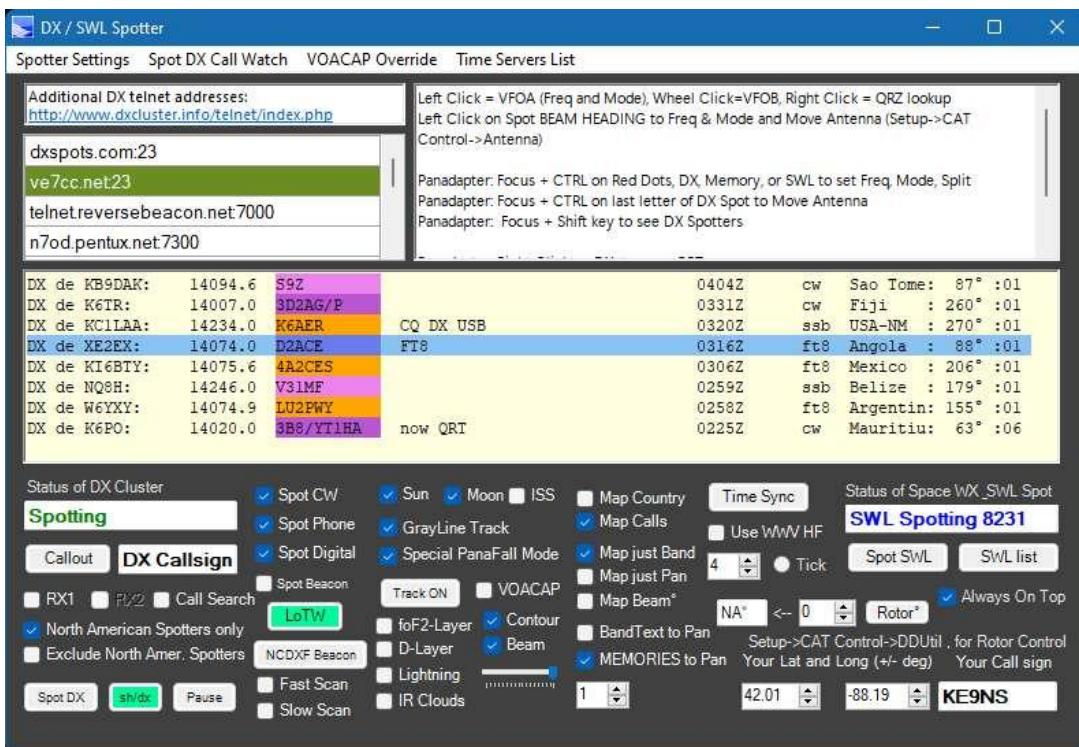
- ❑ **Display Recording SWR Plot(s) to Pan:** When checked, any recorded **SWR** scans will be displayed depending on the **RUN#** selected and whether you have the Waterfall on or off.
- ❑ **SWR Scan(TX):** Transmit a 10watt **TUNE** signal while scanning the current band, using the Low Edge, High Edge limits shown. This will visually show and record your **SWR** for the current Antenna selected and **Run#**. Once you have recorded at least one run, RIGHT CLICK on this button to open the folder containing the **SWR** recording.
- ❑ **Low-Hi Scan(RX):** Receiver only scan the Low-High Edge selected on the current band.
- ❑ **Run#:** (1-5) Which Run# to record SWR, and how many runs to display on the Pan.
- ❑ **Edge RST:** Reset the band Low-High Edge limits to the built in default.
- ❑ **Loop:** Repeat the TX or RX scan when you reach the High Edge.
- ❑ **Low Edge-High Edge:** Shows the default Low / High limits of the current band your on.
- ❑ **Step in Khz:** Current amount of the Step between SWR readings (default is 6khz)
- ❑ **Scan Speed(mSec):** Current speed of each step.
- ❑ **Wait on Squelch Break:** When checked, will hold the Pause of the scan while the Squelch is open, then wait the pause length before continuing the scan.
- ❑ **Pause on Squelch Break:** When checked, will only pause the length time when the squelch is open, and continue afterwards, even if the squelch is still open.
- ❑ **Pause Scan:** Click to pause the scan manually forever. When **Yellow**, indicates the scan is paused.
- ❑ **Pause Length(sec):** Length of an automatic squelch activated pause.
- ❑ **Sig Ident:** Check to visually indicate a signal peak on the Panadapter (unfinished)
- ❑

## (46)Spotter (dx cluster, Visual Display, maps, time, SWL)

**Spotter****Spotting****Closing****SWL Rock**

Spotter OFF, Spotter ON, Spotter closed, SWL ON when Spotter Off

The spotter form is multiple functions, from DX spotting to LoTW tracking, Panadapter Grayline, VOACAP predictions, live Maps, NCDXF Beacon scanning, Time Sync, Antenna beam pointing, SWL



Spotter form:

**Left Click** on a DX Spot to move VFOA to that frequency and mode

**Left Click** on a DX Spot **Beam heading** to also move your antenna to that heading.

**Right Click** on a DX Spot to open QRZ.com page

**Mouse Wheel Click** on a DX Spot to move VFOB to that frequency and mode

**Blue line** indicates the current VFO selection from the DX spotter list.

**DX Spot color codes** active when LoTW active (green). Hold your mouse over any DX spot to indicate the status of this DX

**Green Line** indicates the currently selected DX Cluster in use. You can scroll down and manually add or edit Cluster URLs and ports.

### PC TIME CLOCK:

This feature allows you to accurately set your PC time clock with or without internet. Note: You must launch PowerSDR in ADMIN mode to allow PowerSDR to set your PCs Clock.

- ❑ **Time Sync:** Click to reset PC time clock. This normally uses the internet NIST time servers. See **Time Servers list**.
- ❑ **Use WWV HF:** Check box to all "Time Sync" button to move VFO to a selected WWV frequency and read the current time. Select 1-4 (2.5 to 15mhz www). Using the WWV 100hz sub-carrier BCD coded signal.
- ❑ **Tick:** This should tick along with the audible www. If you do not see the Tick

## (46) Spotter (dx cluster, Visual Display, maps, time, SWL)

### **DX Spotting:**

This feature allows you to see who has been reported to be active on the Amateur radio currently. See upper left corner of Spotter window to select a DX Cluster URL and port (you must have internet to use this feature).

- ❑ **Status of DX Cluster (OFF, Socket, Spotting, Closing):** Indicating the current status of the connection to the DX cluster. Click “**Test Sent <CR>**” on this box if it says “**Spotting**” to verify that the connection is not frozen. If the connection is still good, the Status will return to “**Spotting**”, otherwise click the “**Spot DX**” button to properly close, then re-open a new connection.
- ❑ **Callout:** Click to send your own **Spot onto the cluster**. Enter the “**DX callsign**” into the Box on the right, otherwise the DX call from the **Blue Line** selected will be spotting instead.
- ❑ **Call search: Filter:** Check if you want to see see spots for the “DX callsign” you type into the box. Example you want to see only spots for a particular DXpedition.
- ❑ **RX1: Filter:** Check to see spots related to VFOA RX1 viewable.
- ❑ **RX2: Filter:** Check to see spots related to VFOB RX2 (Flex-5000 only) viewable.
- ❑ **North American Spotters only: Filter:** Check to see only spots reported by North America.
- ❑ **Exclude North American Spotters: Filter:** Check to see only spots reported by anyone outside North America.
- ❑ **Spot DX:** Click to attempt to connect to the DX Cluster (see upper left of Spotter screen for URL and port to select). Click to disconnect as well.
- ❑ **sh/dx:** Click when **blue** to quickly download the last 20 or so DX Spots. Note all spots will still be FILTERED and checked for age (see Spotter Settings at top of Spotter screen). Will turn **Yellow** to let you know you are receiving old spots. Will turn **Green** when done.
- ❑ **Pause:** When your mouse is over the Dx spotter window, the display update will pause (turn **Yellow**) to allow you to see spots (useful during a contest). You can also click to pause.
- ❑ **Spot CW: Filter:** Check to show CW DX spots.
- ❑ **Spot Phone: Filter:** Check to show Phone/voice based mode DX Spots.
- ❑ **Spot Digital: Filter:** Check to show Digital mode DX spots.
- ❑ **Spot Beacon: Filter:** Check to show reported Beacon DX spots.

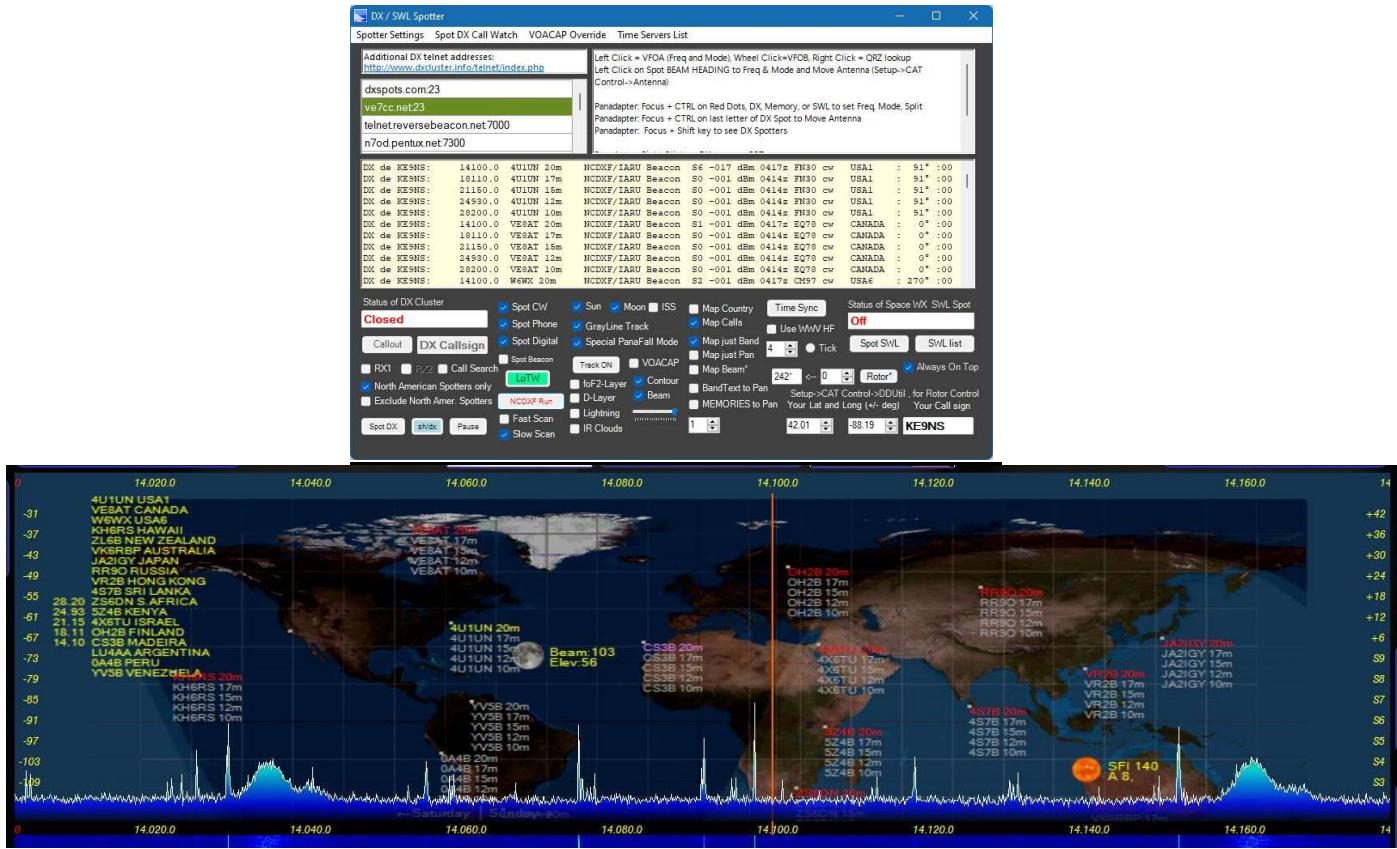
### **ARRL LoTW (Logbook of The World):**

Enter your Call sign into the “Your Call sign” box (lower right corner of Spotter screen). **Right Click** on this Call sign box to open up a Password box. Clear this box and type in your LoTW password and hit Enter. **Right Click** on the Call sign box (for the 2<sup>nd</sup> time) to close the password box. Now PowerSDR can download your entire LoTW log on the first use and saved to a file **LoTW\_LOG.adi**.

- ❑ **LoTW: Right Click** to download updates to your log book since the last time you updated. Note: The very first time will download all your entire log book. **Left Click** to turn on LoTW checking. Button will turn **Green** when ON. Button will turn **Yellow** to indicate downloading. Button will turn **RED** to indicate a failure.

When LoTW ON, DX spots will now be color coded based on data from **LoTW\_LOG.adi** (move mouse over DX Spot to see what the color indicates (i.e. if you need the DX Spot or not). Also, **FCCDATA.dat** file will be accessed for US State data.

## NCDXF Beacon:



International Beacon Project NCDXF currently composed of 10 stations:

4U1UN UN, VE8AT CANADA, W6WX CA, KH6RS HAWAII, ZL6B NEW ZEALAND, VK6RBP AUSTRALIA, JA2IGY JAPAN, RR90 RUSSIA, VR2B HONG KONG, 4S7B SRI LANKA, ZS6DN S. AFRICA, 5Z4B KENYA, 4X6TU ISRAEL, OH2B FINLAND, CS3B MADEIRA, LU4AA ARGENTINA, 0A4B PERU, YV5B VENEZUELA.

NOTE: It is very important to use the Time Sync button to make sure your PC time clock is correct in order for the Beacon scanner to work properly.

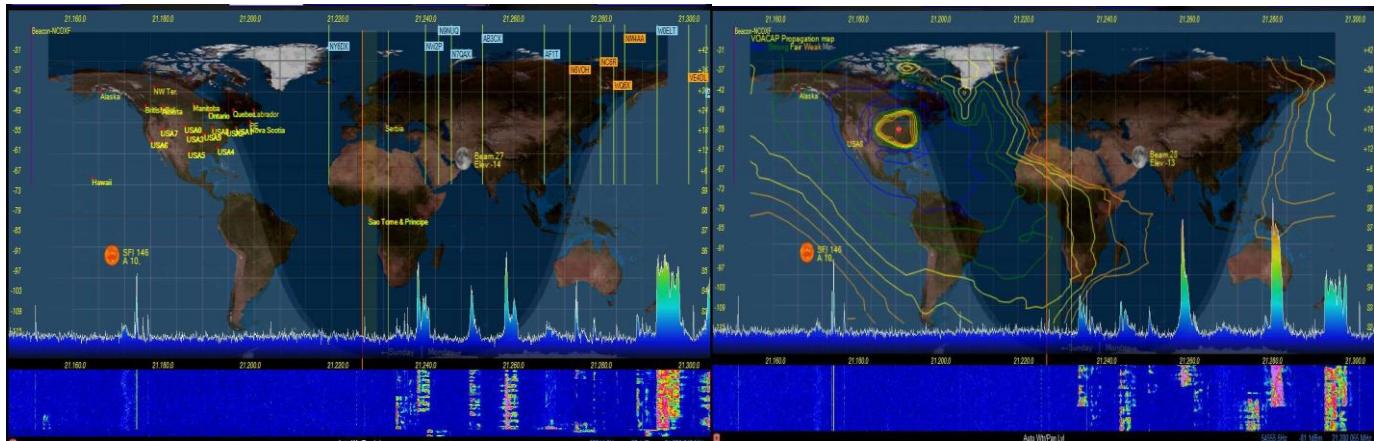
Transmission occurs on 14.1, 18.11, 21.15, 24.93, 28.2mhz, each for 10 seconds (round robin) at 100w to start, then 10w, 1w, and 0.1w

- NCDXF Beacon:** Click to change MAP to show all the beacon stations and show which stations are transmitting on which frequencies. Changes mode to CW waits for the start of the next interval and jumps to a beacon channel to start listening.
- Fast Scan:** Check this box for a quick fast scan. PowerSDR will jump across all 5 channels listening for 1sec each. This takes 3minutes total. Very difficult to see what is going on.
- Slow Scan:** Check this box for the standard slow scan. PowerSDR will remain on each beacon frequency channel for all 18 stations, then move to the next channel. This takes 15minutes for a full scan. Easy to see what is going on as the frequency schedule continually updates on the upper left side of the Panadapter.

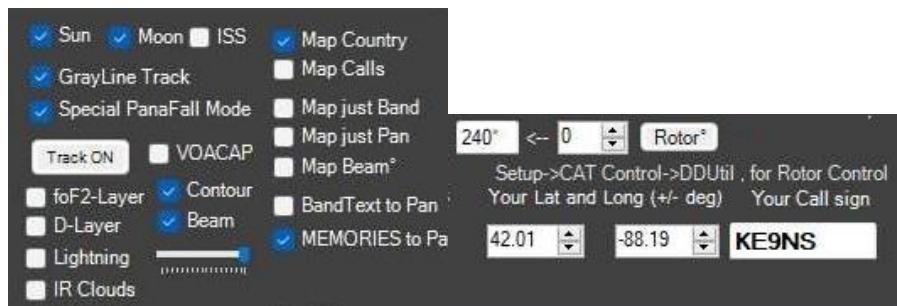
Signal strength of all beacons is displayed on the Spotter screen as well as on the Panadapter.

## (46) Spotter DX Live MAPS (DX Live World Map in the Panadapter):

Live DX spotting World Map. This map does not require Internet, but DX spot data, accurate VOACAP predictions, ISS position, and Solar Data, do require Internet.



Live DX world map "Track On"(left: Map country, Right: VOACAP)



Live DX world map Track On, options.

- Track ON:** Click to toggle Live maps ON/OFF.
- Sun-Moon-ISS:** Check to add Zenith tracking of the Sun (with solar data), Moon (with Elevation and Beam heading), ISS (with Elevation and Beam heading), based on Lat/Long you entered.
- VOACAP:** Check to activate current VOACAP map for the band based on solar data (internet connection).
- Contour:** Check to view as contours (shown above), otherwise dots
- Beam:** Check to adjust VOACAP for those using a Beam
- Beam (slider):** Transmitter power to 1.5kw for VOACAP
- GrayLine Track:** Check to add Gray Line to world map (useful for upper bands DX)
- Special Panafall Mode:** Check to force Maps to go into small waterfall for easier viewing.
- Map Country:** Check to show Country name on map (shown above).
- Map Calls:** Check to show each DX call sign on map (can get crowded in a contest)
- Map just Band:** Check to show **Country/Calls** for only the band you are on currently.
- Map Just Pan:** Check to show only **Country/Calls** for the portion of the band your viewing on the Panadapter.
- Map Beam:** Check to add a Beam heading next to the Country/Call currently on the map
- BandText to Pan:** Check to show the band text for the currently viewed portion of the band. You can also toggle this by Right Clicking on the BandText shown just below the Frequency shown on both VFOA and VFOB

## (47) Maps (Live on the Panadapter):

Live F2-layer map, Live D-Layer map, Live Lightning map, Live IR Cloud layer map

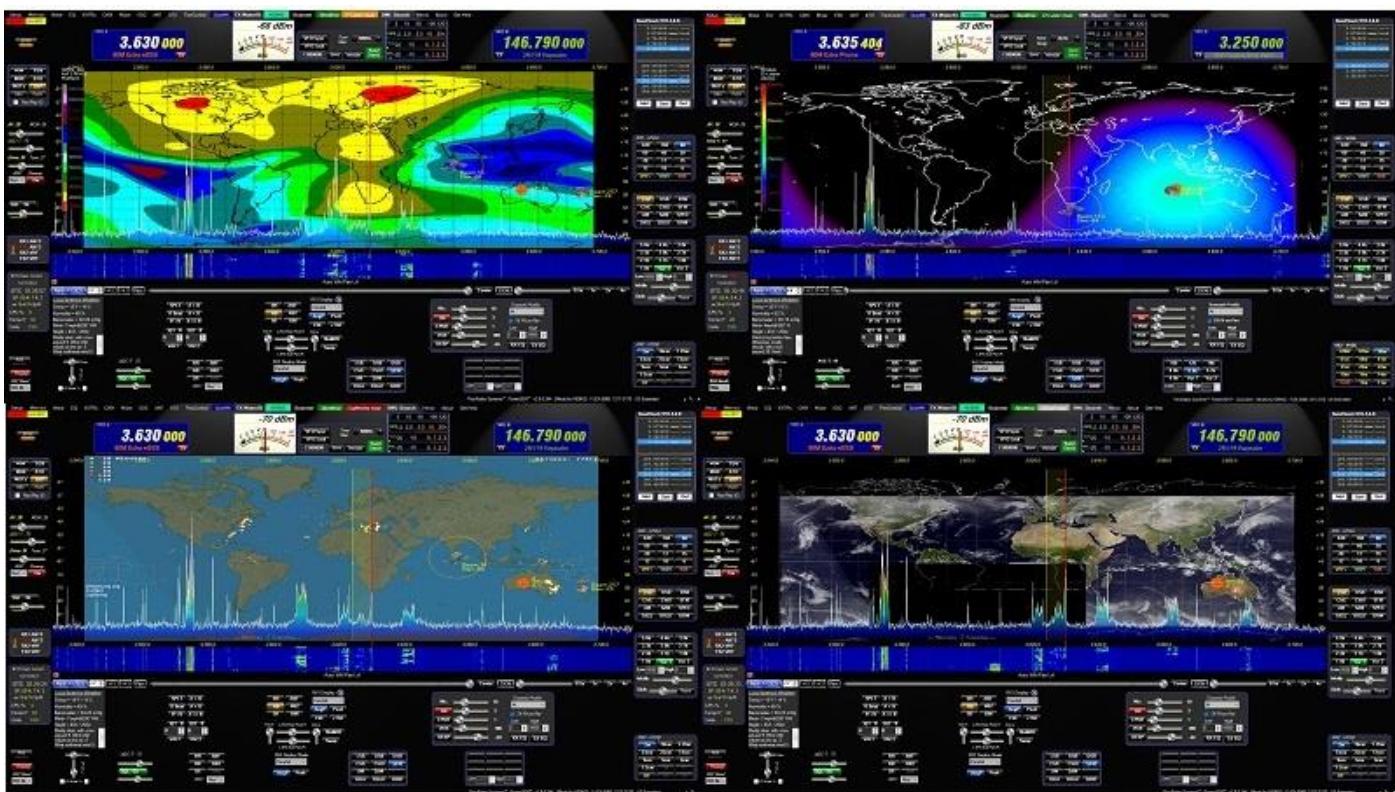
There are 2 ways to access these maps:

1) From the (46) Spotter screen (just below the Track On button)



2) Right Click on the (47) "Maps" menu button on the top line of the PowerSDR console screen. This will shift through these 4 maps + the DX Spot World Map.

Note: All these maps require Internet connection. All maps updated every 30min.



Live Maps (F2-Layer, D-Layer, Lightning, IR Clouds)

- ❑ **foF2-Layer:** Check to display F2-Layer NVIS reflection map. Certain display features are disabled while viewing this map. See scale on Left side. Moving up the scale is better.
- ❑ **D-Layer:** Check to display D-Layer absorption map. See scale on Left side. Moving up the scale is worse.
- ❑ **Lightning:** Check to display real-time lightning map. White = within the last 20min, Red=120min old. Hold down CTRL Z to open a ZOOM window on the screen.
- ❑ **IR Clouds:** Check to display Infrared Cloud cover map. Hold down CTRL Z to open a ZOOM window on the screen.

Video of Live Maps: <https://youtu.be/y7J4ktH2He4>

#### **(48)SWL Search (Short wave listening search):**

There are 2 ways to access the Short Wave listings for the Panadapter. 1) The **(46)Spotter** screen. 2) The **(48)SWL** menu item (at the top of the PowerSDR console)

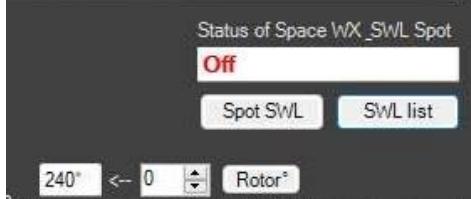
- ❑ **(48)SWL Search:** Click to toggle SWL ON/OFF. If it was OFF, You will see all currently available Short wave stations appear on the Panadater and a Search window will open.

When you activate the SWL feature, a SWL Search window will also open up. You can minimize this without closing it.



*You can search key words or partials and only stations listed as ON at the current UTC time will appear. Quick links are also provided on the right side of the search window.*

## **From the (46) Spotter window**



*From within the (46) Spotter window*

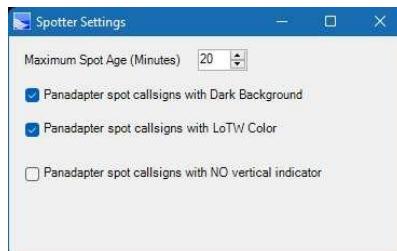
- ❑ **Spot SWL:** Click to toggle SWL ON/OFF. If it was OFF, You will see all currently available Short wave stations appear on the Panadater and a Search window will open.
  - ❑ **SWL List:** Click to Open the SWL search window
  - ❑ **Status of Space Weather and SWL Spots:** Status indicator

#### **(46)Spotter Beam pointing:**

This feature (inside the Spotter window) allow you to automatically or manual move your Beam. **NOTE:** You must first configure your Rotor using Setup->Cat Control->Rotor Control->COM port. Once setup, you can click on the beam heading of any DX spot to move your antenna to the new beam heading and simultaneously change the VFO and mode to match.

- ❑ **Rotor:** Click to move your antenna to the angle in the Right box.
  - ❑ **Left Angle:** Current angle of your antenna.
  - ❑ **Right Angle:** Manually set new angle to move your Antenna.

## (46) Spotter (menus)



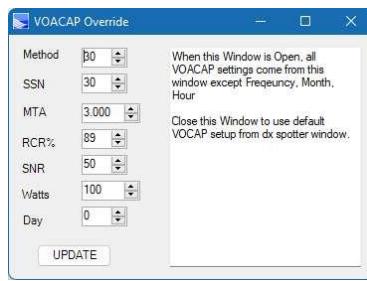
**Spotter Settings**

- ❑ **Maximum Spot Age (Minutes):** Length of time before older DX Spots will drop off the Spotter list. Reduce this time during contests to a few minutes.
- ❑ **Panadapter Spot Callsigns with Dark Background:** Check to place Dark background behind DX Call signs with yellow text when displaying them on the Panadapter.
- ❑ **Panadapter spot Callsigns with LoTW Color:** Check if you have a free LoTW (LogBook of The World) account and have logged in (see Page 136). The same colors over the DX Callsigns you see on the Spotter screen will also appear on the Panadapter (see top left page 138).
- ❑ **Panadapter spot Callsigns with NO vertical indicator:** Check to remove the vertical line that normally helps to identify the true frequency of the DX Spot. The vertical line is not needed since you can just click on the SPOT from the Spotter screen OR place your mouse over a DX Spot on the Panadapter and hit the CTRL key, to move directly on the DX spot (including Mode)



**Spot DX Call Watch**

- ❑ **Watch for DX Spot:** Place a DX call sign (or any part of a call sign). When a Call sign (that gets through your filters) appears, a Red Pop-Up Alert will appear. Click on it go to that Frequency and Mode. Delete the DX call sign to remove the Watch.



**VOACAP Override** (For those who know how to tweak the VOACAP settings)

### **Time Servers List:**

If the Internet "Time Sync" does not appear to be connecting to its default server, Click on the

## (49)PDF-Manuals:

- ❑ **Left Click:** Open PDF PowerSDR KE9NS Flex-5000 v2.8 manual (this will also cover Flex-1500/3000 as well)
- ❑ **Wheel Click:** Open PDF KE9NS ShortCut list (keyboard and mouse and hidden).
- ❑ **Right Click:** Open PDF PowerSDR\_CAT\_Command\_Reference\_Guide.

## (50)Heros:

Click to Open Heros Preselector band filter. Heros communicates with the Flex Radio via IIC bus.

## (51)About:

Click to Open About window.

- ❑ **Check for Update:** Click to check for newer revisions of PowerSDR ke9ns v2.8.0.x

There is a link to download the FCC call sign database to update the LoTW database.

# Chapter

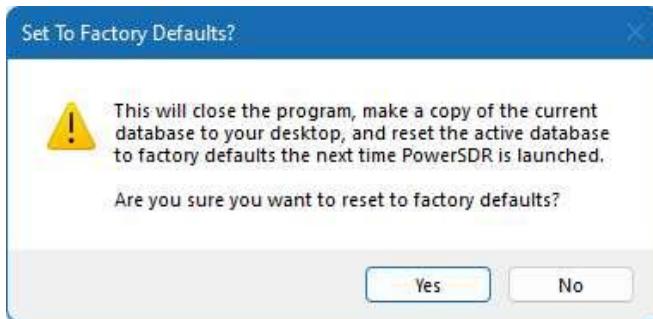
# 7

## 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:

- ❑ **Factory Defaults:** This displays the warning shown in Figure 92. Click **No** to avoid resetting the database. Click **Yes** to reset the database, which entails closing PowerSDR, copying the database file 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-5000 to the database. The copy of the database on your desktop is an xml-file named *PowerSDR\_database\_[date]\_[time].xml*.

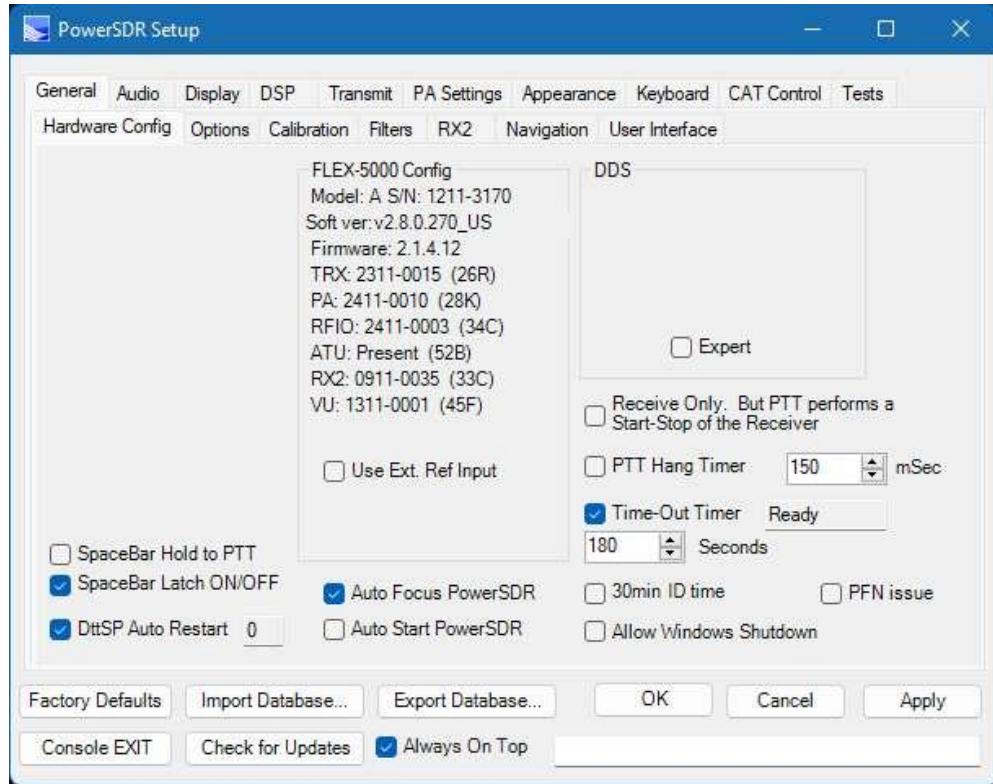


*Figure 92: Reset Database Warning*

- ❑ **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
- ❑ **Console Exit:** Extra option (besides Right Clicking on Start/Stop button) to Quit PowerSDR.
- ❑ **Check for Updates:** Goes out to ke9ns.com to check for a newer incremental download.

## General Tab

### Hardware Config Sub-Tab



### FLEX-5000 Config

With FLEX-5000 selected as the Radio Model, this section lists the serial numbers of your FLEX-5000, installed Firmware version and the installed hardware boards of your radio. The ATU (if installed) is marked as *present*.

- ❑ ATU and RX2, shown in Figure 93, will only be listed if indeed installed in the radio.
- ❑ RFIO will read HRFIO in later versions of the FLEX-5000. The HRFIO or RFIO board house the antenna switching matrix and the HRFIO has more capabilities than the earlier RFIO (see also page 120).

**Use Ext. Ref Input:** Check this box if you have an external reference clock oscillator connected to the Ext Ref Input port on the back panel (see (10) in Figure 3 on page 6 and also page 9) and wish to use it.

**Receive Only:** Check this box to use only the receiver, while disabling the transmitter. When checked, MOX, TUN and VOX will become unavailable on the Front Console but PTT performs a STOP of the receiver, release of PTT performs a Start of the receiver. See Options for Disable PTT checkbox.

**DDS****Figure 95: DDS**

To reveal the **Clock Offset** and the **IF** controls (Figure 95), check **Expert**. This will show a warning; click **Yes** to proceed.

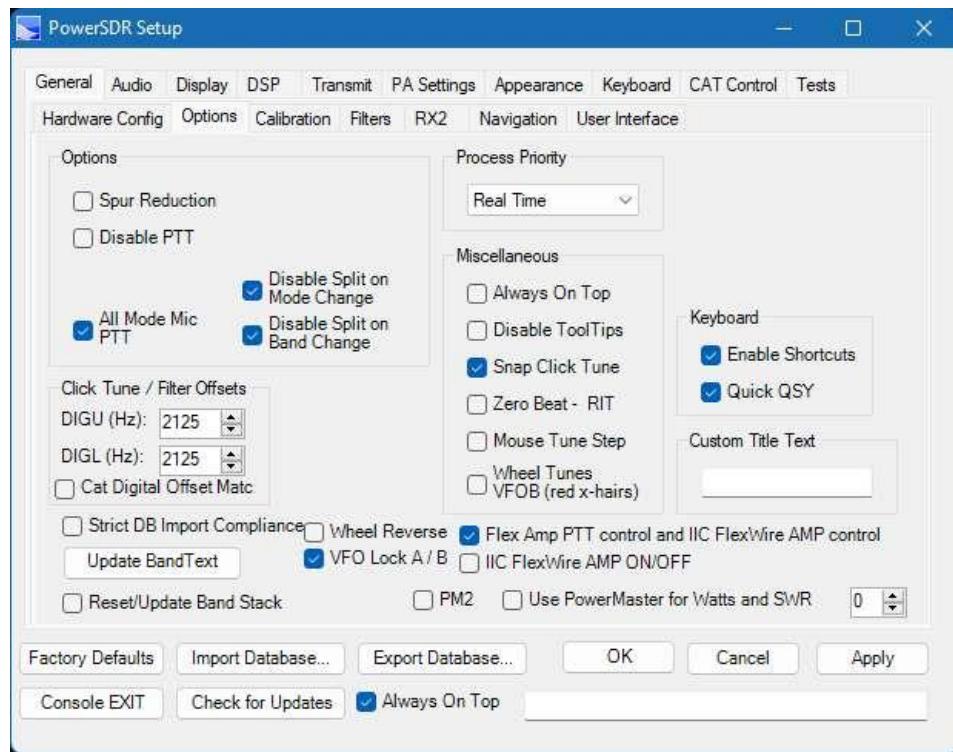
DDS Stands for Direct Digital Synthesis. The DDS chip in the FLEX-3000 produces an analog sine wave at up to micro Hertz resolution. The DDS is used as a local oscillator to tune the radio. Normally there will be no need to adjust the oscillator and the controls are hidden.

- ❑ **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.
  - To adjust the frequency calibration of your radio, first use the automatic Frequency Calibration controls described on page 150. Or Setup->General->Calibration to set the Clock offset automatically.
  - To manually adjust the frequency calibration of your radio, start the internal signal generator by opening the Setup Form, Tests Tab (page 194) and checking **Enable HW Signal Generator**. Select **DSB** mode and tune VFO A to the desired frequency. With **SPLT** turned off you should see a -25 dBm signal at the VFO frequency. Change the display to the Phase display and you will see a single dot. Adjust the Clock Offset control until the dot in the phase display is (almost) standing still. Don't forget to turn the internal signal generator off, when you are done.
  - The Clock Offset can also be calculated as follows. Divide the DDS frequency (500 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  $500/10 * 300 = 15000$ . Plugging in 15000 into the Clock Offset control should zero beat the signal. Note that if the measured frequency were 10.000300 MHz, the offset would be -15000. 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):** Virtual I.F. Default is 9khz or 3.8khz. This is needed to move a SPUR that may occur at the 0hz location during a TX->RX transition. **You must set this to 0hz to make or playback an IQ WAV recording. Engaging "Pan" mode (page 88) sets the I.F. to 0hz to allow moving the bandpass without moving the Pandapter. NOTE: 3<sup>rd</sup> party programs that use the VAC IQ audio (i.e. CW Skimmer) need to offset for the I.F. frequency, since the IQ stream will be offset by the I.F. amount.**

## Options Sub-Tab



*Figure 96: Setup Form - General Tab, Options Sub-Tab*

## Options



*Figure 97: Options*

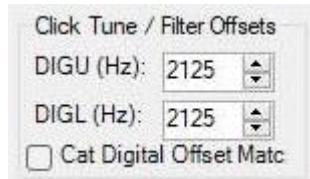
- ❑ **Spur Reduction:** Adds the use of a software oscillator to avoid DDS frequencies known to have a higher phase truncation related spurious response. In short, rather than tuning each frequency using the DDS (this is what happens when this option is turned off), PowerSDR tunes the DDS in 3 kHz steps and the software 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 and PTT connectors) to key the radio.
- ❑ **All Mode Mic PTT:** When checked, the PTT of a microphone connected to the front panel jack will be enabled for all modes. Otherwise, this PTT will be disabled for digital (**DIGL**, **DIGU**) and **DRM** modes.

- Disable Split on Mode Change:** When checked and if Split is enabled, Split will be disabled when the Mode is changed.
- 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. Modern CPUs with more than 4 cores can use "Real Time".

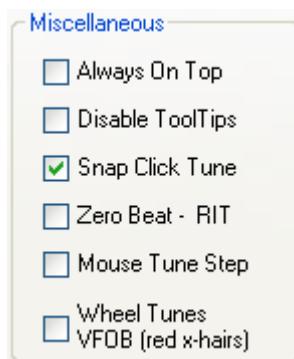
## Click Tune Offsets (Hz)



*Figure 98: Digital Click Tune Offsets*

- DIGU:** Sets the offset in Hz to use when click tuning in DIGU mode. Defaulted to 1200 for SSTV. When you click your mouse on a spot in the Panadapter, the 0hz line will offset by this amount lower in frequency.
- DIGL:** Sets the offset in Hz to use when click tuning in DIGL mode. Defaulted to 2210 for RTTY. When you click your mouse on a spot in the Panadapter, the 0hz line will offset by this amount higher in frequency.
- Cat Digital Offset Match:** Check to set Setup->Cat Control->Cat RTTY/Digital Offset values equal to these values automatically. Cat RTTY/Digital Offset is where CAT will report the VFO frequency offset by this amount.

## Miscellaneous

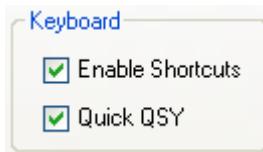


*Figure 99: Always On Top*

- 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 Click Tune:** 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 75). 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 100: Quick QSY*

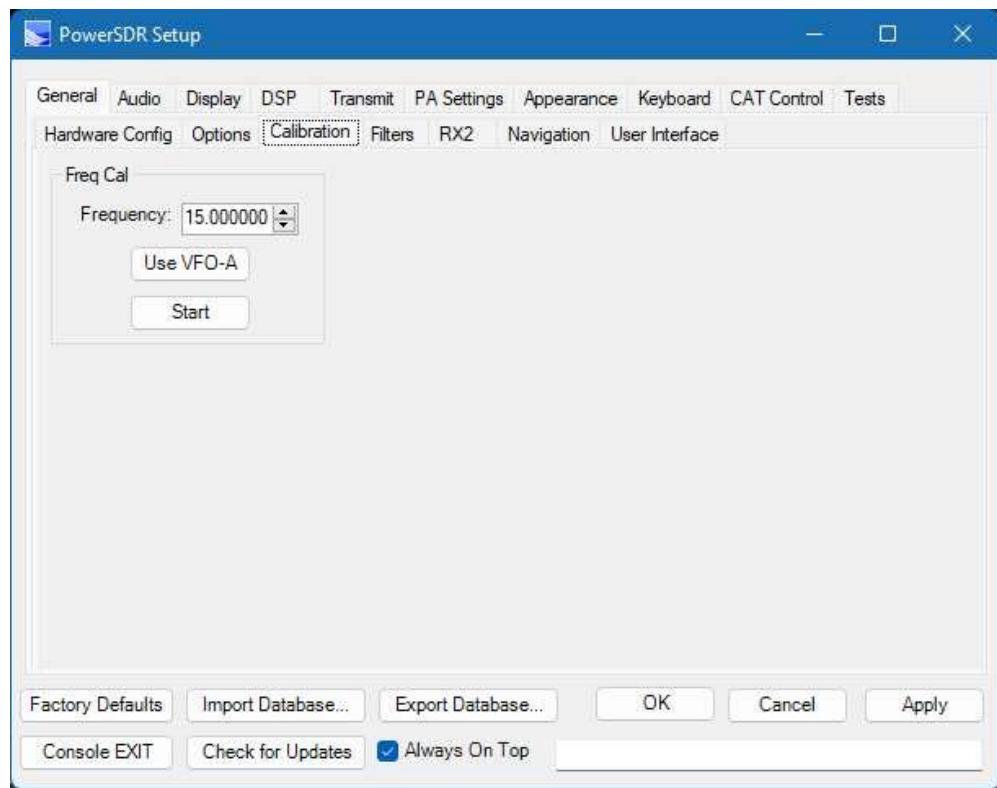
- Enable Shortcuts:** Enables the use of keyboard keys to perform various PowerSDR functions. The keyboard shortcuts can be set on the Setup Form-Keyboard Tab, described on page 170).
- Quick QSY:** Enables the user to quickly enter a frequency in MHz on the keyboard and hit [Enter] to jump to that frequency (main receiver RX1 only). 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.

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

## Calibration Sub-Tab

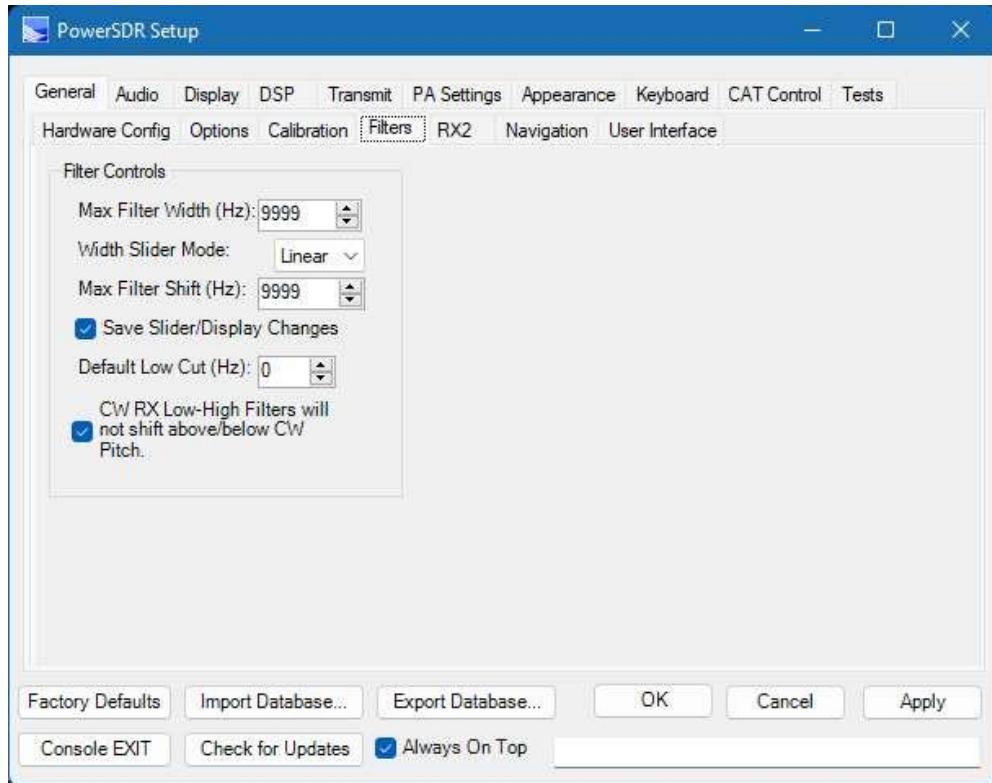


**Figure 101: Setup Form - General Tab, Calibration Sub-Tab**

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

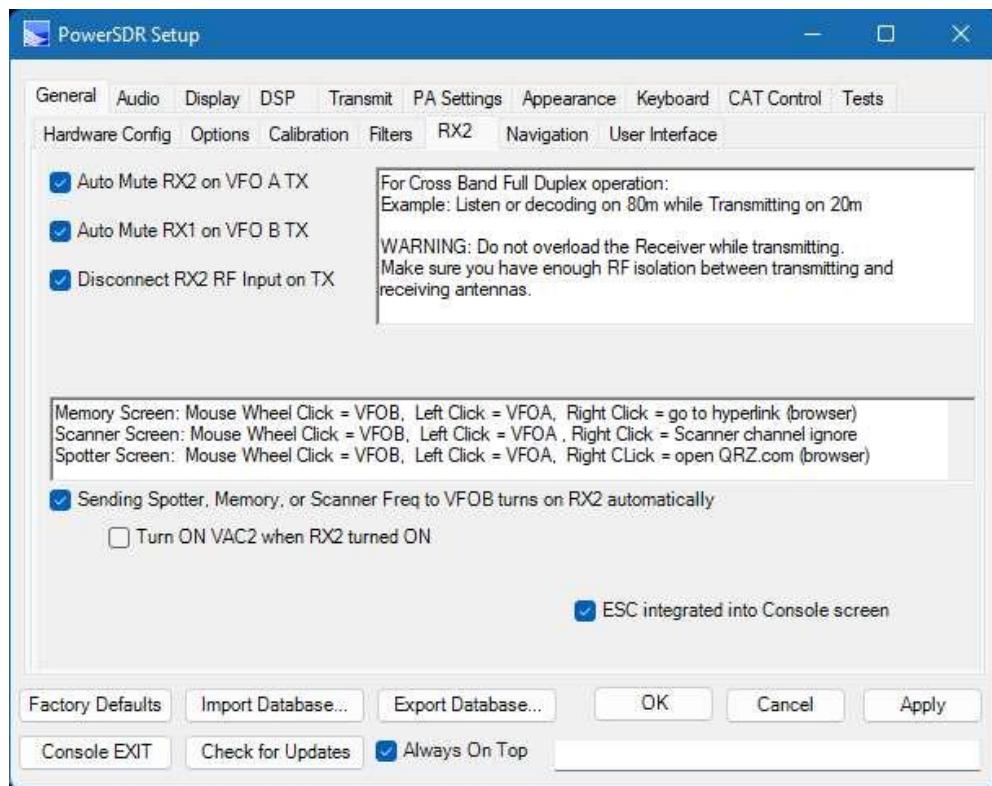


*Figure 102: Setup Form - General Tab, Filters Sub-Tab*

- ❑ **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 for 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 of 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.
- ❑ **CW RX Low-High Filters will not shift above/below CW Pitch:** Unchecked, operates around the CW Pitch value. That is the Low-High filter values are centered on the Pitch offset. When Checked, CW filters operate similar to SSB operation (from the 0hz line, not the pitch offset).

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## RX2 Sub-Tab



*Figure 103: Setup Form - General Tab, RX2 Sub-Tab*

- ❑ **Auto Mute RX2 on VFOA TX:** Mutes RX2 while VFOA is transmitting. (Default ON). You may turn OFF for Full duplex operation, but only if you have enough isolation between bands.
- ❑ **Auto Mute RX1 on VFOB TX:** Mutes RX1 while VFOB is transmitting. (Default ON). You may turn OFF for Full duplex operation, but only if you have enough isolation between bands.
- ❑ **Disconnect RX2 RF Input on TX:** Disconnects the RX2 signal path while transmitting to prevent front end overload.
- ❑ **Sending Spotter, Memory, or Scanner Freq to VFOB, turns on RX2 automatically:** RX2 will turn ON upon any change in VFOB
- ❑ **Turn ON VAC2 when RX2 turned ON:** VAC2 automatically connects to RX2 but only when RX2 is ON, otherwise VAC2 connects to RX1.
- ❑ **ESC Integrated into Console screen:** Enhanced signal Clarity Controls screen is placed directly into the PowerSDR console (if the Console screen has enough room to display it). When OFF, ESC has its own floating Window.

## Navigation

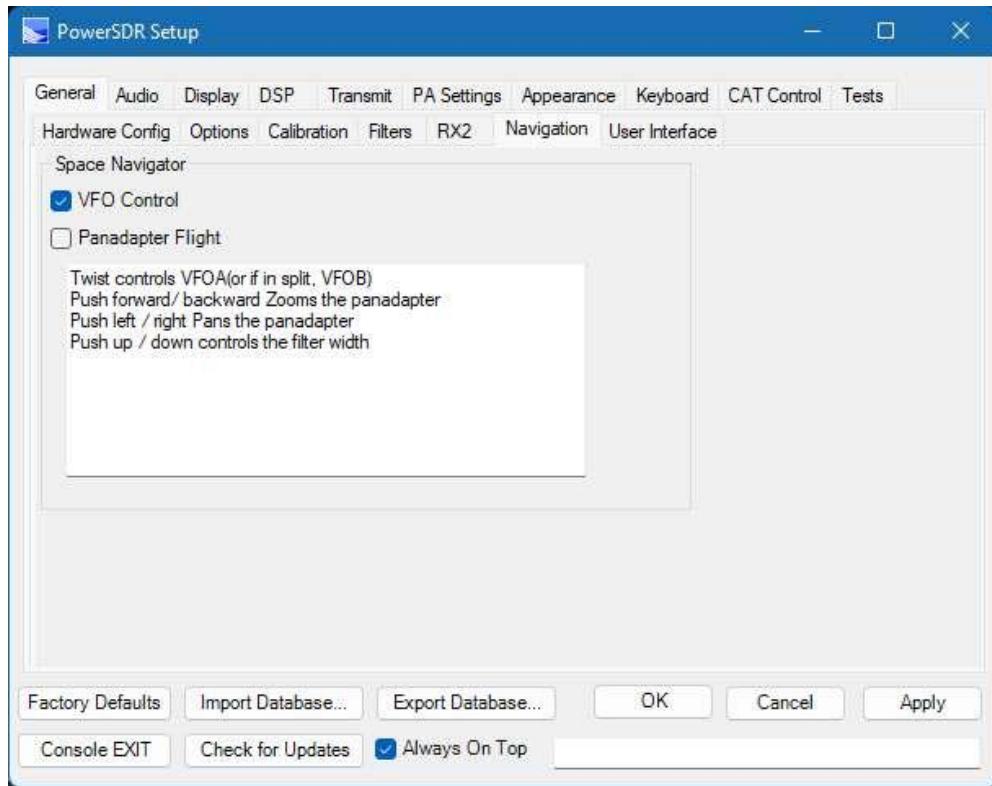


Figure 104: Setup Form - General Tab, Navigation Sub-Tab

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

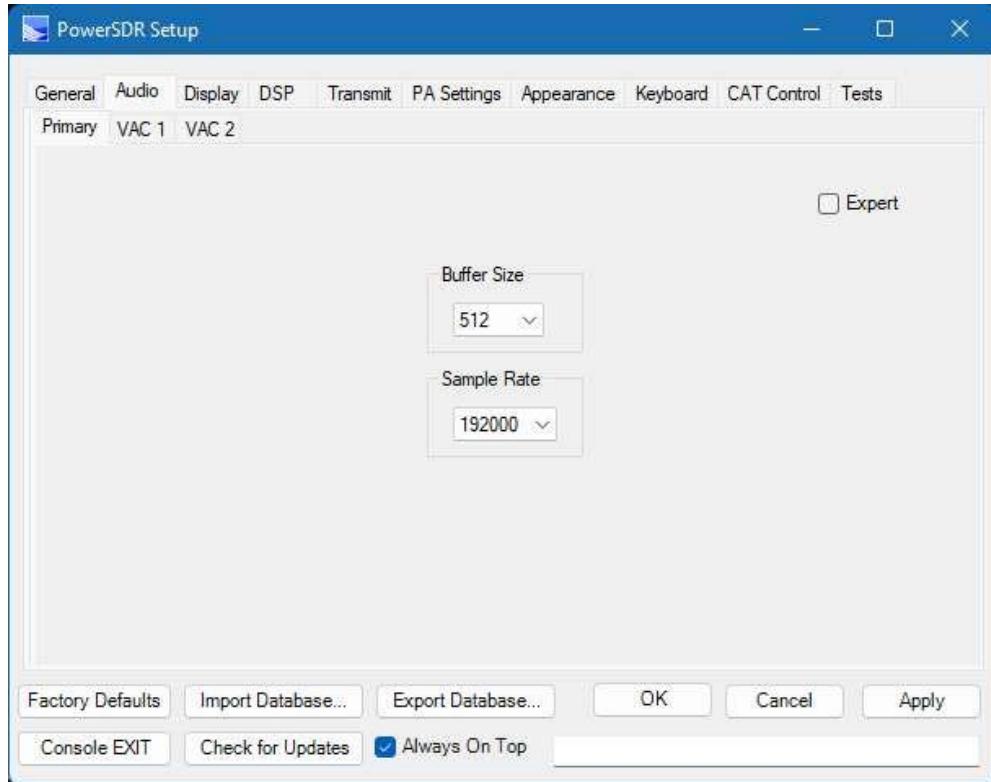
See Flex Control (41) and Setup “User Interface Tab” for alternative Navigation devices

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<sup>1</sup> SpaceNavigator is a trademark of 3Dconnexion.

## Audio Tab

### Primary Sub-Tab



*Figure 105: 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 samples between PowerSDR and the FireWire Driver. ASIO is used in the transfer. 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  $2048/48000 = 42.7$  mSec in length. Faster machines should be able to run with a buffer size of 512 without issue at the lower **Sample Rate** settings (see below). 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 165).

#### Sample Rate

The **Sample Rate** determines the number of audio samples per second transferred between PowerSDR and the FireWire Driver. The sample rate can be set to 48 kHz (Flex-1500 max), 96 kHz (Flex-3000 normal) or 192 kHz (Flex-5000 normal, Flex-3000 optional). Using the higher sample rates will result in a wider frequency range in the Panadapter and waterfall displays. Higher sample rates at a given buffer size will reduce the latency in the system, but at the same time widen the filter skirts. It is this trade-off that needs to be made, especially for CW where latency might be more critical.

**Note:** The FireWire Driver will automatically follow your audio Buffer Size and Sample Rate settings.

## Expert

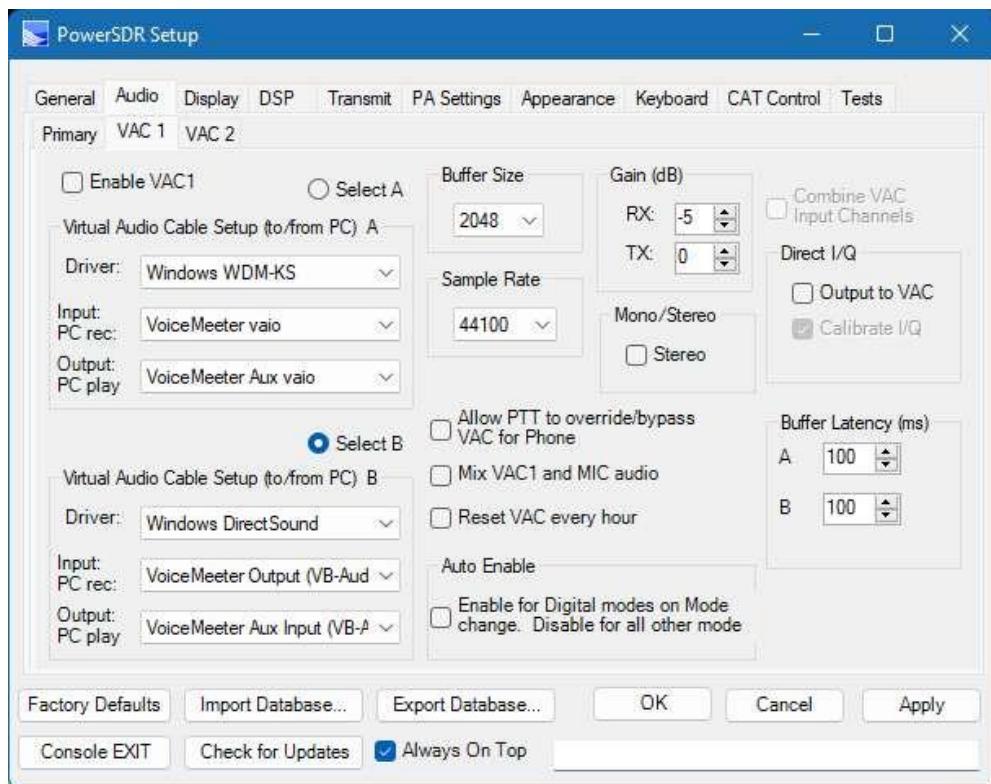
To reveal the **Latency** control, check **Expert**. This will show a warning; click **Yes** to proceed. You should proceed with caution and only consider doing this if you are an experienced user. Vary rarely, if ever, will you need to access this control.

### Latency (with Expert checked)

ASIO is used in the data transfer. 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.

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## VAC1 Sub-Tab



**Figure 106: 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 (i.e. VB-Cable or Voicemeeter banana) 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** are similar to those described in the previous section, but relate to the audio samples transferred between PowerSDR and VAC.

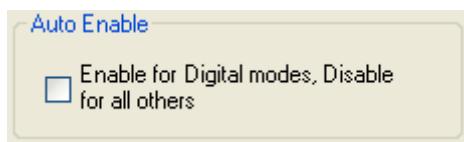
### Virtual Audio Cable Setup

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 106 (see also **Digital Operation** on page 67).

**VAC1** has an A/B option for 2 virtual cable setups. (A) can be setup for Remote audio operation. (B) can be setup for Digital modes like WSJT-X.

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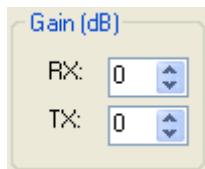
## Auto Enable



*Figure 107: 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 108: 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).

## Buffer Latency

**MME** is the slowest and requires at least 120mSec. **DirectSound** can be set down to 90mSec. **WDM-KS** (similar to ASIO) can be set down to 15mSec (depending on how capable your PC is). **WDM-KS** only allow 1 PC program to connect with a Virtual audio cable at a time (i.e WSJT-X or FLDIGI, but not both at the same time). **MME** and **DirectSound** have no such limitation.

## 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.

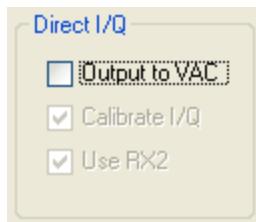
### **Mix VAC1 and MIC audio**

Check this box if you want to mix audio coming in from your PC with your MIC audio to transmit. Also enable this feature if you are using a Speaker/Mic on your PC. This will allow you to use the Monitor (MONps or MONpr) feature, and also hear Quickaudio or voicekeyer audio.

### **Reset VAC every hour**

If you run WSJT-X for hours (with a lot of transmitting) check this box to keep audio timing in sync.

### **Direct I/Q**



*Figure 109: 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.
- ❑ **Use RX2:** Check to use I/Q signals relating to the second receiver RX2 instead of RX1. NOTE: Not used anymore, use VAC2 instead.

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## Display Tab

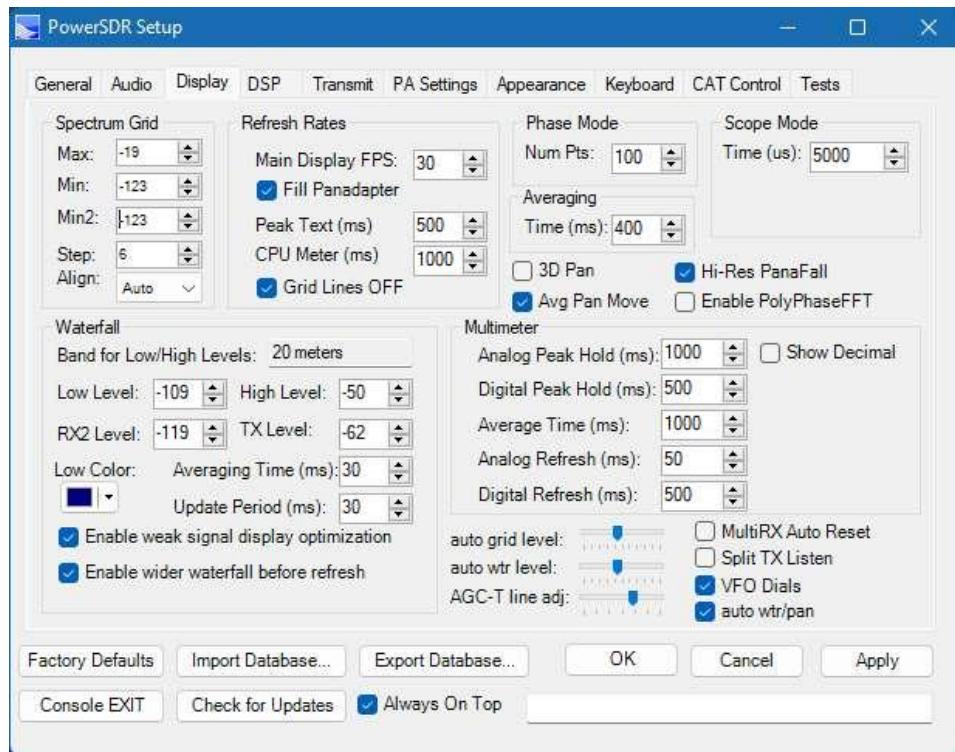


Figure 110: Setup Form - Display Tab

## Spectrum Grid

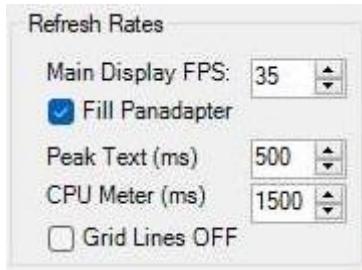


Figure 111: Spectrum Grid

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/Min2 (rx2 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.

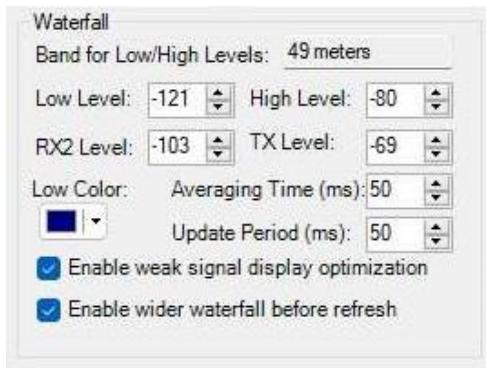
## Refresh Rates



**Figure 112: 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 beneath the signal line in the panadapter.
- ❑ **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.
- ❑ **Grid Lines OFF:** Check when using the Maps (which have their own grid lines based on Longitude and Latitude).

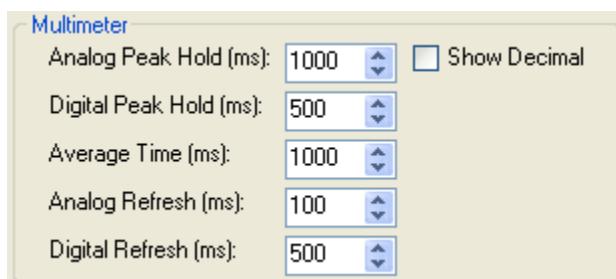
## Waterfall



*Figure 113: Waterfall*

- ❑ **Low Level (RX1):** The lower end of the dynamic range to view in dBm. Signals at or below this level will use the **Low Color**.
- ❑ **RX2 Level:** The Lower end of dynamic range to view in dBm for RX2.
- ❑ **High Level:** The high end of the dynamic range to view in dBm.
- ❑ **TX Level:** Microphone high end 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.
- ❑ **Enable Weak signal display optimization:** Check to optimize display for weak signals.
- ❑ **Enable wider Waterfall before refresh:** Check to enable a wider waterfall history as you scroll left/right before a display refresh is needed.

## Multimeter



*Figure 114: 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.

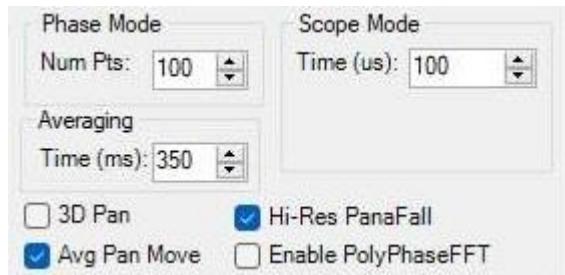


Figure 114a: Other Display options

### Phase Mode (Resolution)

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

### Scope Mode (Time Base)

This control adjusts the time base in  $\mu$ s (horizontal time scale) of the Scope Display.

### Averaging

This control sets the averaging time in mSec of the Spectrum, Panadapter and Histogram displays when **AVG** is enabled on the Front Console. A good number is 350ms

### 3D Pan (checkbox)

Check to Enable the 3D effect on the Panadapter (There is also a 3D button on the Console screen).

### Hi-Res Panafall (checkbox)

Check this to enable high resolution Panadapter and Waterfall. Standard resolution is 4096 point. Hi-Res is 16384 points across the screen. This allows for much more detail especially when you zoom in.

### Avg Pan Move (checkbox)

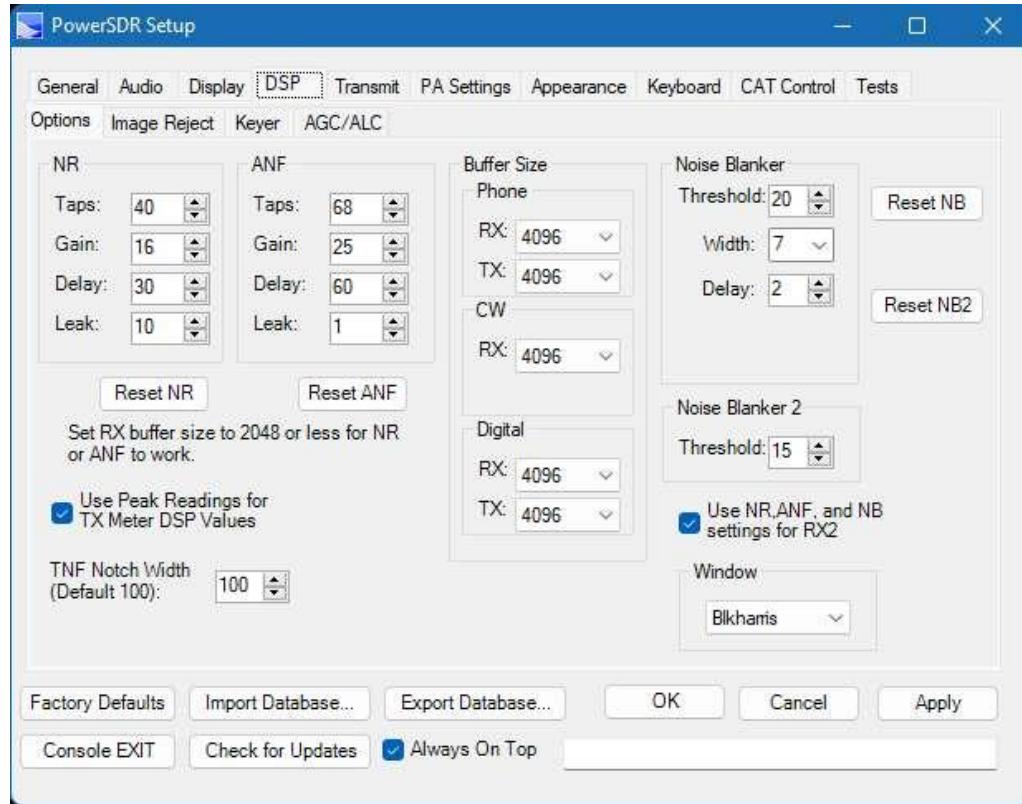
Check to allow smoother left/right scrolling when in "Pan" mode (Pan button is RED, page 88).

### Enable Polyphase FFT (checkbox)

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. Important Note: the display will lag relative to the audio you hear.

# DSP Tab

## Options Sub-Tab



**Figure 115:** Setup Form - DSP Tab, Options Sub-Tab

## Noise Reduction



**Figure 116:** Noise Reduction Controls

Noise Reduction (**NR**) attempts automatic computation of a filter that maximizes the coherent or non-noise like signals and as a result, filters out the rest of the signal, which includes noise. It is best used for speech signals with a good signal to noise ratio.

- ❑ **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.
- Leak** keeps the filter within a reasonable range once converged.
- Reset NR** Reset the filter back to the default values (shown)

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 116 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 117: Automatic Notch Filter Controls

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

- Taps** This determines the length of the computed 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.
- 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.
- 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.

- Leak** keeps the filter within a reasonable range once converged.
- Reset NR** Reset the filter back to the default values (shown)

As with the Noise Reduction filter, an optimum needs to be reached for the best filtering. The values shown in Figure 117 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.

## 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, if the sample rate (see Figure 105 on page 154) equals 192 kHz and the DSP buffer equals 2048 then the minimum attainable 3 dB filter width equals  $1.5 * 192000 / 2048 \approx 140$  Hz<sup>1</sup>. Either lowering the sample rate or increasing the DSP buffer size will enable narrower and sharper filters.

To dramatically illustrate this effect Figure 118 below shows two traces of the same 25 Hz CW filter. The wide trace is at a sample rate of 192 kHz and a DSP Buffer size of 256, yielding a minimum 3 dB filter width of  $1.5 * 192000 / 256 \approx 1125$  Hz!! The narrow trace at 48 kHz and 4096 yields a minimum 3 dB filter width of  $1.5 * 48000 / 4096 \approx 18$  Hz.

<sup>1</sup> The factor 1.5 is due to the Blackman-Harris windowing function



Figure 118: 25 Hz CWL Filter at 192 kHz Sample Rate/256 Buffer Size (Wide) and 48 kHz/4096 (Narrow)

- The minimum audio latency is determined by the larger of the DSP Buffer and the audio Buffer (see page 136). 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  $2048/192000 = 11\text{ms}$ .
- 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 units less than the Noise Blanker threshold.

**Important Note:** *Strong adjacent signal(s) found anywhere within the Sample Rate (example: a strong CW signal with SR=192khz even if its not visible on the Panadapter) can cause the NB to pump in exact relation to the strong adjacent signal(s). This may also cause strong signals visible on the Panadapter to appear wider and possibly distorted.*

## **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.

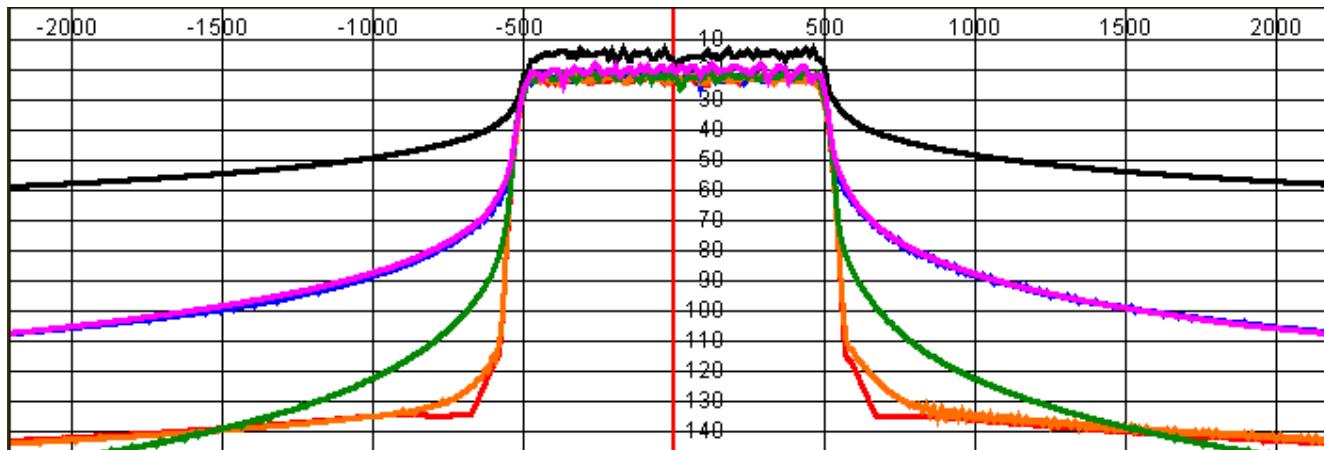
When seeing a significant amount of impulsive noise, being too aggressive with **Noise Blanker (NB)** can damage the signal. However, completely removing the large pulses is desirable prior to operating the smoother acting **Noise Blanker 2 (NB2)**. Therefore, when seeing many repetitive noise pulses, 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 119 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 119: Effect of Various Windows: Rectangle (Black), Welch (Violet), Bartlett (Blue), Hanning (Green), Blackman 3 (Orange) and Blackman-Harris (Red)**

Figure 120 displays a 25 Hz 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 very weak CW signals, where dynamic range is less important than a narrower passband.

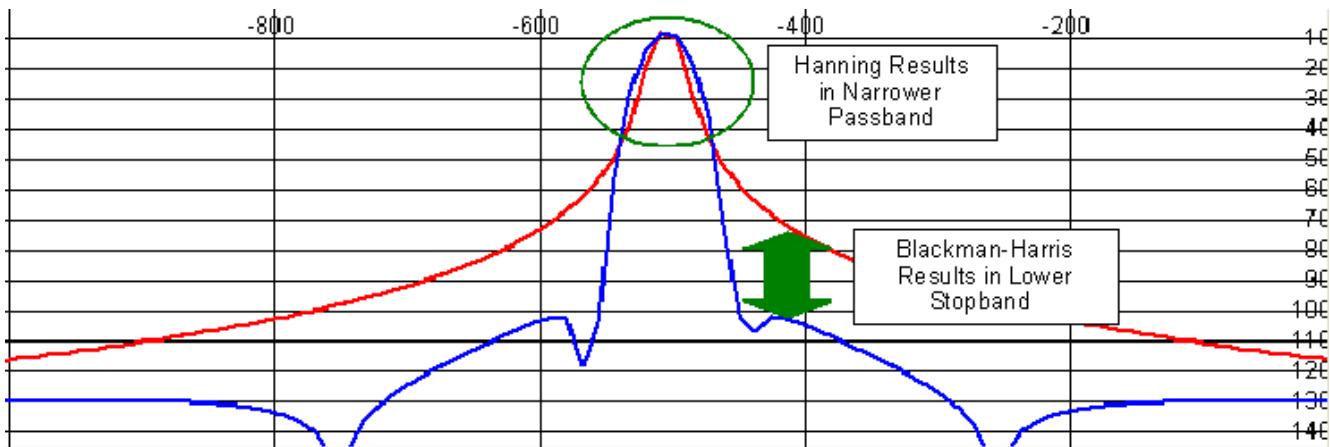


Figure 120: 25 Hz CW Filter with Hanning (Red) and Blackman-Harris (Blue) Windows

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## Image Reject Sub-Tab

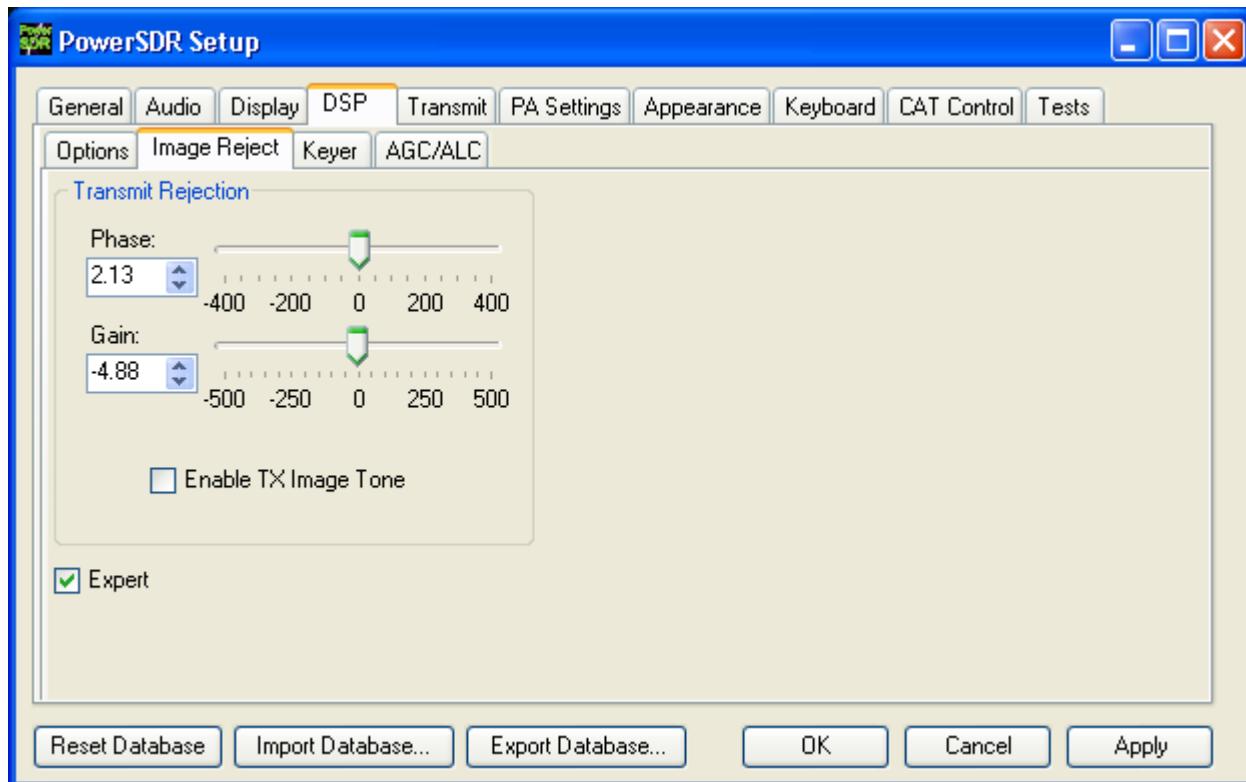


Figure 121: Setup Form - DSP Tab, Image Reject Sub-Tab

**Note:**

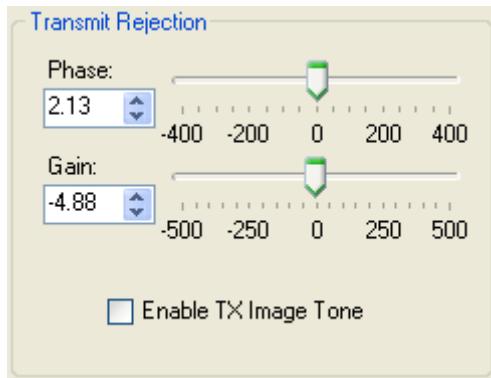
Your FLEX-5000 is completely calibrated and needs no further adjustments.

### 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 122: 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:

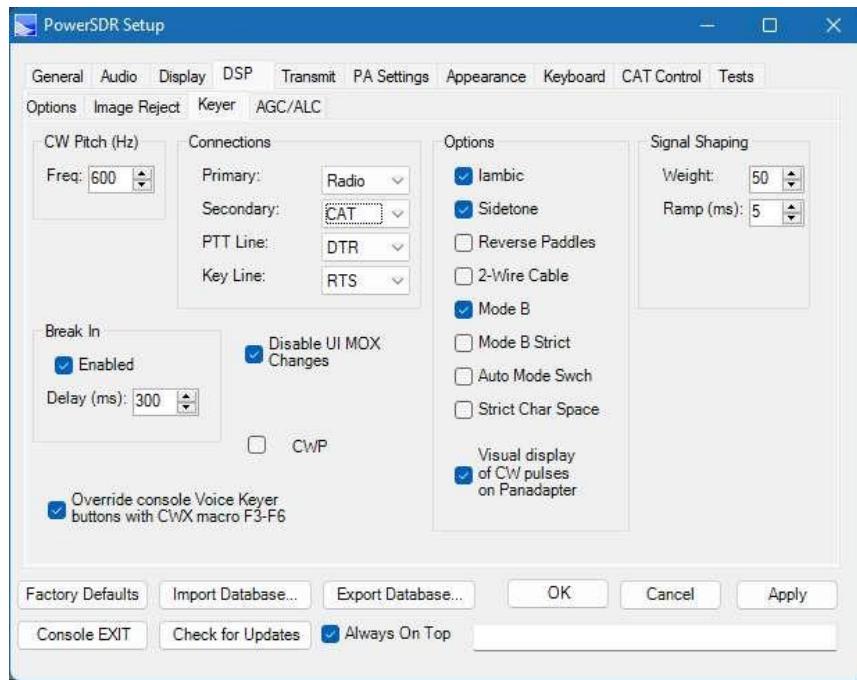
1. Set the radio to either USB or LSB. Connect the radio to a dummy load and select **Enable TX Image Tone**.
2. Click **MOX** (front console) and a full strength tone will be transmitted at the frequency shown in **VFO A**. Adjust the output power with the **Drive** control (front console).
3. If the 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

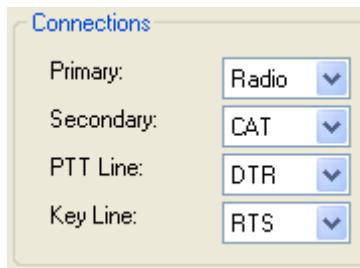


*Figure 123: Setup Form - DSP Tab, Keyer Sub-Tab*

### 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 Click Tune functions.

### Connections



*Figure 124: 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 back of the FLEX-5000.
- ❑ **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 171). 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

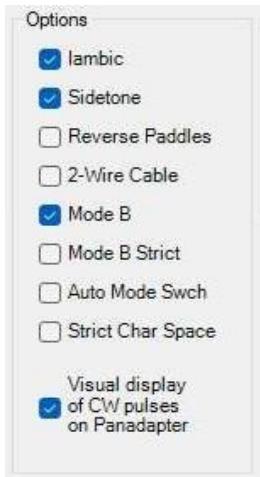
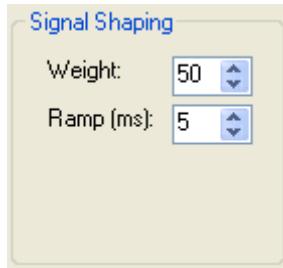


Figure 125: Internal Keyer Options

- ❑ **Iambic:** Check this box to enable Iambic mode A emulation unless mode B is selected (see below). With the box unchecked, the key input will act like a straight key.
- ❑ **Sidetone:** (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.
- ❑ **2-Wire Cable:** (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.
- ❑ **Strict Char Space:** Check to automatically force a full space after each character sent.
- ❑ **Visual display of CW pulses:** Check to Display CW transmit pulses on the Panadapter/Waterfall.

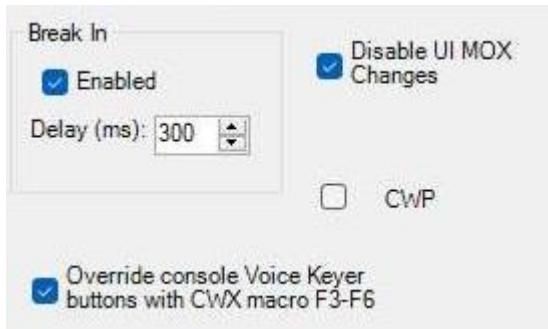
## Signal Shaping



*Figure 126: 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

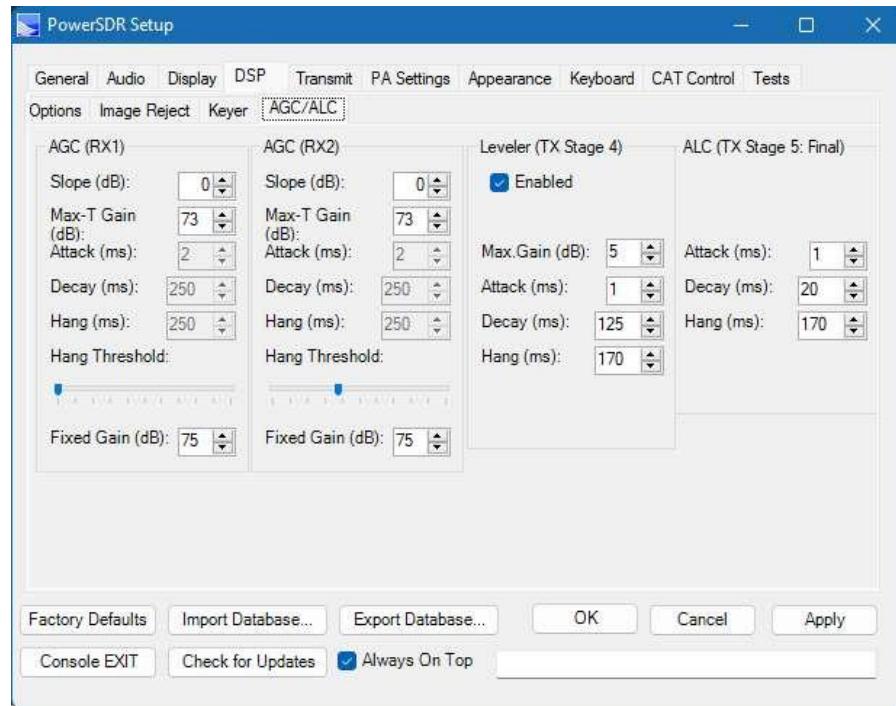


*Figure 127: Internal Keyer Semi Break In Controls*

- ❑ **Enabled:** Check this box to enable **Break In** for the internal keyer. NOTE: When using Macros CWX **Drop Delay** is used if **Break In** is not enabled.
- ❑ **Delay (ms):** Sets the amount of time between the last detected input and when the radio will drop back to receive. The smallest possible setting is 10 ms.
- ❑ **Disable MOX UI Lockout:** Check box to prevent all controls from being locked out during Transmit
- ❑ **CWP:** Check to allow the use of the CWX panel without being in CW mode.
- ❑ **Override console Voice keyer buttons with CWX Macro F3-F6:** to allow you to hide CWX panel but use the voice keyer buttons or F3-F6 keys to send CWX macros F3-F6 whenever in CW mode

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## AGC/ALC Sub-Tab



**Figure 128: 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](#) 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.

- ❑ **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 to 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 14 details the AGC parameters used in the various settings.

*Table 14: 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

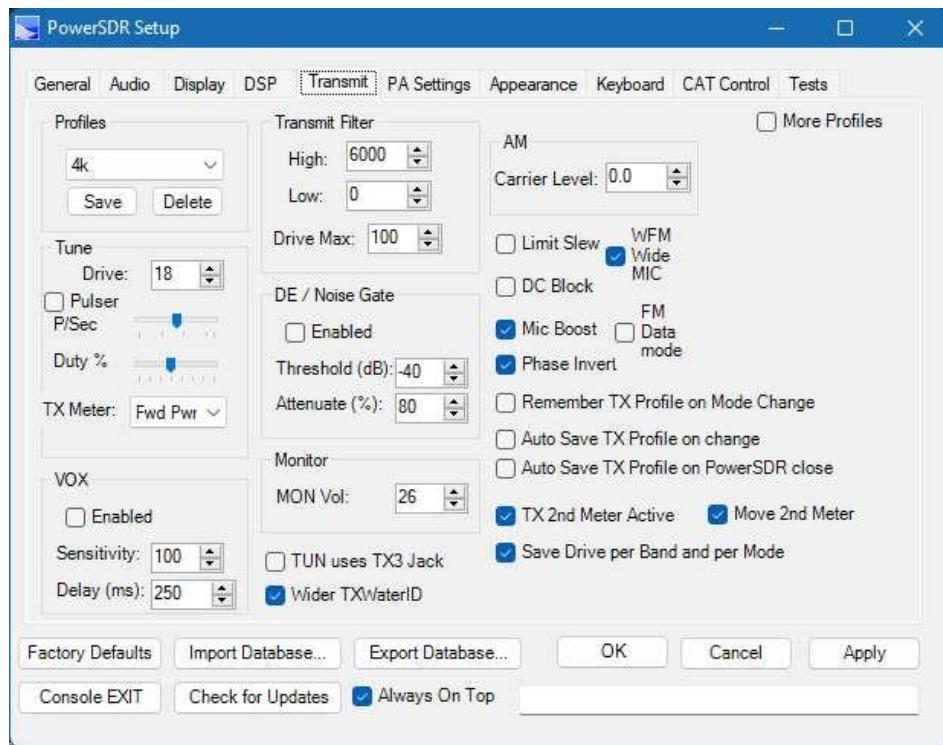
## Leveler

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 Comander (**DX** and **CPDR** on the Front Console - see Mode Specific Controls – Phone on page 82) work very well together with the ALC to increase average power without overdrive.

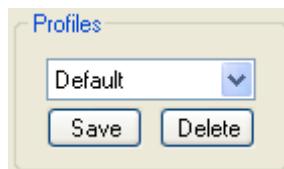
## Transmit Tab



**Figure 129: 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.

### Profiles



**Figure 130: 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.

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

## Transmit Filter



*Figure 131: Transmit Filter Controls*

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

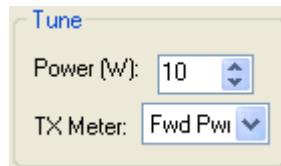
**Note 1:** You will receive a good practice warning if the transmit filter bandwidth exceeds 3 kHz.

**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.

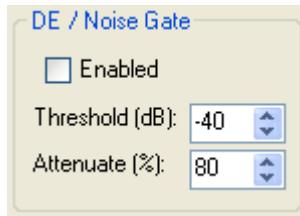
## Tune



*Figure 132: Tune Settings*

- ❑ **Power:** Sets the power in Watts 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 133: DE/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.

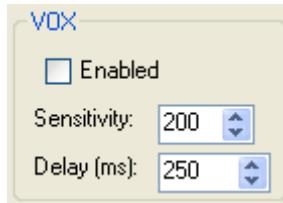
A noise gate on the other hand does not decrease the gain but switches it completely off below the threshold level. A noise gate works well if the ambient background noise level is low or mostly constant. If the background noise levels are close to your voice level or not constant, it will not provide 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 133 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.

## VOX



*Figure 134: VOX*

- ❑ **Enabled:** Enables/Disables the VOX operation.
- ❑ **Sensitivity:** The threshold above which PowerSDR automatically starts transmitting. Use this in combination with the **Downward Expander (DEXP)** for best results.
- ❑ **Delay (ms):** Time to stay in transmit after the last peak above the threshold.

## Monitor



*Figure 135: 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

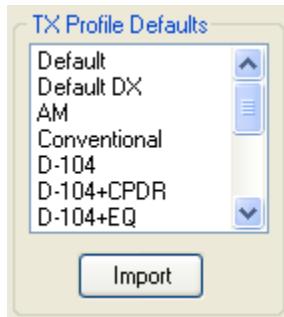


*Figure 136: AM Carrier Level*

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 (25W when **Drive** on the front console is set to 100). So a setting of 80 would yield roughly 16W when **Drive** is set to 100. This is useful as it allows the modulation to appear much stronger due to the weaker carrier.

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## Standard TX Profiles



*Figure 137: TX Profile Defaults*

Click to place a check mark in the **Expert** box to reveal many more **TX Profile Defaults**, as shown in Figure 137. 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 158.

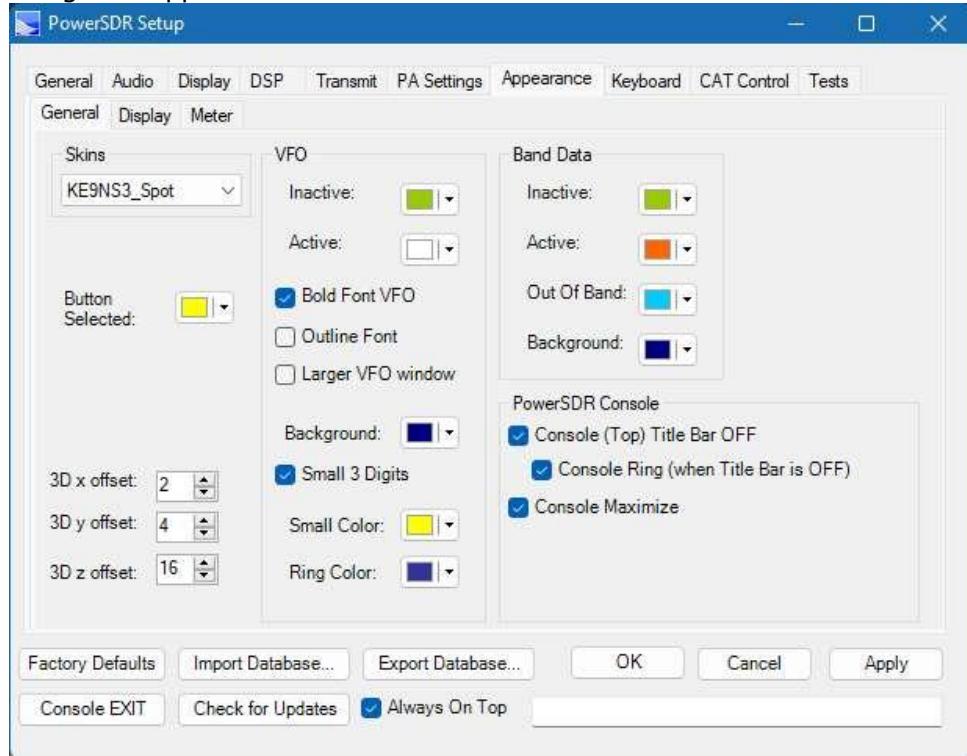
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## Appearance Tab

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

### General Sub-Tab

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



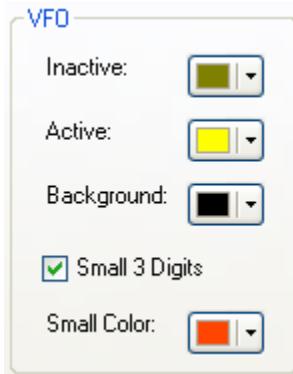
*Figure 138: Setup Form-Appearance Tab, General Sub-Tab*

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

### Skins

If you have downloaded and 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.

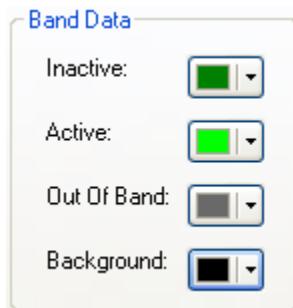
## VFO



*Figure 139: 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 140: 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

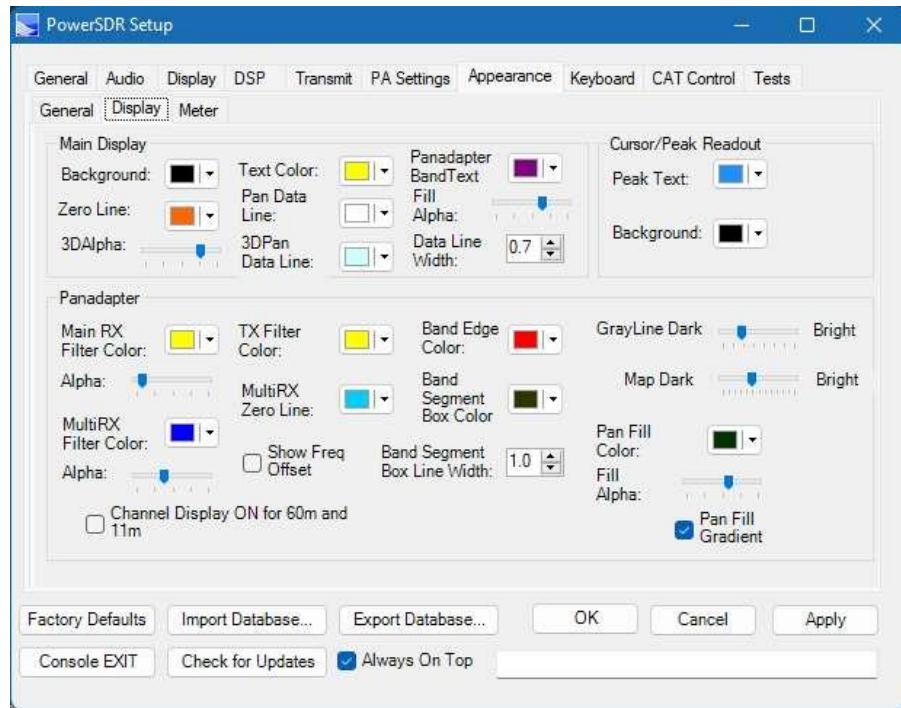


Figure 141: Setup Form-Appearance Tab, Display Sub-Tab

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## Overall Display

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

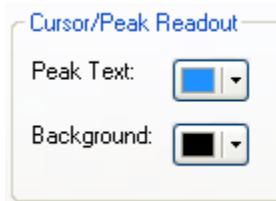


*Figure 142: Overall Display Appearance Controls*

- **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 143: Cursor/Peak Readout Appearance Controls*

- **Peak Text:** The color of the Peak signal location text located below 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).

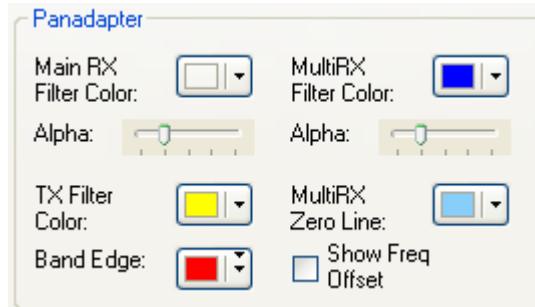


Figure 144: PanadAPTER Appearance Controls

- ❑ **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.

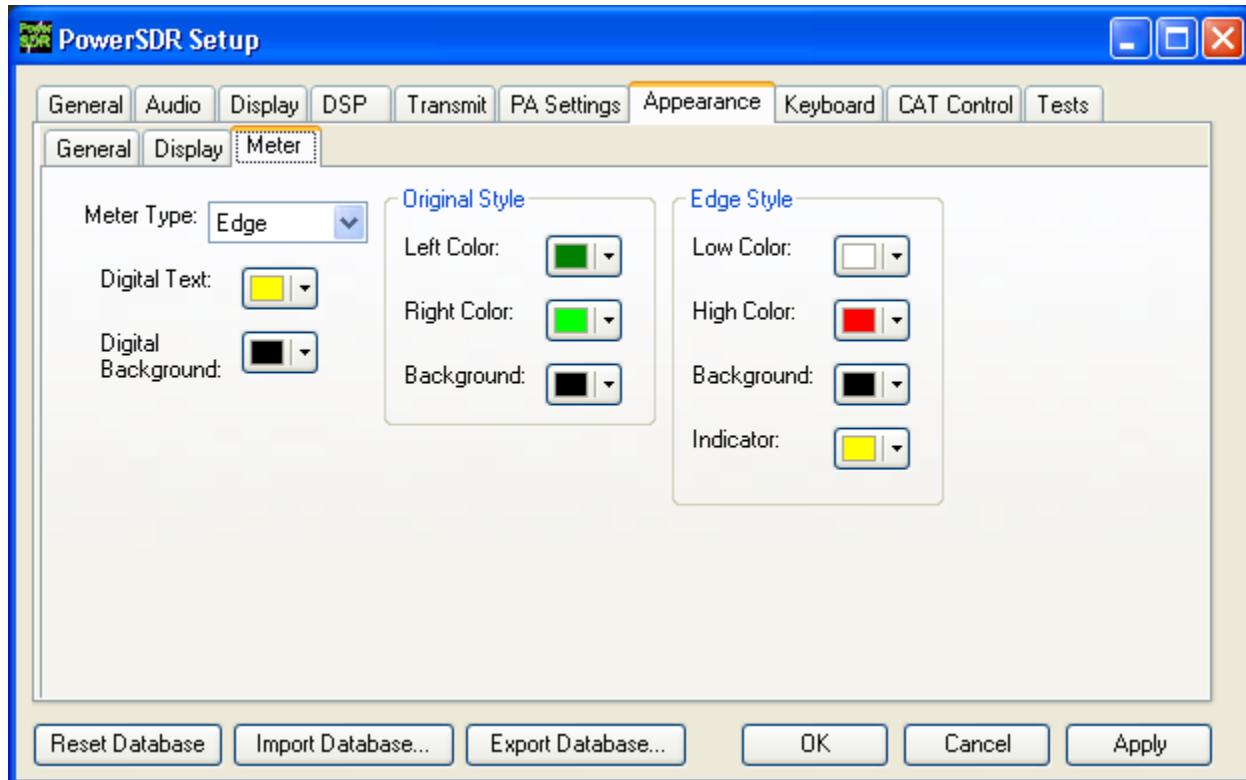


Figure 145: Setup Form-Appearance Tab, Meter Sub-Tab

- ❑ **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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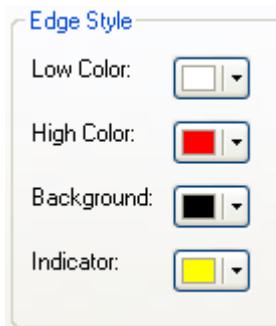
## Original Style



*Figure 146: 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



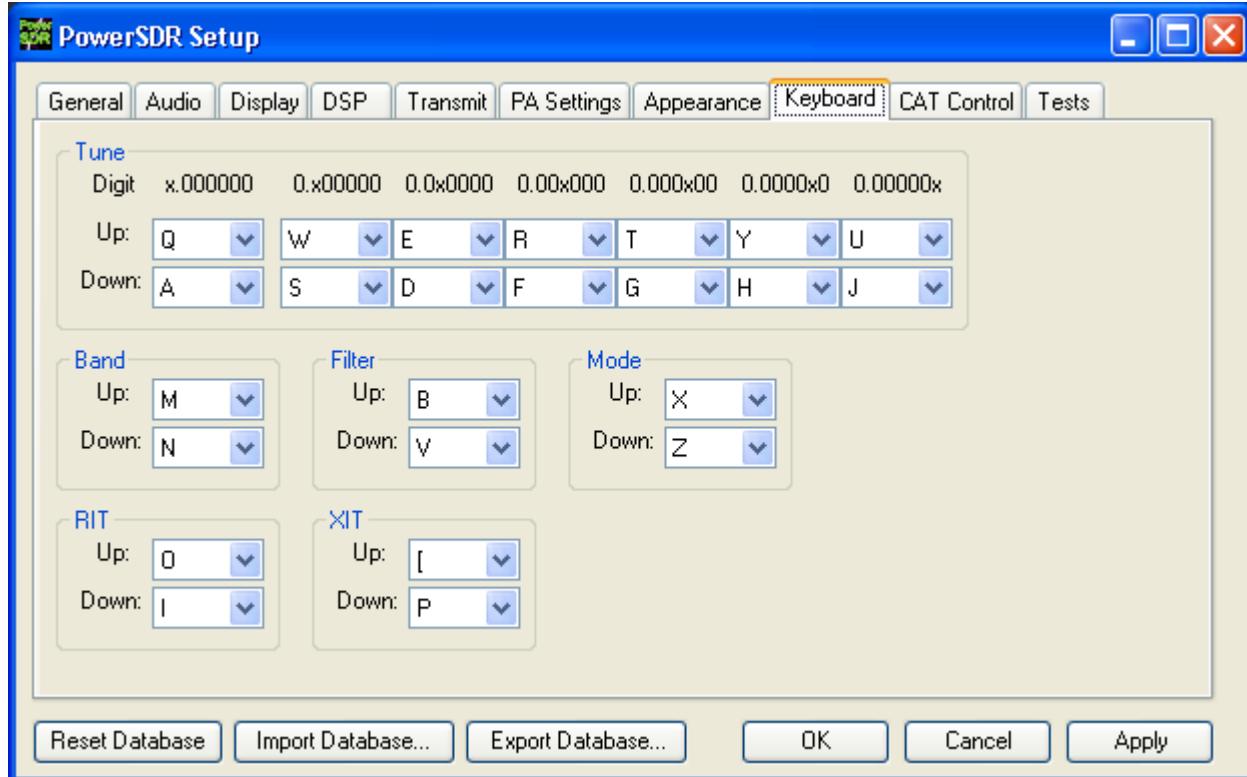
*Figure 147: Appearance Controls for the Edge Style Meter*

- ❑ **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 148: 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

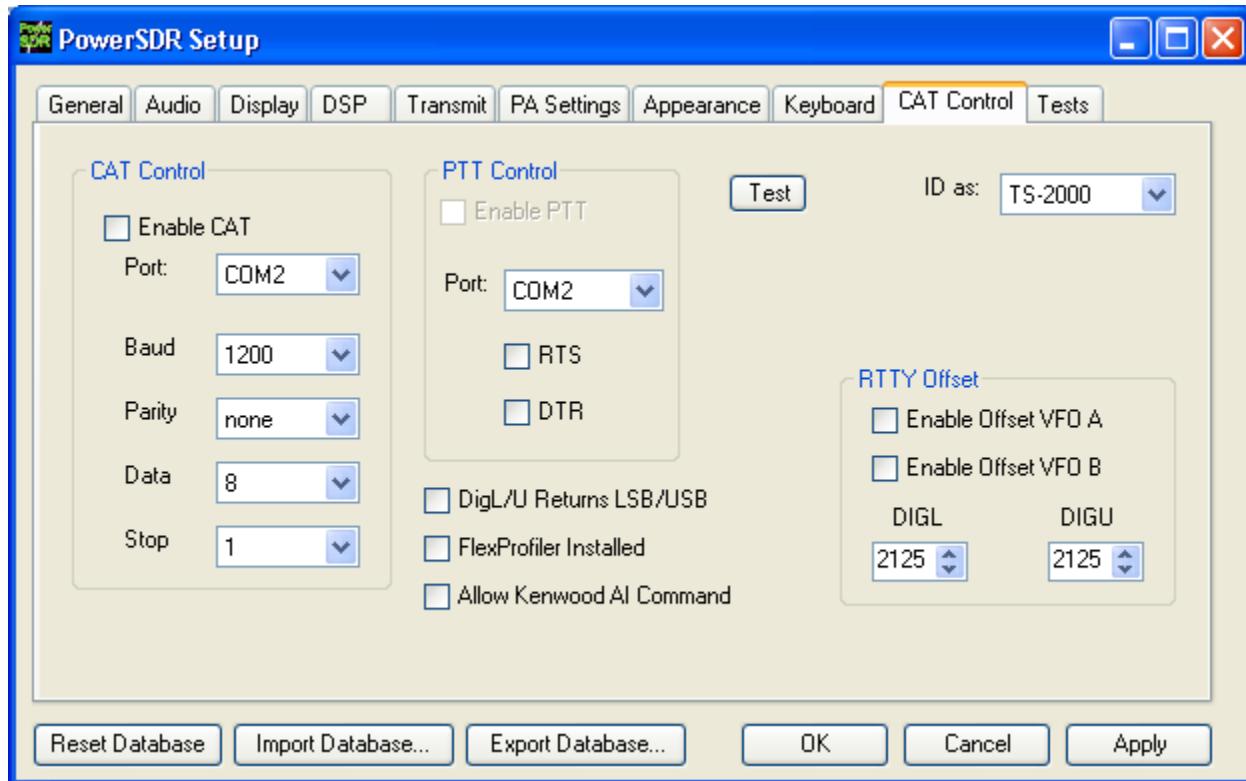


Figure 149: Setup Form - Cat Control Tab

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 65 and 67) interaction is possible with third party programs such as digital mode programs and logging programs.

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## Cat Control

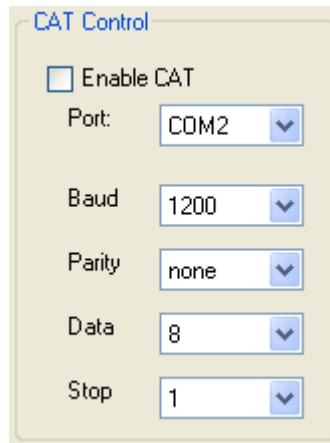
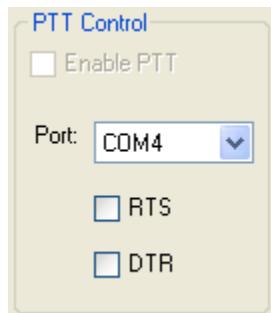


Figure 150: CAT Control

- ❑ **Enable CAT:** Check this box to open the serial port using the settings below. Note that you will need to uncheck this box in order to adjust the settings.
- ❑ **Port:** Serial 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 151: 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.

## DigL/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 FlexProfiler<sup>1</sup> 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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<sup>1</sup> 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 152 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 a semicolon, the CAT terminator, at the end of the command is optional. The CAT response will appear in the **CAT Response** text box.

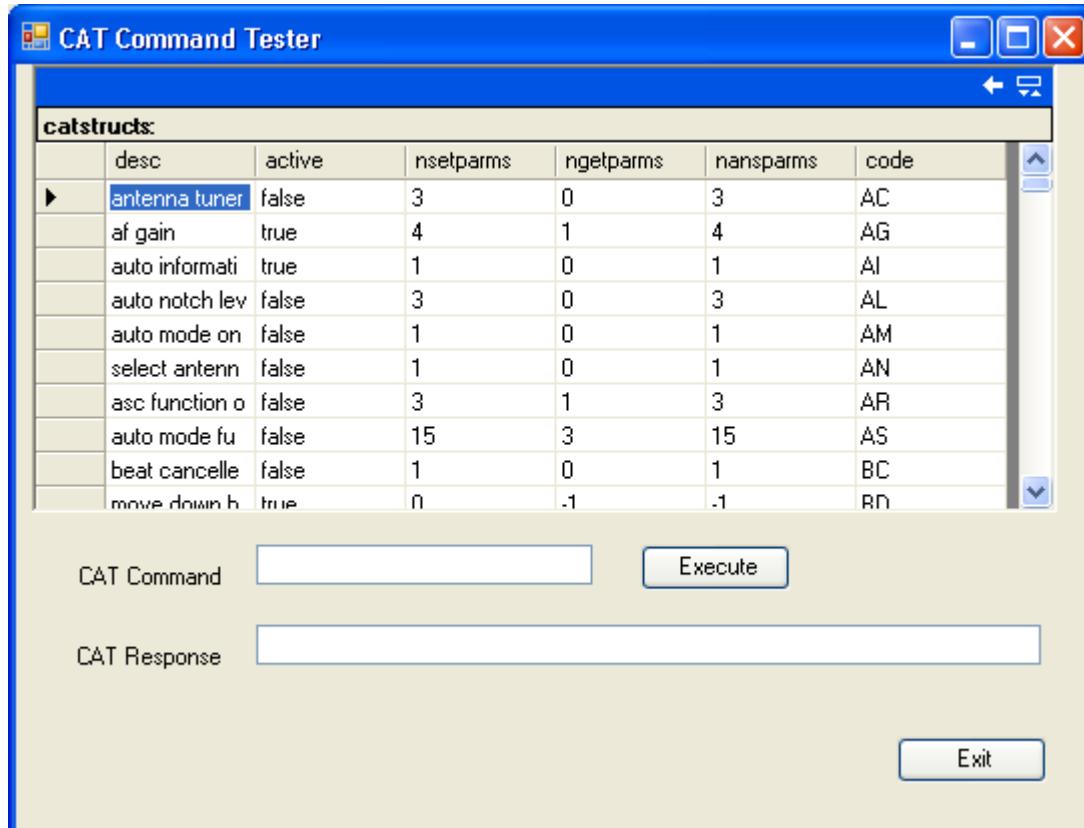


Figure 152: CAT Command Tester Form

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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 153: RTTY Offset*

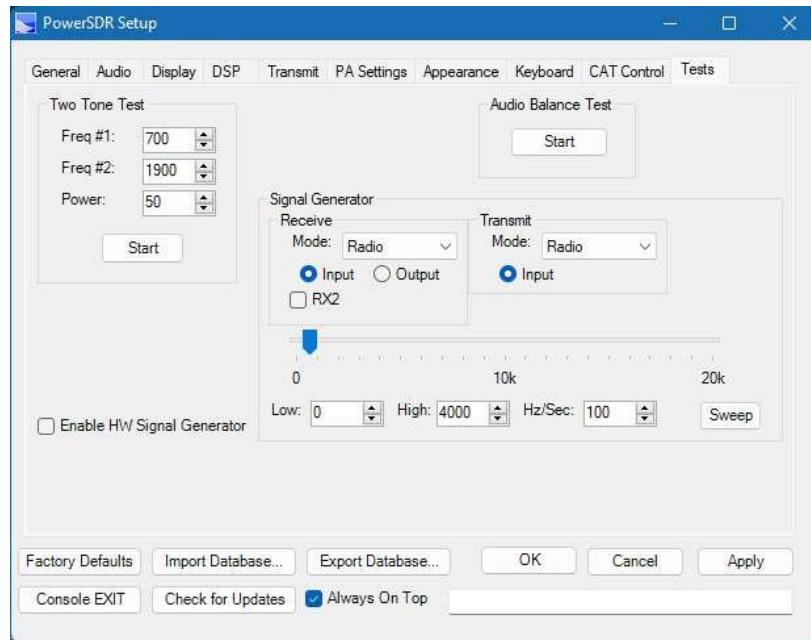
The **RTTY Offset** controls add or subtract the offset entered in **DIGU** and **DIGL** respectively, from the VFO frequency before CAT reports it to a third party program.

- ❑ **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 130), 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 154: Setup Form - Tests Tab**

### Two Tone Test:

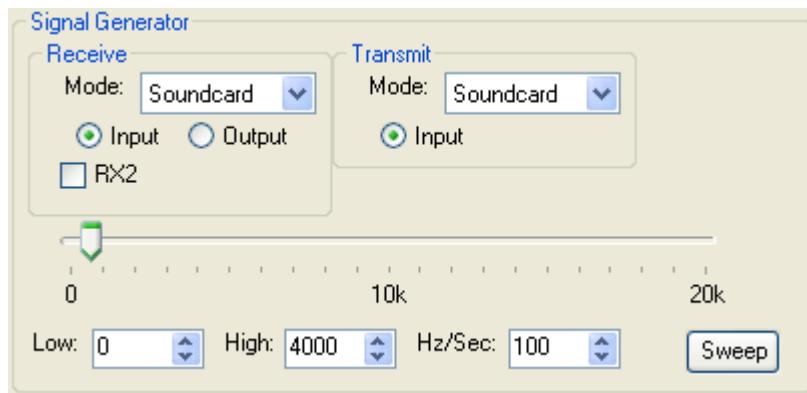
Used to test the two-tone IMD of the transmitter. To run the test, enter the two tone frequencies in the **Freq #1** and **Freq #2** controls. Enter the **Power** to be sent to the front panel **Drive** control. Make sure you have a dummy load connected. Click the **Start** button to begin transmitting 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 Powered Speaker/Line Out 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 Powered Speaker/Line out jack on the Back Panel.

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## Signal Generator



**Figure 155: 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. *Soundcard* means the Signal Generator is turned off and the FLEX-5000 hardware can be used.

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

- ❑ **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 the Line Out 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.
- ❑ **RX2:** Check to send the generated signal to the second receiver RX2.
- ❑ **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.

## Enable HW Signal Generator

The so called **HW Signal Generator** is an RF signal generator as opposed to the AF Signal Generator described above. Check to activate the HW Signal Generator and adjust its frequency by using **VFO B**.

- To test RX1, switch RX2 off (if installed), and set the VFO to **SPLT**.
- To test RX2, switch RX2 on and make sure **SPLT** is off.

**Note 1:** The Receive AF **Signal Generator** must be set to *Soundcard*, to use the RF **HW Signal Generator**.

**Note 2:** In actual fact, the RF signal is generated using the transmit DSP and sent through the QSE (Quadrature Sampling Exciter), which is then looped back to the QSD (Quadrature Sampling Detector) and the receive DSP.

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# Driver Control Panel

The FlexRadio Driver comes with a Control Panel which enables you to verify and set various parameters. To open the Driver Control Panel make sure your FLEX-5000 is turned on and then double-click on the FlexRadio Driver's desktop icon you created during installation. Alternatively, click on Start → All Programs → FlexRadio Systems → FlexRadio. You will see the Control Panel as shown in Figure 156.

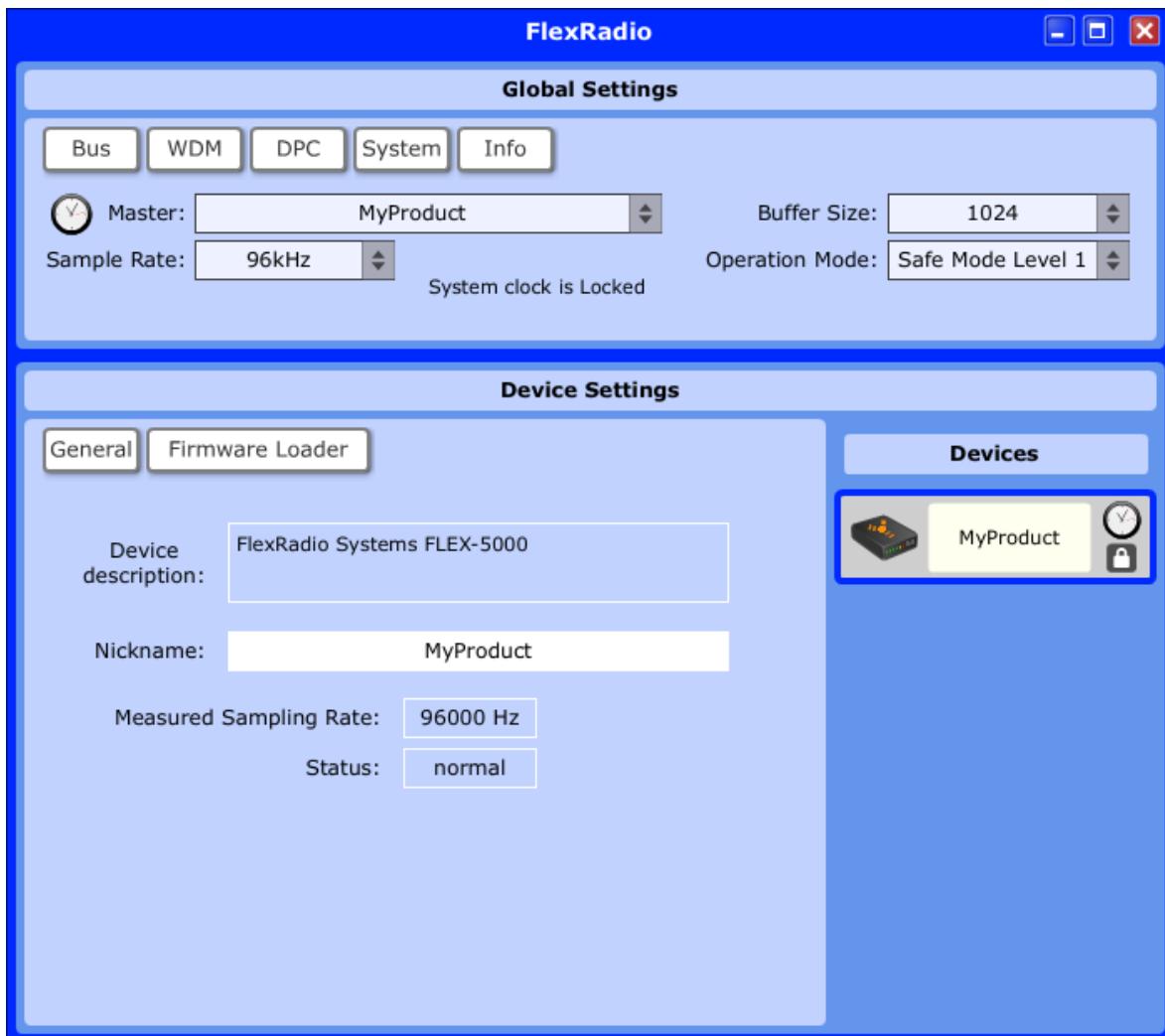


Figure 156: FlexRadio Driver Control Panel - Default View

The Control Panel is divided into two sections, **Global Settings** and **Device Settings**.

## Global Settings

The Global Settings section has across the top 5 buttons which act as tabs. For our purposes only the buttons **Bus** and **DPC** are relevant.

### Bus Settings

On opening, the Control Panel displays the **Bus Global Settings** panel.

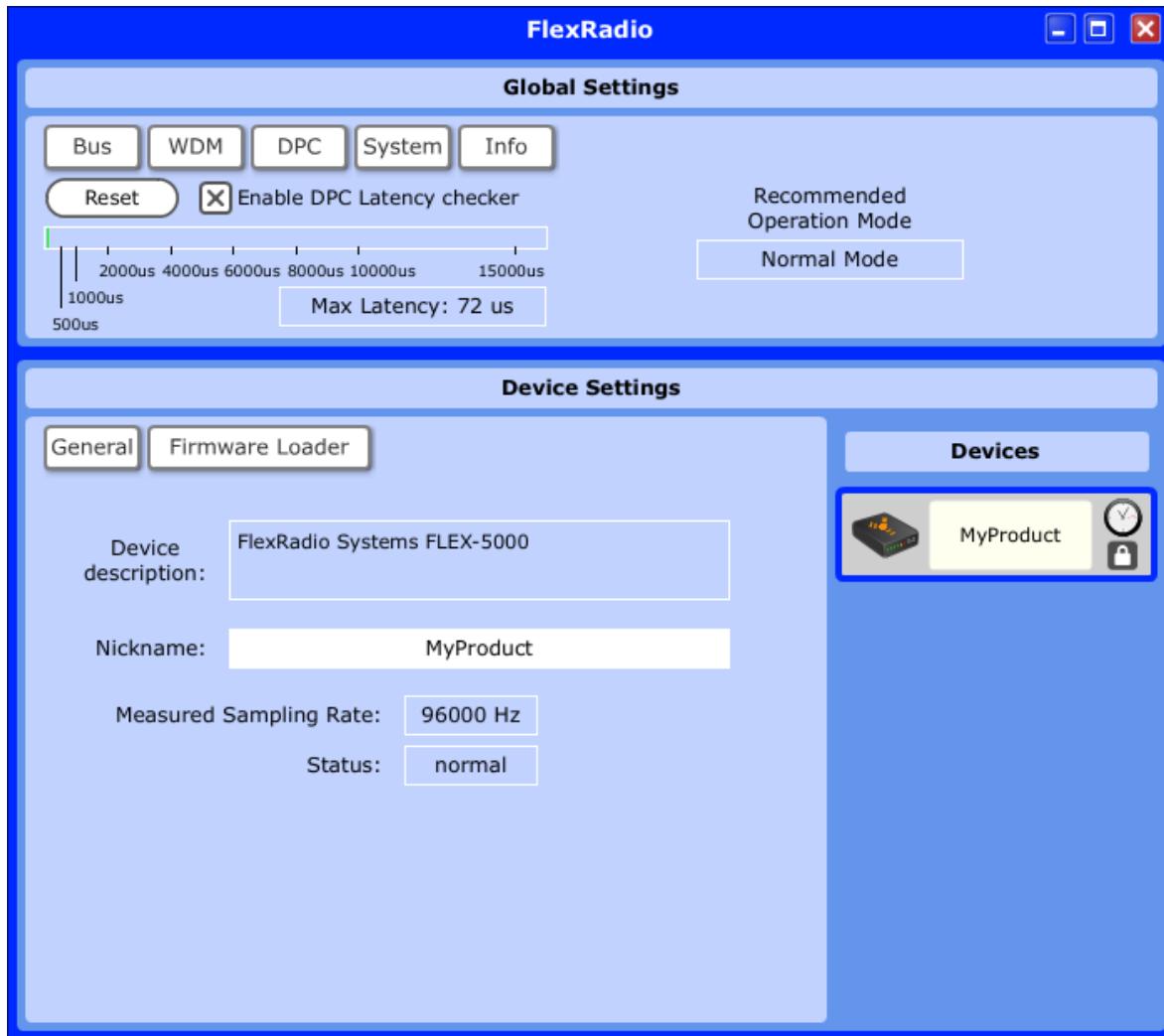
- ❑ **Master** displays the **Nickname** of your FlexRadio. The default **Nickname** is **MyProduct**, as shown in Figure 156 on page 179. (You can change this to any nickname you desire by clicking on the **Nickname** displayed in the lower **Device Settings** section).
- ❑ **Buffer Size** and **Sample Rate** display the Buffer Size and Sample Rate as set in PowerSDR in the Setup Form - Audio Tab, Primary Audio Sub-Tab (see page 136). The Control Panel settings are designed to follow the values as set in PowerSDR. Therefore, **do not** adjust the Driver Control Panel values.
- ❑ **Operation Mode**<sup>1</sup> defaults to **Safe Mode Level 1**, which has been proven to work well for most systems, but yours may work better at a different setting. If you are experiencing audio drop-outs, you can try changing your **Operation Mode** to a higher Safe Mode level. We have also had several reports of **Normal** working better than **Safe Mode Level 1**. See also the section **DPC Latency Checker** on page 181.

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<sup>1</sup> The Operation Mode controls how successfully the device driver recovers from buffer over and under runs. Some hardware drivers and third-party applications issue what are called Deferred Procedure Calls (DPCs). Higher Safe Modes allow the driver to handle longer DPC latencies at the cost of more (audio) latency.

## DPC Latency Checker



*Figure 157: FlexRadio Control Panel - DPC Latency Checker*

The FlexRadio Driver comes with a DPC (Deferred Procedure Calls) latency checker to check the maximum DPC latency incurred on your system. Click the **DPC** button (Figure 157) and then click **Enable DPC Latency** checker to enable it. For the result to be meaningful, you should run all applications you usually run while running PowerSDR (email, digital mode software, logger, etc.) and let it run for at least 5 minutes. The latency checker will display the maximum latency found during the test period and recommend an **Operation Mode** (see page 180) based on the result. While it may sometimes recommend **Normal Mode**, we recommend you keep your **Operation Mode** at **Safe Mode Level 1** unless you experience latency issues.

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**Note 1:** If your FLEX-5000 is performing as desired, there is no need to be concerned about DPC latency.

If on the other hand you are experiencing (audio) latency issues, then you should see the DPC Latency checker as a diagnostic tool to help you track down the cause of these anomalies.

**Note 2:** For further information go to the FlexRadio Knowledge Center on our website and read the article [How to Use the FlexRadio FireWire Driver DPC Latency Checker to Determine Operating Mode](#) (search for *firewire driver* in our Knowledge Center at <http://kc.flex-radio.com/search.aspx>).

## Device Settings

The lower Device Settings section has two buttons which act as tabs: **General** and **Firmware Loader**. (see Figure 156 on page 179).

### General

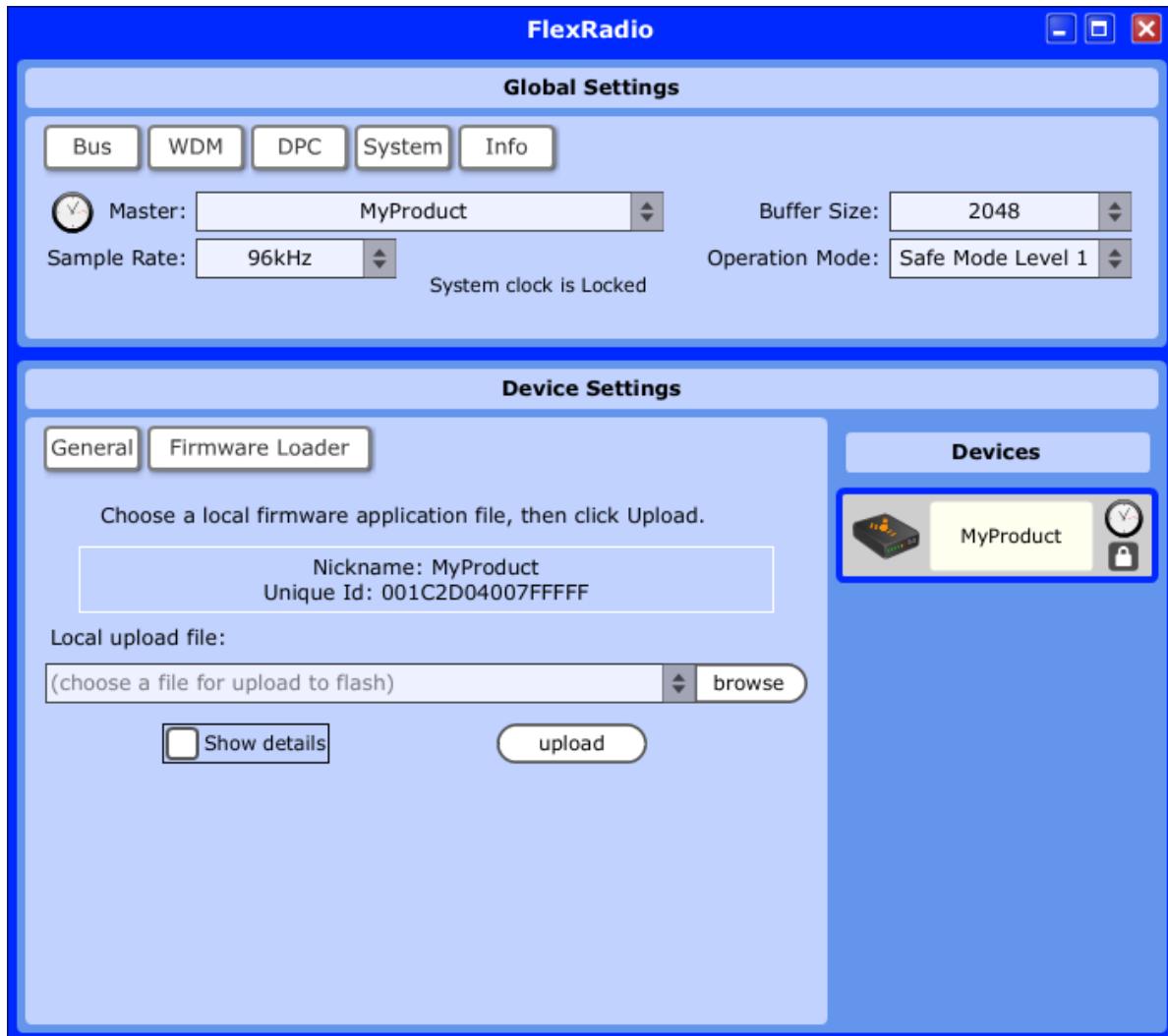
On opening, the Control Panel defaults to the **General** panel.

- ❑ **Device description** displays **FlexRadio Systems FLEX-5000** when the driver has been loaded successfully.
- ❑ **Nickname** displays the nickname given to the device. The default **Nickname** is **MyProduct**, but you can change this to any nickname you desire by clicking on the displayed nickname (**MyProduct**).
- ❑ **Measured Sample Rate** should equal the **Sample Rate** shown in the Bus Global Sections panel (see Figure 156).
- ❑ **Status** should read **normal**.

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## Firmware Loader

To upload new firmware to your FLEX-5000, first make sure PowerSDR is **not** running. Then click on **Firmware Loader** to display the Firmware Loader Panel (Figure 158).

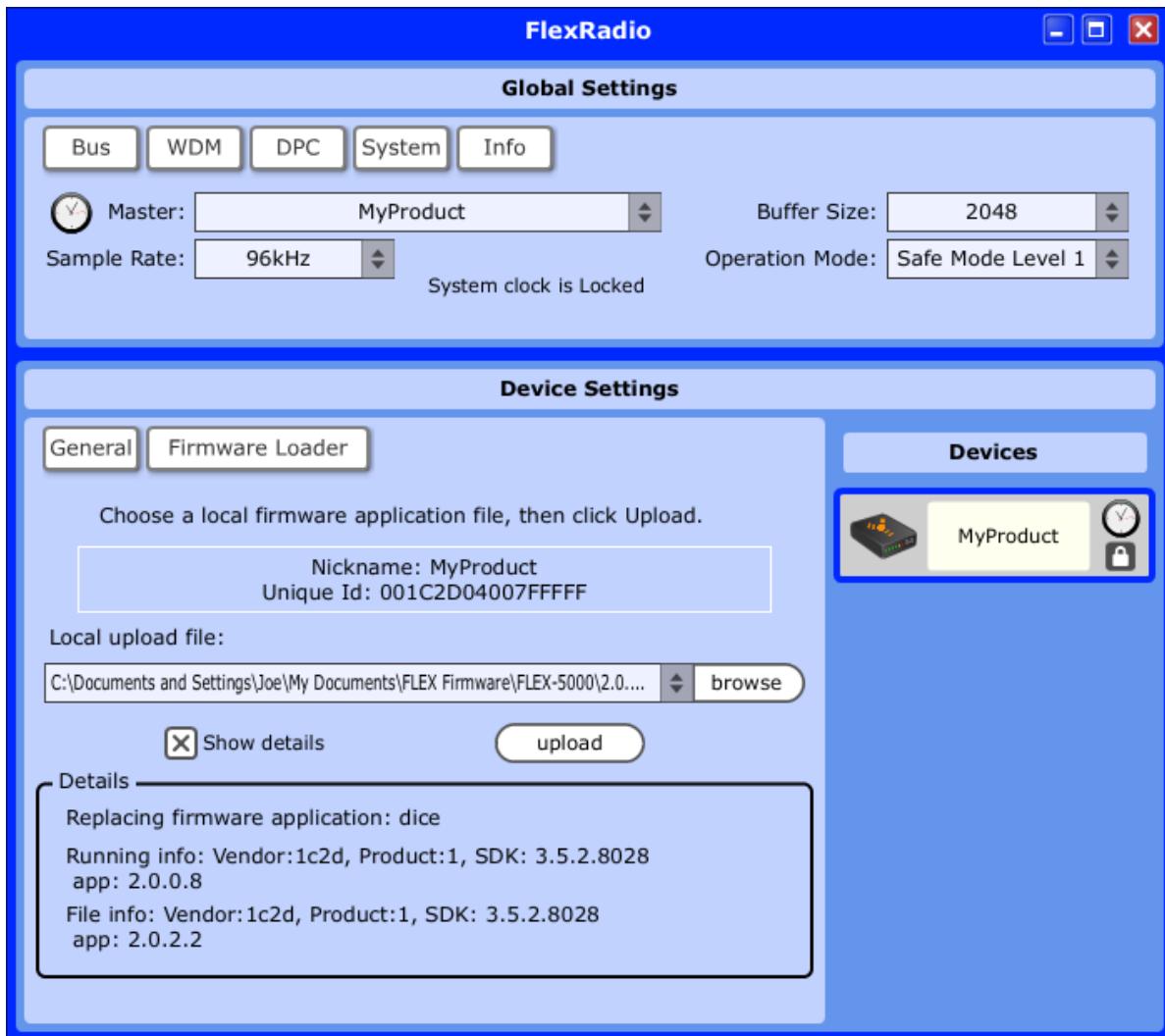


*Figure 158: FlexRadio Control Panel - Firmware Loader Initial View*

When you ran the FlexRadio Installer application, the FlexRadio InstallShield Wizard created in your (My)Documents directory a folder called FLEX Firmware. To upload new firmware you will need to browse to this folder.

- ❑ Click **browse**. This will default to your (My)Documents directory. Locate the FLEX Firmware folder, open it and click on the folder named FLEX-5000. You will see one or more folders, each with the version number of the firmware file it contains. Usually you will want to click on the folder and then the firmware file with the highest number.

- Click **Show details** to view the firmware details (Figure 159). The **Running Info** displays the firmware version you are currently running (**app: 2.0.0.8**), whereas the **File info** displays the version you are about to upload (**app: 2.0.2.2**).



*Figure 159: FlexRadio Control Panel - Firmware Details*

- Click **upload** to upload the selected firmware to your FLEX-5000. During the upload process you will see two Firmware progress bars. When the upload is complete you will hear a relay click.

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