

WiNRADiO

G3 Series Radio Receiver

User's Guide

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WiNRADiO Communications
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Printed in Australia

FCC Notice

The WiNRADiO G3 SERIES receiver has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and the receiver
- Connect the computer into a different outlet so that the two devices are on different branch circuits
- Consult an authorised dealer or an experienced radio/TV technician for help

Caution

To comply with the limits for the Class B digital device, pursuant to Part 15 of the FCC rules, the WiNRADiO card must be installed in computer equipment certified to comply with the Class B limits. Only peripherals certified to comply with the Class B limits may be attached to the computer containing the WiNRADiO receiver. All cables used to connect the computer and peripherals must be shielded and grounded. Operation with non-certified peripherals may result in interference to radio and TV reception.

Modifications

Any changes or modifications to the WiNRADiO receiver not expressly approved in this book could void the user's authority to operate this equipment.

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In certain countries or states it may be illegal to monitor certain frequencies. We cannot accept any responsibility for the consequences of your non-compliance with government regulations. If you are in doubt about the regulations in your country or state, please contact your nearest radio communications regulatory authority.

Introduction

One could easily conclude that, in the era of the Internet and communication satellites, short waves are destined for obsolescence. But the reality is quite different. On the contrary, shortwave communications seem to be experiencing a new period of revival and vigorous growth.

This revival is partially caused by the fact that shortwave is still the only technology able to send signals around the globe with minimum power and without the need for expensive, and potentially failure-prone or sabotage-prone infrastructure. In the era of increased security concerns, this is an important reason for the continuing interest in shortwave.

The other reasons include newly found applications, for example HF email, and emerging new types of digital modulations (such as DRM broadcasting), offering more reliable and higher quality communications than before.

All this will ensure that shortwave will remain what it always has been; an amazing place of action, a cacophony of sounds; a babel tower of exotic languages and music, alive with broadcasters both official and clandestine; a haven of spies; a playground of pirates, terrorists and freedom fighters alike; an exciting mix of the respectable, the serious, the crazy and the dangerous. Long before the Internet, the shortwave world was always borderless. And quite like the Internet, impossible to tame and control.

Welcome to shortwave. And welcome to the WiNRADiO G3 SERIES receiver. Your new receiver is a world-first in more than one respect. Most importantly, it is the first commercially available *Software Defined Receiver* (SDR), where the entire demodulator and the last intermediate frequency stage are performed by software running on a personal computer rather than using conventional hardware circuits, or a dedicated Digital Signal Processor. Your PC probably has more power than even the fastest DSP had only a few years ago. Your new WiNRADiO G3 SERIES receiver is now ready to take advantage of that power. Enjoy!

WiNRADiO provides regular upgrades to our application software. Don't forget to register as a WiNRADiO user to receive news about new products, accessories and software upgrades for your WiNRADiO G3 SERIES receiver. Use our on-line registration form on www.winradio.com/register to take advantage of this free service.

Installation

The WiNRADiO package contains the following items:

- WiNRADiO G3 SERIES receiver card
- WiNRADiO software on a CD ROM
- Start-up indoor antenna
- Audio cable
- This User's Guide
- Warranty information

In order for the WiNRADiO receiver to function, your IBM PC compatible computer must meet the minimum system requirements specified below.

System Requirements

	Minimum	Recommended
CPU	500 MHz, Pentium III	1GHz or higher, Pentium IV or Athlon
RAM	64 MB	256 MB or more
Display	SVGA	SVGA (16 mil. colors)
HD free space	20 MB	40 MB
Sound card	SoundBlaster compatible, 16 bit, full duplex	Creative Sound Blaster, 16 or 32 bit
OS	Windows 98/ME/NT/2000/XP	Windows 98/ME/NT/2000/XP

Hardware Installation

1. Turn the off computer and disconnect the power cord.
2. Remove the computer case. Choose an empty PCI slot, as far as possible from the power supply and from other cards.

3. First touch the computer metalwork with your hand to drain any static charge, then carefully insert the card into the vacant slot and push down until it is firmly seated. Screw the metal bracket at the end of the card to the computer case. (*This must be done to provide proper grounding for the card.*)
4. Replace the computer case and reconnect the power cord.
5. Connect the supplied audio lead between the receiver output (a standard audio jack) and the sound card Line Input. (*If there is no Line input on your PC, as is the case with some laptops, you may use alternative inputs, such as the Microphone input.*)
6. Connect the supplied start-up antenna to the SMA connector at the rear of the card.
7. Extend the antenna so that it is as far away from the computer as possible.

Please use only the WiNRADiO-supplied audio lead cable to connect the receiver to the sound card. This is a stereo cable (as is the case with all standard PC multimedia cables). Mono jacks are not compatible with stereo ones because they short the right channel to ground. A mono cable should not be used under any circumstances and will not work with the G3 SERIES receiver.

Software Installation

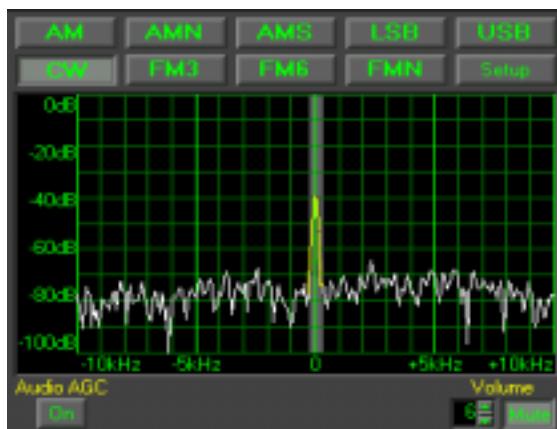
1. After installing the card, turn the PC on. Windows will find the card and automatically start the usual *New hardware found* driver installation routine. Insert the installation CD ROM into the drive, and follow on-screen instructions. (*Note: Windows NT will not automatically detect the card, as it does not support Plug and Play.*)
2. After installing the drivers, choose the **Run** command from the **Start** menu in Windows and type D:INSTALL (if the CD ROM is the D: drive on your PC).
3. This will run the application installer, which will guide you in the installation process.
4. After all the files have been installed to your hard disk, run the WiNRADiO G3 SERIES application.

Note: If the card is not detected by Windows, you can simply skip the driver installation procedure, insert the CD ROM, and run the installation program, which will also install the drivers.

After installing the hardware and software, you will now need to set-up the sound card parameters. This is done both in the WiNRADiO application and in the Windows sound card control panel – this provides the actual connection between the receiver *front-end* and the PC *back-end* of your radio system.

Setting up the Sound Card

In computer terminology a sound card is a *wave device*. A computer may have several such wave devices installed (for example a modem with voice capabilities). That's why you need to select the sound card as the desired wave device first. Start the WiNRADiO G3 SERIES application and click on the **Setup** button (located below the **USB** button) in the Demodulator panel:



The Demodulator set-up window opens, as shown:



The **Wave device** drop-down list shows all the installed wave devices: *Windows default* is the Control Panel setting specified under *Start | Settings | Control Panel | Multimedia Properties | Audio*. If a sound card is specified in this Control Panel setting for both playback and recording (this is very likely, but not always necessarily so), then you can simply select **Windows Default** as the **wave device** for the demodulator. Otherwise, the specific name of the sound card should be selected. The selected sound card **must support duplex operation** and the standard 44100 or 48000 samples/second sampling rates, 16 bits per sample, stereo. Most modern sound cards do satisfy all these conditions, but some cards may have a high level of distortion at 48000 samples per second; for such cases, the 44100 samples/second sampling rate is provided.

The next parameter to select is the mixer device associated with the already selected sound card, using the **Mixer device** drop-down list, and the **Mixer line** (the sound card input line). If the signal is arriving at the sound card via an external cable, the cable should be physically connected to the **Line Input** of the sound card. If the receiver is connected internally, most probably the input would be called **Aux** or **CD Line**.

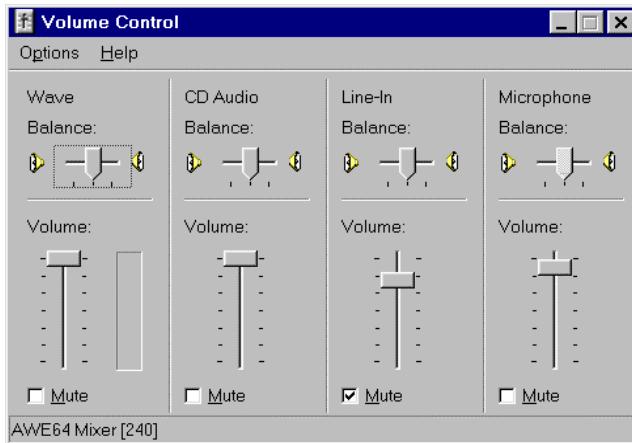
*With some laptops, only the **Microphone** input may be available; in such case you will need to connect the receiver to this input, and also select this input in the software.*

*In the drop-down list of sound card inputs, each line is available either as normal, or **Reversed**. If the reversed line is selected, this means that the Right and Left channels (of the sound card stereo input) are to be reversed. Normally, you should not need to select any of these reverse inputs. However, there is a very small number of sound cards where the Left and Right inputs are swapped. Normally, the G3 SERIES Demodulator expects the receiver output to be connected to the Right sound card input. If it is to*

be connected to the *Left input* instead, the *reverse input line* needs to be selected from the drop-down list.

These are all the settings required on the WiNRADiO G3 SERIES application side. Now you need to set up your Windows sound card control panel, and the marriage between the radio and the PC will be complete.

Click on the speaker icon in the task bar in the bottom, to bring up the sound card *Volume Control* panel (consult **Appendix B – Sound Card Controls** if you have difficulties locating and the sound card settings).



Sound Card Volume Control Panel

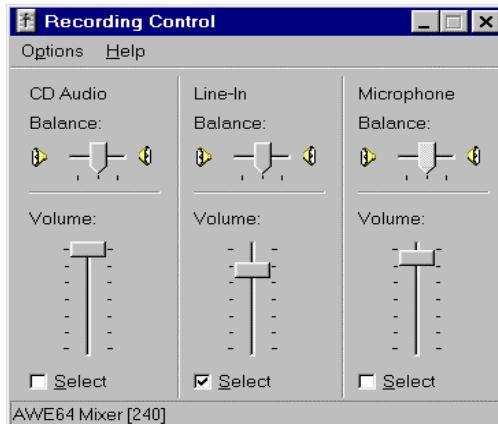
Mute the input line the receiver is actually connected to. (This is the same line as selected in the WiNRADiO G3 SERIES Demodulator Setup. Usually, this will be the *Line-In* input.)

Why are we muting the input line? This is because the signal coming from the receiver is not an audio signal, but rather the intermediate frequency signal. It needs to be processed (demodulated) by the PC first, before it is output back to the sound card. (That's why the sound card needs to be full duplex, to allow for such simultaneous input/output processing.)

Failure to mute this line will cause a high-pitched intermediate frequency sound to be combined with the demodulated signal.

If you are using the *Microphone input* instead of *Line input*, please check if there is an **Advanced** button under the *Microphone volume control* in the sound card control panel. If so, then click on it and uncheck the **+20dB gain** check box if it exists. (The extra large gain would result in overloading the sound card and cause distortion.)

The same line must be now selected in the *Recording Control* of the sound card control panel. To get to the Recording Control, you need to select *Options / Properties / Recording* in the top bar menu of the Volume Control panel.



Sound Card Recording Control

The position of Volume control slider should be set to approximately half, to get started. The same control is duplicated in the Demodulator Setup panel (where it is labeled *Input level*).

You can adjust this level either in the sound card recording window, or, preferably, return to the Demodulator Setup panel to take advantage of the *Clipping indicator*. The *input level* must be adjusted below the point of the input signal clipping, i.e. just before the Clipping indicator turns red.

While adjusting the input level, you will also see the floor of the signal spectrum shown in the main demodulator window rising proportionally.

Please pay attention to the **sound card set-up**, as most initial problems associated with using this type of receiver can be attributed to an incorrect sound card setting. Typical problems include:

- Not selecting the Recording input line correctly (which will manifest itself by the absence of any signal appearing in the spectrum scope);
- Failing to mute the Volume control line (which will result in listening to the high-pitched 12 kHz intermediate frequency sound superimposed on the demodulated signal);
- Failing to adjust the signal input level properly, which may result either in low (or no) audio output, or, on the other hand, distortion if the signal level is too high.

Getting Started

There is often a degree of understandable impatience when exciting new equipment such as a new WiNRADiO receiver is acquired. The following fast-forward introduction makes it possible for you to start using your new acquisition as quickly as possible. Detailed operation is described in the subsequent chapter *Using WiNRADiO G3 SERIES Receiver*. We hope you will return to that chapter, as the WiNRADiO G3 SERIES receiver has many fine features which it would be a shame to miss.

Start the WiNRADiO G3 SERIES receiver application (double clicking on the WiNRADiO icon). The WiNRADiO G3 SERIES receiver control panel will appear as shown in the next page.

Did you know?

The first shortwave transmission across the Atlantic was accomplished by six US radio-amateurs on December 11, 1921. The message was picked up by a Scottish radio-amateur. This achievement sparked a period of intensive research and development which led to wide-spread use of short waves. (Before then, it was believed that frequencies over 1.5 MHz were useless.)



WiNRADiO G3 SERIES Receiver Control Panel

The WiNRADiO G3 SERIES receiver control panel has some elements similar to from conventional shortwave receivers, and many additional features as well.

The quickest way to get started with this receiver is to check its operation on local AM stations.

Using the keyboard, type in the frequency of one your local AM stations: For example, for 774 kHz, type in **7 7 4**, then **k** for kHz, then press **Enter**. The typed-in frequency will appear on the digital frequency display. Then select the AM mode by clicking on the **AM** button. At this point, you should hear the station. You can adjust the volume using the two buttons next to the small Volume display. (Note also the little slider between these two buttons: you can drag it up and down to change the volume faster.)

Manual tuning can be done in several ways. Let's start with the tuning knob: Place the mouse cursor to the upper half of the tuning knob, at which point you will see the cursor change to a curved double ended arrow. Hold down the right or left mouse buttons to increase or decrease the frequency, and the knob will rotate clockwise or anti-clockwise, respectively. If you place your cursor in the bottom half of the tuning knob, the direction of the rotation will reverse.

The rotation increment of the tuning knob is 0.5 kHz. This can be changed easily using the Shift, Ctrl or Alt keys: If you press the Shift key while tuning, the increment will increase ten times (to 5 kHz). Pressing Ctrl will increase the increment a hundred times (50 kHz). On the other hand, if you use the Alt key, the increment becomes ten times finer: 50 Hz.

*If you are still unable to tune to any stations at this point, please refer to **Appendix A - Troubleshooting**.*

There are also several other ways to tune the WiNRADiO receiver other than typing the frequency or using the tuning knob. These will be explained in detail in the *Using WiNRADiO G3 SERIES Receiver* chapter.

Connecting the Antenna

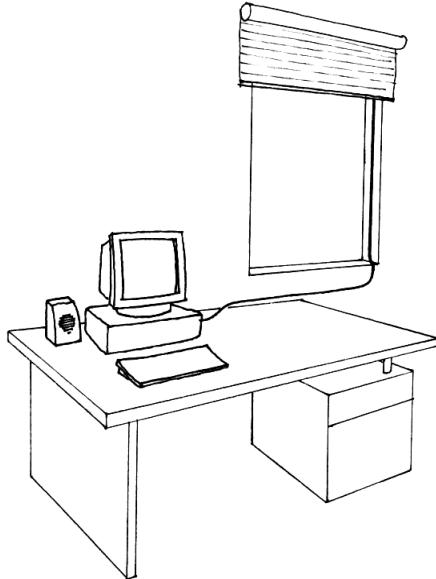
Your WiNRADiO G3 SERIES receiver comes with a start-up antenna consisting of a 3-meter length of coaxial lead-in cable, with an additional 3 meters of insulated wire. The thinner, insulated wire at the end is the actual antenna. The lead-in cable is necessary for the antenna to be as far away from the PC as possible, to reduce interference from the PC.

Please note that this start-up antenna is supplied for immediate gratification only and is not intended to replace a good shortwave antenna.

The best placement of the start-up antenna depends on your actual situation, and will often involve some experimentation. However, the basic rule is simple: Place the antenna as close to the window as you can, and keep the active part of the antenna as far away from the PC, and other electronic and electrical devices, and metal objects, as possible.

Did you know?

The first commercial shortwave station was Radio Luxembourg. It was the first station to target areas outside of its own country with programs in other languages. For most of the 20th century, this was the most powerful shortwave station in Europe.



An example of WiNRADiO start-up antenna placement

No matter how good a radio receiver is, the performance of the entire receiving system will depend on the quality of the antenna. The same applies to a WiNRADiO receiver. To make most of your WiNRADiO receiver, you should install a proper shortwave antenna. There are many vendors offering shortwave antennas. WiNRADiO may also be able to assist – check our Web page www.winradio.com.

Did you know?

During the cold war, the Soviet Union and other Communist countries used to jam shortwave transmissions such as the BBC, Voice of America, Radio Free Europe and Deutsche Welle to their own citizens. The Soviet Union alone was spending about \$1 billion per year on jamming, and had 200 jamming stations that were continuously pumping out 600 Megawatts of power.

Using WiNRADiO G3 SERIES

Tuning to a Frequency

To change frequency, simply type the new frequency into the keyboard. As soon as you press a number or decimal point, the frequency display will activate, waiting for a frequency to be typed. You can also click on the display to type in a new frequency. After typing the new frequency, press **Enter** and the receiver will instantly retune. To abort, press **Escape**.

To enter units, such as kHz or MHz, simply press **K** for kHz or **M** for MHz after entering the digits. Any invalid keystrokes are ignored. Frequencies outside the receiver limit (9 kHz to 30 MHz) will not be accepted and the display will revert to the previous frequency.



WiNRADiO G3 SERIES Receiver Frequency Display

The up/down buttons under the individual digits make it possible to quickly step up or down the frequency in the corresponding positions. (The little slider buttons between the up/down buttons can be used for faster adjustment.)

Under these buttons there is a *band description window*. This shows the band allocation of the currently tuned frequency. These band descriptions are based on those applicable to North America. However, these allocations are based on international treaties and therefore are generally applicable worldwide.

*Note that the default band allocation can be overridden with a call sign or a user-defined description of a frequency stored in memory. The default band description is also user modifiable: it resides in the file **bands.csv** in the WiNRADiO installation folder. This file can be edited using a spreadsheet application, such as Microsoft Excel.*

Fine Tuning

The Fine Tune knob makes it possible to finely adjust the frequency in 0.5 kHz steps.



WiNRADiO G3 SERIES Receiver Tuning Knob

To use the tuning knob, position the mouse cursor over the knob (the cursor will turn into a curved double ended arrow) and click on either the left or right mouse button. If the cursor is on the top half of the knob, the left button will decrease the frequency, and the right button will increase the frequency. If the cursor is in the lower half, the opposite will occur (and the cursor will invert its shape).

Using the keyboard only, the frequency can be similarly adjusted using the **up/down** cursor keys.

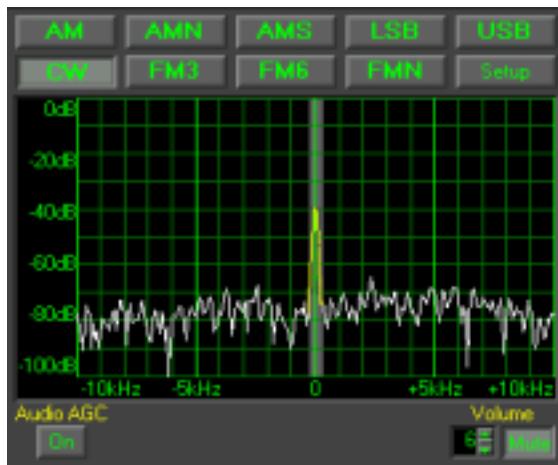
To speed up tuning, the step size can be increased ten or one hundred times by holding the **Shift** or **Ctrl** keys respectively, while clicking the tuning knob with mouse button or using the **up/down** keyboard keys. This is a very convenient feature if you wish to tune quickly across a frequency range: hold the mouse button and accelerate the movement by pressing the **Shift** or **Ctrl** keys. On the other hand, pressing the **Alt** key will reduce the tuning step ten times (to 50 Hz).

Did you know?

Most Space Shuttle astronauts are radio amateurs and the first elements of a permanent amateur radio station in space have already been despatched to the International Space Station.

Setting the Modulation Mode

To select the modulation mode, click on the appropriate Mode button in the Demodulator panel:



WiNRADiO G3 SERIES Standard Demodulator Panel

The real-time spectrum display shows the output of the receiver (i.e. the intermediate frequency signal) as it is applied to the PC sound card. When you press the mode buttons, you will note that the central highlighted region of the spectrum changes its width. This corresponds to the IF (intermediate frequency) filter bandwidth associated with the different modulation modes. For example, standard AM mode has 6 kHz bandwidth, while narrow AM (AMN) uses 4 kHz bandwidth. The CW mode uses a narrow bandwidth of 500 Hz. You will see the trace color change from white to yellow where the spectrum falls within the filter bandwidth. This indicates that you are only receiving the yellow part of the displayed spectrum and the surrounding frequencies are rejected.

If you mistune the receiver somewhat, you will see the spectrum shifting. This assists you to tune the receiver right to the center of the transmitter frequency, and to select the correct AM mode to avoid interference from adjacent signals.

If you also purchased the optional *Professional Demodulator*, you can select this demodulator from the **Demodulators** top bar menu. The basic functions such as volume control, audio muting and mode selection are identical to the Standard Demodulator.



WiNRADiO G3 SERIES Professional Demodulator

For details of the additional functions such as continuous IF bandwidth adjustment and other special features of the Professional Demodulator refer to **Appendix E - Professional Demodulator**.

Volume Control

The *Volume control* is also located in the *Demodulator panel*. The volume can range from 0 (no sound) to 31 (full volume). To enter a value directly, click on the display and type in the new volume level. The volume can be also increased or decreased by clicking on the up/down buttons next to the volume display.

Another convenient way of changing the volume is by using the small *slider* button between the up/down buttons. Place the mouse cursor on it and see the cursor shape change, to indicate a 'slider' type of control. Hold down the left mouse button to drag the slider up or down and the volume will change accordingly.



Finally, another convenient way of changing the volume is using the **left** and **right cursor** keys on the keyboard.

Mute Control

Next to the Volume control is the *Mute* button, which allows you to switch off audio output quickly. It is faster to use than setting the volume to zero, with the added benefit of not changing the set volume level. To use the mute control, simply click on this button. Click again to release.

AGC

The AGC (Automatic Gain Control) has four settings: *Off*, *Slow*, *Medium* and *Fast*. These make it possible to disable the AGC, or to select the speed with which the AGC reacts. Typically, the AGC would be in the *Medium* position.



AGC Control

The receiver must process a considerable variation of signals, ranging from very weak to very strong. This requires the sensitivity of the receiver to vary according to the incoming signal strength.

The incoming signal can vary in intensity, with changing propagation conditions, and also depending on the modulation type and content. For example, with CW signals (where information is transmitted by keying the transmitter on and off), the signal strength will vary substantially during the transmission. The demodulated signal will then sound better with a slow AGC (so that the receiver will not have time to increase the gain during the "off" intervals, and so increase the background noise and causing a raspy sound).

On the other hand, use fast AGC when listening to especially weak signals buried in static and noise. Otherwise, each new burst of noise would desensitize the receiver for a long time and you could miss long periods of useful transmissions.

If unsure, use the medium speed AGC setting.

IF Gain

The AGC can be turned off entirely, using the *AGC Off* button. The receiver gain must then be adjusted manually. This is done using the *IF Gain* setting. Note that by setting an excessive gain, the receiver will overload and the demodulated signal will be distorted. On the other hand, if the gain is too low, it will make the receiver appear “deaf”.

Manual IF Gain setting is useful for hunting for very weak signals buried in noise.



Manual IF Gain Control

The IF Gain control is only enabled when the AGC is switched off. The gain “value” ranges from 0 to 100, where 100 corresponds to maximum gain.

Audio AGC

The *Audio AGC* facility is available in the Demodulator panel, and provides a supplementary function to the main AGC. (The main AGC employs a hardware circuit, while the Audio AGC works in software.)



Audio AGC

Audio AGC is useful to compensate for audio volume changes when the antenna signals are so weak that the main AGC is not yet activated, or when the main AGC is disabled and the manual IF gain is used.

Attenuator

The *Attenuator* makes it possible to reduce the receiver sensitivity by 18 dB (i.e. 6 times).



Attenuator

Why would you ever need to reduce the sensitivity? This is because unusually strong signals from local stations may occasionally cause overloading. This overloading can make the reception worse, and even cause stations to appear on frequencies, where none exist (*ghost* stations). See **Appendix C - Dealing with Interference** for more information on this phenomenon.

If a received signal is too strong, causing overloading, distortion or the appearance of ghost stations, you should reduce its level by pressing the Attenuator button.

Squelch Control

The *Squelch control* can be used to mute the receiver when no signal is being received. Without a signal, all you will usually hear is noise. Squelch is provided to cut out the noise until a station is found, making the receiver more comfortable to use.



Squelch Control and Squelch Defeat Button

The squelch setting controls the signal level at which muting occurs. Muting will occur when the signal level drops below the squelch level. When a signal of a higher level returns, the sound will be restored immediately.

The squelch is always shown in *dBm* units. To adjust the squelch control, first tune to an unoccupied frequency that produces only noise. Increase the squelch until the receiver is muted. You will see the red-colored segment of the S-meter growing until it gets higher than the current S-meter value. At that moment the receiver will be muted. Add a few dB extra (to allow a margin for background noise fluctuation on the band). Now when you tune to an occupied frequency, if its signal strength is higher than the squelch level, the receiver will be unmuted.

Next to the squelch setting is the **Squelch Defeat (Def)** button. When activated, the squelch action will be turned off (it is the same as if the squelch was set to its lowest level, but more convenient). The red segment in the S-meter will turn blue to indicate this condition.

It is easy to forget that squelch is active. If the receiver doesn't seem to be operational (no sound from the speaker), check the squelch and mute settings first.

Frequency Stepping

The *Frequency Stepping* facility makes it possible to specify an arbitrary frequency step size. To change the step size, click on the associated display and enter the required value (from 1 Hz to 1 MHz). You can also use the up/down buttons on the right of the display, to select from commonly used step sizes. For convenience, you can also use the small slider between the two buttons.



Frequency Stepping Panel

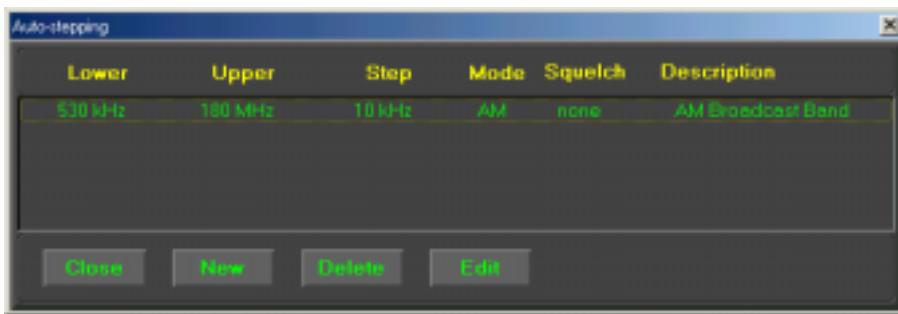
When the step size is selected, you can step up/down from the currently displayed frequency using the left/right arrow buttons under the Step size display. The double-arrow buttons further down will cause stepping by a step size ten times larger. Stepping can also be done using the keyboard **Pg Up/Down** keys.

For example, if you wish to browse the AM broadcast band (approx. 530 to 1620 kHz), set the step size to 10 kHz (for North and South America) or 9 kHz (for the rest of the world), which is the channel separation for AM broadcast stations. Tune manually to any station first, then step up or down to browse the band. To browse the shortwave broadcast stations (2.3 to 30 MHz), 5 kHz works well.

This type of fixed-size stepping is convenient if you wish to explore a frequency band where the channels are equally separated. However, you should ensure that the stepping frequencies fall on the actual channel frequencies in the band. If you know the channel separation but are unsure about the exact frequency of the first channel, tune to an active channel using manual tuning first, and only then step up or down in fixed steps.

The **Auto** button engages *Auto-stepping*, which provides a significant enhancement over fixed stepping. When properly configured, auto-stepping will automatically set the step size according to the frequency you are tuned to. Auto-stepping can be also used to associate particular mode and squelch settings with specified frequency ranges.

To configure the auto-stepping ranges, go to *Options / Autostepping* in the top bar menu. The following window opens:



You can use the **New** button to add a new range. For each range, you need to specify the start and end of the range, step size, and optionally mode, squelch and description. You can specify as many such bands as you like. When done, close the window.

Next time when you tune to a frequency, and the **Auto** button is pressed, the step size (and optionally mode and squelch) will be set to the predefined value if the new frequency falls within a specified auto-step range.

Frequency Memory

The WiNRADiO G3 SERIES receiver has the ability to store up to one thousand frequencies in one memory file. It also allows you to load and save different memory files for a huge amount of total storage, limited only by the size of your hard disk.



Memory Control Panel

Storing a Frequency into Memory

With each frequency, you can store several attributes: mode, callsign, user comment, group assignment, squelch and a hotkey.

To store a frequency into memory, the receiver must first be tuned to that frequency (and the appropriate mode must be selected if you also wish to store the mode). Next click on the **S** button in the Memory Control Panel as shown above.

A *Store frequency* dialog box will pop up, allowing you to assign a memory number to the current frequency.

Did you know?

The first shortwave message from the UK to Australia was received on March 6, 1924. On April 8, 1927, the regular Australia-Britain wireless service started operating, and the AWA company (Amalgamated Wireless Australasia Ltd.) built a shortwave receiving station at La Perouse, a suburb of Sydney (named after the French explorer La Perouse, who in 1788 was the first Frenchman to arrive in Australia).



Storing Frequency to Memory

At the top of the dialog box is the frequency you are storing. The next line shows the next available memory number. You can change this to another memory number if you wish (including one which is already allocated). The third item contains the group assignment buttons. You can assign the frequency to one or more of 16 different groups (whose meaning you define yourself). When you are searching or scanning for a particular type of frequencies (for example "Airforce"), the group assignment will allow you to confine the searching and scanning to that particular type.

Note that a frequency may be associated with more than one group at the same time.

There are also several additional items that can be optionally stored with each frequency:

- Most stations have a name or callsign. You can store up to 11 characters in the **Callsign** field.
- For quick tuning to your favorite stations, you can assign **Hotkeys** (function keys F2 to F12) to up to eleven different frequencies. If you then press a hotkey, the associated frequency will be instantly recalled. Hotkeys which are already assigned will be shown in this dialog box as 'used', however you can overwrite the previous assignment with a new one if you wish.
- User **Comments** can also be stored with a frequency. The size of the comments is limited to 31 characters.
- The **Mode** and the **Squelch** values can also be stored, which will be then set automatically when the frequency is recalled.
- Finally, a **Memory Scan Lock-out** can be set for each memory, which means that the memory will not be included in a memory scan. In the memory Recall window, such memories will be shown with a small 'x' preceding the memory number.

Finally, when everything has been set, click on **OK** or press **Enter**, to save the new frequency.

Recalling a Frequency from Memory

There are several ways to recall a frequency from memory:

- Using Memory Recall
- Typing a number into the memory number display
- Using a hotkey
- Memory stepping

To recall a frequency, click on the **R** button. A dialog box will pop up showing a list of all memory frequencies.

To select a frequency, click on an item in the list, and the frequency will be tuned. Then close the window. Alternatively, use the **up/down** cursor keys to choose the frequency and press **Enter**.

No.	Frequency	Mode	Groups	Callsign	Squelch	Comments
3	6.11 MHz	AM	--- ---	BBC	-	BBC World Service
4	6.14 MHz	AM	--- ---	CHN	-	China Radio International
5	6.245 MHz	AM	--- ---	DWA	-	Vatican Radio
6	6.383 MHz	AM	--- ---	MNG	-	Ulaanbaatar 2, Mongolia
7	7.105 MHz	AM	--- ---	GRC	-	Voice of America, Kavala
8	7.12 MHz	AM	--- ---		-	Radio France Internationale
9	7.185 MHz	AM	--- ---	BRM	-	Voice of Myanmar
11	7.202 MHz	AM	--- ---	SUI	-	Red Cross Broadcasting Geneva

Recall Frequency from Memory

The assigned memory groups are shown as color bars for a quick visual overview of which frequencies are associated with which groups (see the corresponding colors in the Store frequency window). When you position the mouse cursor over a highlighted memory, the actual group numbers will be displayed in a floating 'hint' box.

Editing Memory

To change the settings for a particular frequency, open the Recall frequency dialog box as described in the previous section. Select the item you want to edit and click on **Edit** (alternatively, double-click on the item). A dialog box will pop up showing the current settings. All the settings (except the memory number) can be edited. After the entry has been edited, click on **OK**.

Deleting a Frequency

To remove a frequency, open the *Recall frequency* dialog box. Select the frequency you wish to delete, and click on **Delete**. You will be asked to confirm that you want to delete this frequency from memory.

To delete all frequencies, select **Clear** from the **Memory file** sub-menu in the **File** menu. You will be asked to confirm that you want to clear all the frequencies in the memory.

Saving a Memory File

Each memory file, containing up to one thousand frequencies, is stored separately, allowing different memory files to be loaded and saved. To save the current memory file, simply select **Save** from the **Memory file** sub-menu in the **File** menu. If you wish to save it with a different name, select **Save as** instead, and a dialog box will pop up allowing you to specify the file name.

When you exit the WiNRADiO G3 SERIES application, all memory changes are automatically saved; there is no need to use the Save command before exit.

Opening a Memory File

When WiNRADiO starts up, the most recently used memory file will be opened automatically.

To open a different memory file, select **Open** from the **Memory file** sub-menu in the **File** menu. A dialog box will pop up allowing you to choose a memory file to load.

Memory Stepping

Memory stepping makes it possible to step through frequencies stored in the current memory file.

To step through memory frequencies use the left/right arrow buttons located under the memory **S** and **R** buttons. The double-arrow buttons located further down make it possible to advance ten frequencies up or down (or to the start/end of the memory list if it is less than ten frequencies away).

Memory stepping will only work if there are frequencies stored in memory. If no frequencies have been stored, nothing will happen if you try to step through the memory.

Scanning

The WiNRADiO G3 SERIES application contains a comprehensive set of scan functions to enable the user to search for stations which are currently on the air. There are three basic types of scanning: *Immediate Scanning* (Searching), *Range Scanning* and *Memory Scanning*. The scanning method is selected using the appropriate button in the *Scanning Control Panel*:



Scanning Control Panel

Immediate Scanning (Searching)

This is the simplest scanning method. Click on the **Search** button to select this scanning mode, then use the [>] or [<] buttons to scan either forward or backward from the currently tuned frequency. To stop scanning, press the **Stop** button (marked with a green square). To pause, press the **Pause** button (marked with two vertical bars).

A signal is considered 'found' when the signal level is higher than squelch. Correct setting of the squelch value is therefore essential for scanning.

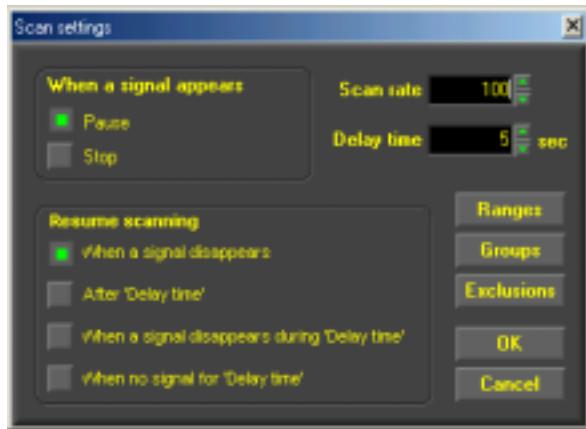
If you set the squelch level too low, then scanning will stop even if there is no signal (the background noise will be higher than the squelch level). On the other hand, if the squelch level is set too high, then a useful signal may be missed because it will fall short of the squelch level. With a bit of trial and error, you will need to adjust the optimum setting for the squelch level (usually a few dB above the background noise floor).

Scanner Configuration

When a signal strength level is higher than the squelch level, this indicates that a signal has been found. You can configure the software to specify what action you want to be taken at this point. To access this configuration facility, go to **Options | Scanning** in the top bar menu.

Did you know?

The survivors of the Titanic disaster owed their lives to shortwave. The SOS signals transmitted by the sinking ship's spark-gap transmitter were picked up by the Carpathia 58 miles away, proving that radio saves lives.



Scan Settings

There are two basic actions the software can do when a signal is found: **Pause** scanning or **Stop** scanning. If Pause is selected, then you need to further specify the conditions under which the scanning will **Resume**. The conditions to resume can be one of the following:

1. When the signal disappears (*i.e. the scanning resumes immediately when the signal disappears*);
2. After a certain user-defined **Delay time** (*i.e. no matter if the signal disappears during this Delay Time or not, the software will always wait for the Delay Time interval, then resume*);
3. When the signal disappears during **Delay time** (*i.e. the scanning will not resume if the signal returns within an interval shorter than, or equal to, Delay Time*);
4. When there is no signal during the **Delay time** (*i.e. the scanning will resume if there is a no-signal gap equal to, or longer than, Delay time*).

The **Delay time** interval can be set from 1 to 100 seconds.

The **Scan rate** controls the speed at which scanning occurs, and specifies the maximum number of scanning steps per second.

Note that the upper scanning speed limit may be restricted by the actually available CPU resources of your computer.

When signal is found and scanning pauses, waiting for the pre-set *Delay time* to expire, the countdown timer will appear inside the [<><] or [>>] buttons. If no *Delay time* was set and scanning is pausing until the signal disappears, then the [<><] or [>>] button will flash.

Groups

The **Groups** setting is useful for Memory Scanning, which will be described later: it serves to restrict Memory Scanning to particular memory groups only.

Exclusions

Sometimes it is desirable to exclude certain frequencies from scanning. This means that such specified frequencies should be ignored even if the signal level on these frequencies is higher than the squelch.

The WiNRADiO G3 SERIES receiver application makes it possible for multiple frequency ranges to be excluded. This is done using the **Exclusions** button. When you press this button, you will open an **Exclusions editor** window, allowing you to enter a range of frequencies to be excluded.

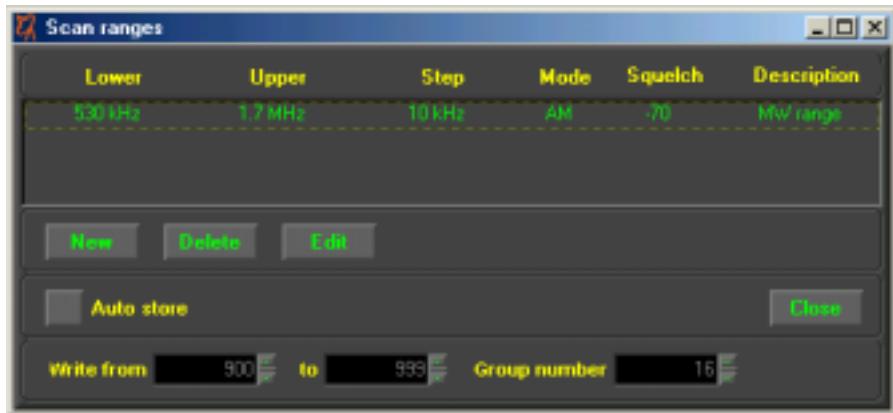
For these exclusions to become active, check the **Enable excluding while scanning** checkbox in this window.

Frequency Range Scanning

To be able to use Frequency Range Scanning, you need to set up the desired scanning ranges first. This is done using the **Ranges** button in the **Options | Scanning** top-bar menu.

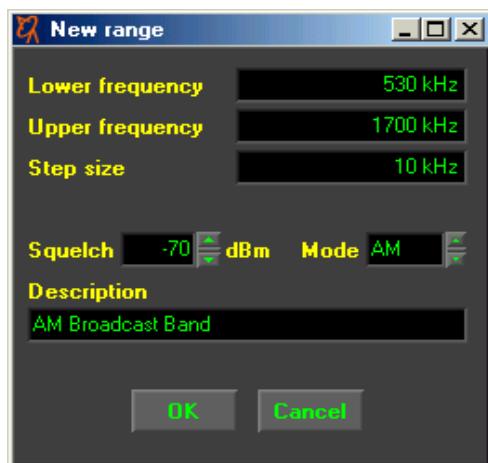
Did you know?

*Unlike medium wave or FM broadcast stations, shortwave stations change their frequencies and program schedules very often. One of the best publications providing regular frequency updates and transmitting schedules is the **Monitoring Times** magazine (www.monitoringtimes.com).*



Setting up Scan Ranges

Enter a new range using the **New** button. This will open a dialog box, where you will be asked to specify lower and upper limit frequencies of the range, the modulation mode, squelch level, and, optionally, a description. You can enter as many such ranges as you like:



Adding a New Range

When the range definition is done, close this window, then close the scanner settings. Then activate the **Range** button in the **Scanning** control panel:



Scanning Control Panel

When you press the **Scan Forward** button [**>>**], the scanner will commence scanning from the start frequency of the first range. When the last frequency of the first range is reached, it will then continue onto the next range, etc. When it reaches the end of the last range, it will go back to the start of the first range and continue looping infinitely until a signal is found, or until manually stopped or paused. If you use the **Scan Backward** [**<<**] button, the process will be exactly reversed (i.e. starting from the top frequency of the last range and working its way downwards).

You can stop or pause this activity using the **Stop** or **Pause** buttons. If you use the **Pause** button, then restarting scanning using Scan Forward or Scan Backward buttons will resume the action from the paused frequency. If you stop scanning with the **Stop** button, then using the Scan Forward or Scan Backward buttons will recommence scanning from the initial (or the last) frequency again.

If no ranges are specified in the Ranges list, then activating scanning in the Range mode will result in no action.

An additional useful feature of frequency range scanning is that all found frequencies can be automatically stored in memory, even if the receiver is left unattended. To do this, enable the **Auto Store** checkbox in the Scan ranges set-up window, and specify the memory range to which the frequencies should be written. You can also specify a special Group Number to be assigned to such frequencies.

When using the Auto Store option, you should also set the appropriate conditions for scanning when the signal is found (for example, Pause when signal found, and Resume after the minimum delay time will provide the fastest scanning and writing into memory).

Note that if more signals are found than there are allocated memories, the excess frequencies will not be stored.

Memory Scanning

The last scanning method is *Memory Scanning*. Here the receiver will step through memory frequencies, starting from the first one to the last one, and repeating the loop until a signal is found or until manually stopped.

If a squelch value is stored with a memory this value will be used to compare with the current signal level. If there is no value stored, the current squelch value will be assumed.

It is possible to restrict scanned frequencies to particular memory groups only. These groups can be selected from the **Options | Scanning | Groups** window, accessible from the top bar menu. Groups can be enabled/disabled using the check box **Enable group restriction** in the same window.

S-meter

The WiNRADiO G3 SERIES receiver *Signal Strength Meter (S-meter)* makes it possible to measure signal strength in either *S-units*, *dBm* or μ *V* (*microvolts*). The units are selected by correspondingly marked buttons on the right side of the display. In the microvolt mode, the **p-p** button is also enabled, making it possible to select *peak-to-peak* values rather than the default *RMS (Root Mean Square)* values.



S-meter

The S-meter also shows the currently selected value of the squelch (the red section at the bottom side of the scale). When the signal strength falls under

the squelch level (i.e. the needle falls in the red region and turns red also), the receiver audio will be muted.

The squelch value is always indicated in dBm units (even if the signal strength is displayed in S-units or microvolts).

Note that when the AGC is off (and manual IF gain control is activated), the S-meter is disabled. This is because the S-meter relies on the AGC for its proper function.

Tuning Pad

A unique fast-tuning facility is located under the Attenuator, IF Gain and Squelch settings.



Tuning Pad

If you place the mouse cursor inside the long horizontal window of the *Tuning Pad*, you will see a frequency increment displayed, which can vary from 1 Hz to 1 MHz in convenient steps. The value of this increment can be changed quickly by moving the cursor mouse horizontally within the Tuning Pad. The current increment value is always shown under the pad. You can quickly change between incrementing and decrementing by alternating the left and right mouse buttons. The sign of the displayed increment value will also change accordingly.

By combining horizontal movement of the mouse with alternating the left/right mouse buttons, you can quickly tune to any frequency, and step through the band with the appropriate step size.

The row of yellow squares under the Tuning Pad serves a similar purpose, providing convenient increment sizes in a narrower band between 1 Hz and 10 kHz. These increments are selected by placing the mouse cursor over the yellow squares, and using the left or right mouse buttons for incrementing or decrementing.

Power Switch

The Power switch, located at the bottom-right corner of the application window, controls the receiver power. When it is off, the receiver circuitry will be powered down and no sound will be heard in the speaker or headphones.

When you exit and restart WiNRADiO application, the power on/off status at exit will be remembered.

Date and Time Displays

The clock displays, located under the Tuning Bar, indicate the current time and date.



The *UTC* clock shows *Universal Coordinated Time*, formerly called *GMT* (Greenwich Mean Time), which is the standard time used around the world. This is provided because most shortwave stations announce their broadcast times in UTC. Both displays derive their information from the PC clock. The time difference is determined by Windows **Time Zone** setting (*Start | Settings | Control Panel | Date/Time Properties | Time Zone tab*).

Spectrum Scope

Click on the yellow triangle button on the left of the On/Off switch and the *Spectrum Scope* display will slide out at the bottom:



Unlike the spectrum display window inside the Demodulator panel, which is real-time and narrow band, the Spectrum Scope is wide-band and the graph is created by fast tuning the receiver across the specified frequency range.

To set up spectrum sweeping, enter the Start and End frequencies, to specify the start and end of the sweeping range, respectively. Next specify the frequency step.



Spectrum Scope

The sweeping is controlled using a set of buttons similar to a tape recorder: The **Start** button (with a triangle) starts sweeping. The **Stop** button (with a square), stops sweeping, while the **Pause** button pauses it. The button with a red round arrow selects continuous sweeping, which means that the sweep will continue from the start frequency when the end frequency is reached, and continue in this loop until manually stopped.

The **Min**, **Max** and **Diff** buttons enable the display of minimum, maximum and differential values when continuous sweeping is selected. (A scale for the differential trace will be displayed on the right-hand side whenever the **Diff** button is pressed.) *The differential trace is very useful when examining long-term activity on a given band. The receiver can be left unattended in the continuous sweeping mode, and any activity on the band will be clearly visible on the differential trace.*

There are also two **Zoom in/out** buttons performing their self-explanatory functions, and a **Clear** button, which clears the graph and the min/max values.

Clicking anywhere on the spectrum graph tunes the receiver to the corresponding frequency. You can also drag the mouse horizontally across the spectrum and continuously tune the receiver.

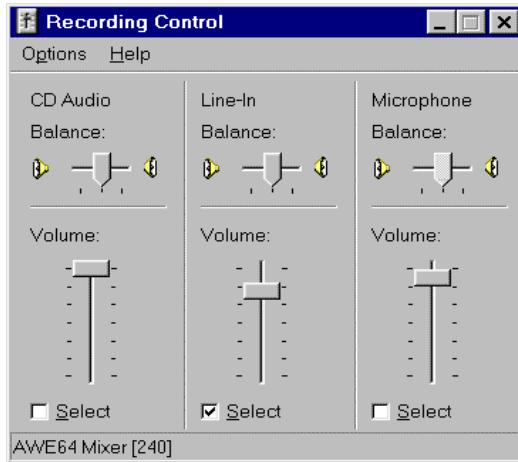
To hide the Spectrum Scope, use the yellow triangle button next to the power switch again.

Appendix A - Troubleshooting

Problem: The WiNRADiO application installed OK, but there is no sound coming from the speaker.

Solution: Check if you see any noise appearing in the spectrum scope in the Demodulator panel (under the AM, AMS, etc., mode selection buttons). If there is a flat line or only very little noise visible, check the following:

- The receiver output is connected to the sound card *Line input* using the supplied cable. (If your PC sound card does not have a Line input, you can use alternative inputs such as *Aux* or *Microphone*, but the software settings need to be changed accordingly.)
- The sound card has been set up correctly. Especially make sure that the *Recording* Line input has been enabled (you will find this panel under *Options / Recording* in your sound card volume control panel – click on the speaker icon in the bottom bar to get to the volume control panel first):



Note: If you have difficulties accessing the sound card control panels (for example if there is no speaker icon), refer to Appendix B – Sound Card Controls.

- The receiver demodulator has not been set up properly. Make sure that the sound card type and the audio input are properly selected (this panel is accessible under the *Setup* button in the Demodulator panel):



- The sound card has the Left and Right inputs reversed. Normally, the G3 SERIES Demodulator expects the receiver to be connected to the Right input. Using the **reverse** input makes the Demodulator use the Left input instead. (*This is a very rare problem, so use this only when all other possible remedies have been explored.*)

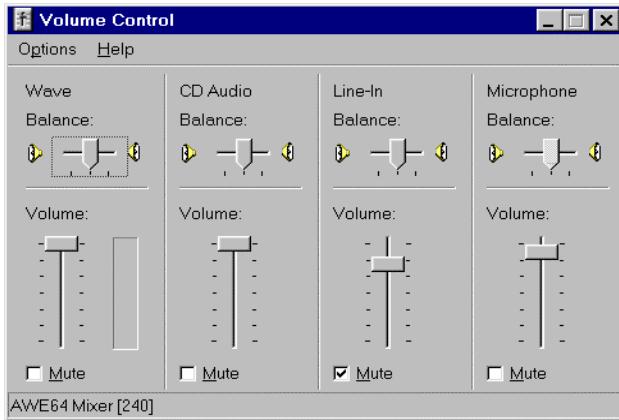


Problem: I can tune the receiver and see the signal peaks in the spectrum scope, but I can't hear any sound at all.

Solution: Check that your speaker or headphone is connected to the speaker output of the sound card. Set the volume to medium (say 15), the squelch to the lowest value (-130 dBm) or defeat the squelch by clicking on the **Def** button. Make sure the **Mute** button in the Demodulator panel is released, too, and the speaker output of the sound card is unmuted in the sound card control panel.

Problem: I can hear the audio, but it is not a pleasant sound. There is an interfering high pitch tone.

Solution: You need to mute the Line input in the sound card control panel - see the panel on the next page. (*What you are probably listening to is the intermediate frequency signal mixed with the demodulated audio signal.*)



Sound Card Volume Control Panel

Problem: I can hear the audio and tune the receiver, but the sound is distorted.

Solution: Check if the AGC is switched on (i.e. either the Slow, Med or Fast buttons are down – typically the Med setting is used). Check the *Input gain* in the Demodulator Setup panel: it should be set just below the clipping level. If both settings are correct, try to reduce the sampling rate from 48000 samples/second to 44100 (also in the Demodulator Setup). (*Some sound cards do not provide good quality sampling at 48000 sampling rate.*)

Problem: I can hear the audio and tune the receiver, but the volume is too low, even if I adjust the Volume control to maximum.

Solution: Check the *Input gain* in the Demodulator Setup panel: it should be set as high as possible, just below the clipping level. Also, engage the *Audio AGC* in the Demodulator front panel.

Problem: I can hear the audio and tune the receiver, but the audio drops-out occasionally, and the display is very sluggish, sometimes it even freezes.

Solution: Close all other simultaneously running programs to reduce the burden on the CPU. If the CPU usage shows consistently more than 80%, this may indicate insufficient CPU resources for the G3 SERIES application. (*Check the CPU usage under the Settings button in the Demodulator window. The CPU resource meter is at bottom left.*)

Problem: I can hear the audio and tune the receiver, but the audio is very noisy. The background noise level displayed on the spectrum scope appears very high.

Solution: Make sure the *Attenuator* is switched off. Check that your antenna is properly connected, the connector is not loose and that the antenna cable is not damaged. Does the noise floor drop significantly if you disconnect the antenna? If so, then the antenna is picking up too much ambient noise. Try to improve the antenna, or move it further away from the PC. (*Additional noise-defeating measures may be in order; see also Appendix C – Dealing With Interference.*)

Problem: Reception is obscured with a buzzing interference.

Solution: Check for the sources of interference in your surroundings: it could be fluorescent lights, a lamp dimmer, or some other household appliance. Your PC (especially the monitor) could be also the culprit. Unless you can suppress the interference at the source (which is not always possible), the only solution is to install a better antenna, preferably an outdoor one. Computer networks are especially noisy and if your PC is connected to one, you will almost certainly need an outdoor antenna. If the interference level varies periodically with peaks about 40-50 kHz, apart, the most likely culprit is the monitor or the video card. Switch the monitor off - if the interference disappears then the cause is the monitor. Modern LCD monitors generate much lower levels of interference than CRT ones. (See also **Appendix C – Dealing With Interference**.)

Did you know?

*The WiNRADiO G3 SERIES software is **XRS** (Extensible Radio Specification) compatible, making it possible to add additional software functions to your receiver. There are many **XRS Plug-ins** to choose from. You can download them from <http://xrs.winradio.com>.*

Appendix B – Sound Card Controls

Sound card control panels and their settings can be somewhat confusing. They are also rather inconsistent from one version of Windows to another.

WiNRADiO G3 SERIES receivers require a full duplex sound card, meaning that the card must be able to simultaneously process signals in two directions (i.e. record and playback) at the same time. The majority of modern Sound Blaster compatible cards are indeed like that. However, some older cards may not be full duplex.

The Recording section of a sound card is used to input and digitize the *IF* (*Intermediate Frequency*) signal arriving from the receiver (only the Right channel is used, of the Left and Right stereo channels). The Playback section is then used to output the demodulated audio signal to the speaker(s).

For the WiNRADiO G3 SERIES application, there is a need to independently control both sound card sections: The Recording section volume needs to be adjusted to provide the correct IF signal level for the demodulation process; the Playback section control is needed to be able to control the speaker volume.

Typically, you would access the Playback volume control panel by clicking a speaker icon in the Windows task bar. From this panel, you can get to the Recording control panel by selecting *Options* | *Properties* | *Recording* in the top bar menu.

However, the speaker icon may be missing. An alternative way of accessing the Recording/Playback controls is via the Windows Control Panel. Here you can also enable/disable the speaker icon.

The table on the following page shows how to enable/disable the speaker icon, and how to get to the recording/playback controls from within the Windows control panel. The methods vary depending on the version of Windows you are using.

Windows	Enable "speaker" icon	Recording/playback volume controls
NT	<i>Control Panel Multimedia Audio-tab</i> Checkbox: "Show volume control on the taskbar"	Make sure speaker icon is displayed, then double-click on speaker icon in task bar to display the Volume Control dialog. Sound Playback: Select Options Properties Playback Sound Recording: Select Options Properties Recording
98	<i>Control Panel Multimedia Audio-tab</i> Checkbox: "Show volume control on the taskbar"	<i>Control Panel Multimedia Audio-tab</i>  Sound Playback: Click on  button  Sound Recording: Click on  button
ME	<i>Control Panel Sounds and Multimedia Sounds-tab</i> Checkbox: "Show volume control on the taskbar"	<i>Control Panel Sounds and Multimedia Audio-tab</i> Sound Playback → <u>Volume</u> button Sound Recording → <u>Volume</u> button
2000	<i>Control Panel Sounds and Multimedia Sounds-tab</i> Checkbox: "Show volume control on the taskbar"	<i>Control Panel Sounds and Multimedia Audio-tab</i> Sound Playback → <u>Volume</u> button Sound Recording → <u>Volume</u> button
XP	<i>Control Panel Sounds and Multimedia Sounds-tab</i> Checkbox: "Place volume icon in the taskbar"	<i>Control Panel Sounds and Multimedia Audio-tab</i> Sound Playback → <u>Volume</u> button Sound Recording → <u>Volume</u> button

Appendix C - Dealing with Interference

Electromagnetic Interference (EMI) is what prevents us from receiving a clear signal, even when the receiver should be sensitive enough to receive it. There are many types of interference you can experience with radio receivers, emanating from both natural and man-made sources.

Natural interference is produced by atmospheric phenomena such as storms and sun activity.

Not so surprisingly, man-made interference is often worse. Sources include electric motors, power lines, passing cars, welders, fluorescent lights, fax machines, computer networks, etc. Receiving antennas should always be as far away from sources of electromagnetic interference as possible.

One significant source of man-made electromagnetic interference is the personal computer, and the video monitor in particular. Since the WiNRADIO G3 SERIES receiver requires a personal computer to operate, this creates a potential paradox. The WiNRADIO receiver itself is designed to be substantially immune to PC interference. However, any receiver needs to be connected to an antenna, and antennas can't discriminate between useful signals and interference. The interference from your PC can either radiate directly to the antenna, or it can be conducted to it along the outer conductor of the lead-in cable. Even in professional radio receiving stations, a lot of care and effort is always needed, if this type of self-interference is to be avoided.

Some computers are worse than others in terms of generated electromagnetic interference. The worst culprits are usually video monitors, which radiate radio frequencies at multiples of horizontal deflection frequencies. These frequencies range from about 30 to 100 kHz, and you can sometimes hear their harmonics right across the entire shortwave band. If you find strong signals sounding somewhat like a tractor engine, spaced between approximately 30 and 100 kHz apart (on modern hi-resolution monitors, the typical frequency is around 94 kHz), your monitor is most likely the cause.

To check this, tune to one of the interfering signals, then switch off the monitor and see if the signal disappears. You could continue using the WiNRADIO receiver, and live with the fact that some useful frequencies will be obscured by your monitor's interference, or you can replace your monitor with a 'quieter' one (modern LCD displays are far quieter than old CRT

monitors), or you can try to relocate your antenna further away from your computer.

A good remedy to try is to wind five to ten turns of the antenna lead-in cable through a large ferrite core (the doughnut shaped *toroid* type), near the PC end of the cable. This suppresses *common-mode interference*, which is a typical but curable problem with PC-controlled receivers.

Another type of interference which you may encounter is *intermodulation interference*. This is usually caused by strong local stations, whose frequencies combine to create 'ghost' signals on frequencies which are arithmetic combinations of the stations' frequencies. These 'ghost' signals can sometimes coincide with useful frequencies, rendering them partially or completely unusable. They will usually disappear when you switch on the *Attenuator* in the receiver control panel. You may also try shortening the antenna.

If you live very close to a strong local transmitter, these measures may be insufficient. In such case, you should be able to eliminate intermodulation by fitting a special filter to your antenna, to reduce the level of the signals causing the interference. The design and application of such filters falls beyond the scope of this book, since the large majority of WiNRADiO users should not experience this problem (after all, not too many of us live next door to a radio station). However, broadcast frequency filters and tunable *preselectors* are standard items and can be obtained from good radio equipment suppliers.

Did you know?

The first shortwave transmission from space took place on October 4, 1957, when the first Russian satellite, the Sputnik, was launched. The Sputnik transmitted amplitude modulated signals on 20,008 kHz. The characteristic beeping of Sputnik's telemetry was listened to by millions, ushered in a new era of political, military, technological, and scientific developments, and marked the start of the US-USSR space race.

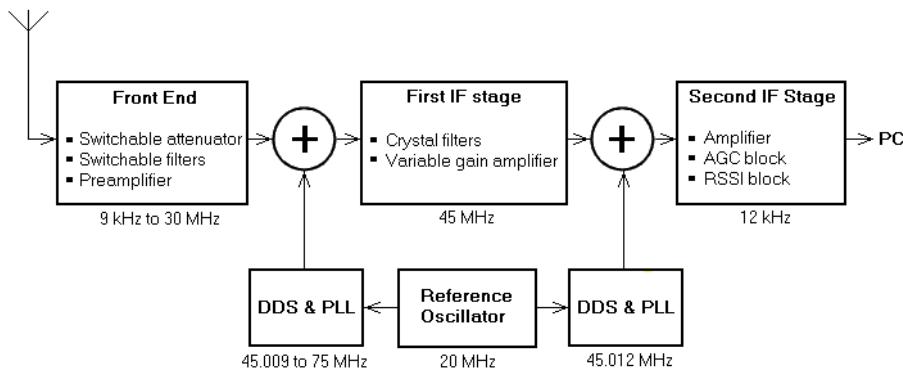
Appendix D - Inside WR-G3 SERIES

Technically minded users may like to explore the WiNRADiO G3 SERIES Receiver and experiment with some of the innovative concepts of *Software Defined Radio*.

The WiNRADiO G3 SERIES Receiver is the world's first commercially available *Software Defined Radio*, where the Demodulator function is fully performed in software running on a standard PC. It is also the world's first shortwave radio on a PCI card. The potential for experimentation is therefore substantial. This receiver and its software have been indeed designed to promote and encourage such experimentation.

The WiNRADiO G3 SERIES receiver represents only a half of the entire radio. The other half is your PC.

The receiver hardware contains the following functional blocks:



The incoming signal from the antenna (in the 9 kHz to 30 MHz range) is filtered and amplified, then fed into a mixer. Here it is mixed with the first LO (local oscillator), which is performed by a DDS (Direct Digital Synthesizer), with a PLL (Phase Locked Loop). The resulting 45 MHz intermediate frequency is filtered using a 4-pole 45 MHz crystal filter with an IF bandwidth of 15 kHz, and then amplified.

The second mixer again uses a DDS with a PLL to mix the 45 MHz signal down to the last intermediate frequency, which is 12 kHz.

Both DDS circuits derive their reference frequency from a 20 MHz reference oscillator.

The 12 kHz IF output is then fed to the Right channel of the Line Input of the PC sound card. You can hear what it sounds like if you use the sound card mixer panel to listen directly to this input (rather than using the G3 SERIES Demodulator software).

The AGC is performed in the first IF stage, based on the level of the last IF output (at 12 kHz IF). As the IF bandwidth of the first IF stage is 15 kHz, the AGC action is delayed until the dynamic range of the first IF stage is fully utilized – this is in order not to cause desensitization of the receiver in the presence of neighboring strong signals, falling within the 15 kHz IF bandwidth. The resulting variation in audio output is then compensated for in software, using *Audio AGC* in the software demodulator.

The final IF bandwidth is then adjusted entirely in software. If the *Professional Demodulator* is used, this bandwidth is continuously variable from 1 Hz to 15 kHz.

Did you know?

The largest shortwave transmitters nowadays operate with 250,000 – 500,000 Watts of power. Using the CW mode, and in suitable atmospheric conditions, radio amateurs make regular contact around the world with only a very tiny fraction of this power: reports exist of round-the-world communications achieved with less than five Watts of power.

Appendix E – Professional Demodulator

The WiNRADiO G3 SERIES receiver has provision for additional demodulators, in place of the supplied standard one. Installed demodulators can be selected via the **Demodulators** top bar menu. Check the WiNRADiO Web site www.winradio.com periodically, for demodulators available.

The *Professional Demodulator* which is available as an optional extra, takes the concept of software-defined shortwave receiver a step further. The main differences between the Standard and the Professional demodulator are as follows:

- Additional demodulation modes (DSB and ISB)
- Continuously variable IF bandwidth (from 1Hz to 15 kHz)
- User-adjustable IF filter coefficients and other parameters
- User-adjustable audio AGC
- User-definable IF bandwidth presets
- Interactive demodulator structure with two spectrum scopes and a vector voltmeter
- Additional instrumentation (SINAD and THD meter)
- AF Squelch for FM mode



WiNRADiO G3 SERIES Professional Demodulator

The front panel of the Professional Demodulator looks similar to the Standard one. Note in particular the added DSB and ISB modes, the continuous IF filter bandwidth control, enhanced Audio AGC (the time constants are user definable in the Setup window), and a row of IF bandwidth preset buttons at the bottom. The numbers on top of the IF bandwidth preset buttons indicate the associated bandwidth (in kHz). These presets, too, are entirely user-definable.

To change the IF bandwidth, you can type the desired value (in Hz) directly in the IF bandwidth editbox, or use the associated up/down buttons.

Do not overlook the small but very significant slider button between the bandwidth up/down buttons: It allows you to change the IF bandwidth within a large range, by moving the slider cursor up and down, with a very impressive effect.

In the spectrum scope, the selected IF bandwidth is shown using a different background color around the center frequency. The portion of the signal spectrum falling within the IF bandwidth is shown in yellow.

Adjusting Demodulator Parameters

The entire demodulation process can be observed in the demodulator structure window, accessible from within the Demodulator Settings (press the **Settings** button under the **CW** mode button), then the large **View Demodulator Structure** button). Each mode has its own associated structure. By selecting the mode either using the front panel or the tabs at top-right of the Demodulator Settings window, you can observe the different structures applicable to the selected modes. Each mode also has a number of filter settings to experiment with.

The meaning of each filter is best understood looking at the demodulator structure. All of these filters are linear phase *FIR* (*Finite Impulse Response*), with cut-off frequencies and lengths that can be adjusted and optimized by the user, either by direct typing in the parameter or using the sliders, according to the received signal characteristics.

Each filter length (i.e. the number of its *taps*), can be an odd number between 3 and 255. The more taps, the better the filter characteristics, and the better the selectivity of the receiver, but the computing task for the CPU is harder. Therefore, while increasing the filter lengths, always watch the CPU usage in order not to starve the operating system of CPU resources (80% is a good upper limit). Starving the system of CPU resources

manifests itself by the computer becoming sluggish or possibly "freezing" entirely.

The first parameter, the *IF bandwidth filter*, is the length of the first filter in the digital path, which is responsible for much of the receiver selectivity. The factory default length is 63. Reducing this value will decrease the receiver selectivity and make the receiver more prone to interference from nearby strong signals. However, for slower computers it may be necessary to compromise on this figure if the demodulator appears too slow (to the point of the panel "freezing" or drop-outs of audio) because of insufficient CPU resources.

The post-mixer filters, which appear in all demodulators, are all of the low-pass type, their bandwidths being automatically related to the IF bandwidth filter (whose center frequency is 12kHz). For AM, AMN, AMS, CW, DSB, ISB, FM3, FM6 and FMN, the post-mixer filters bandwidth is half of the IF bandwidth, while for LSB and USB both bandwidths are equal.

If you have a preference for particular IF bandwidths, you can associate them with any of the ten preset buttons (located at the bottom of the demodulator front panel) by double clicking the Bandwidth column of the IF bandwidth presets table, and then typing in the numerical bandwidth value in Hz. The buttons are numbered (1 to 10) from left to right. The factory default values can be restored at any time, by pressing the **Restore default settings** button.

For the AM, AMN, FM3, FM6 and FMN demodulators, a supplementary low-pass filter was introduced in the audio output path, to reduce harmonic distortions generated in the demodulation process. Its cut-off frequency (the upper limit of the pass band) and length adjustments can also improve the overall signal-to-noise ratio under bad receiving conditions.

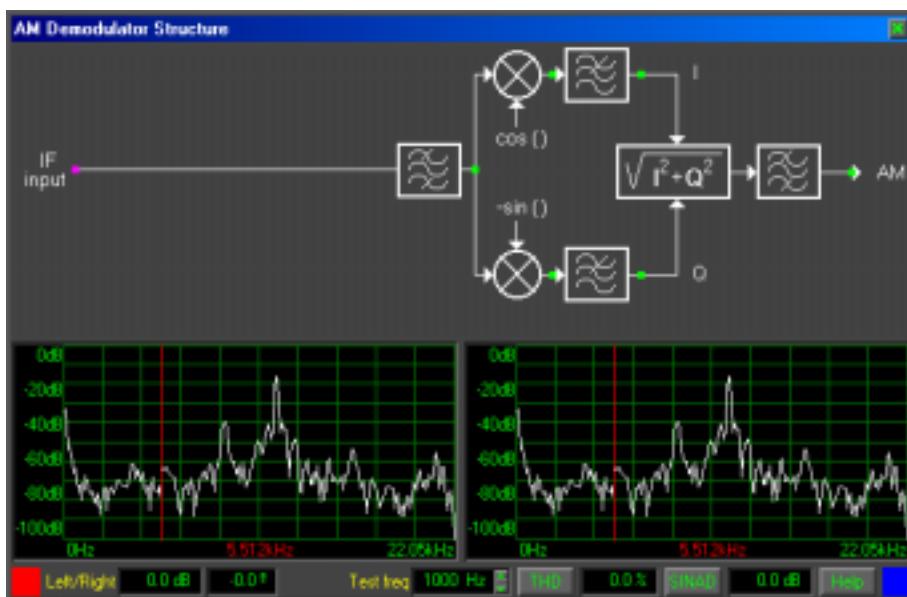
Finally, a noise-derived squelch is implemented for frequency modulation modes, FM3, FM6 and FMN. The energy of the noise present above the useful voice baseband is used as a signal presence indicator. The user can modify the length of the high-pass filter separating that noise, *squelch filter length*. The squelch control appears on the demodulator front panel when any of the FM modes is selected. This makes it possible to adjust the noise threshold level at which the squelch will mute the audio.

Finally, all demodulated audio output is scaled up by an *Audio gain* factor. The scaled audio signal level is further adjusted with the Volume control in the demodulator main panel. When the Audio AGC is active, the fixed Audio gain is ignored. The attack and decay times for the three possible Audio

AGC speeds (slow, medium and fast) can be also configured, under AGC *Speed Constants* on the left of the demodulator settings window.

Demodulator Structure

The G3 SERIES Professional Demodulator implements the general quadrature representation of all narrow-band modulated signals. Such signals can always be considered as the sum of two amplitude-modulated carriers having a 90 degree offset, usually referred to as *I* and *Q*. Users familiar with *Software Defined Radio* digital signal processing concepts, will find the G3 SERIES Professional Demodulator to be a useful tool for experimentation and study, where the effects of various filter settings can be easily observed and optimized.



AM Demodulator Structure

The demodulator structure windows include two spectrum analyzers making it possible to view signal spectra in real-time. Each analyzer can be "connected" to any of the *test points* shown as green dots in the diagram. To

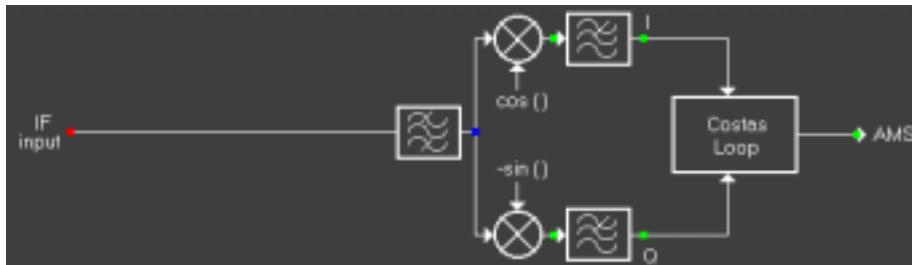
connect the left spectrum analyzer to a particular test point, left-click on the green test point. Its color will change to red. Right-clicking on a dot will connect it to the right analyzer, and the color will change to blue. If both displays are connected to the same test point, the point color will turn magenta.

Within the displayed spectra, a red color frequency cursor can be manually dragged, using the left mouse button, over a particular spectral component. The two *Vector Voltmeter* displays labeled Left/Right indicate the relative amplitude and phase difference between the two spectral components at the cursor frequency.

There are two additional tools provided in this window: *THD* (total harmonic distortion) and *SINAD* (signal-plus-noise-plus-distortion to noise-plus-distortion) meters. They can be used to test the overall receiver performance as well as provide indication of the sound card quality. To use these facilities, a pure tone-modulated signal must be applied to the receiver antenna input, and the frequency of the modulating tone must be equal to the *Test freq* setting.

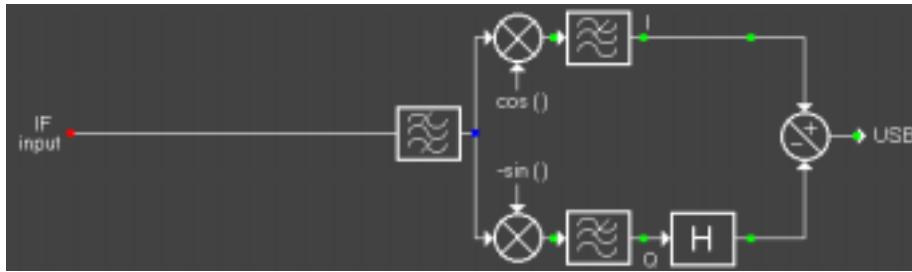
When either of the **THD** or **SINAD** buttons is activated, the right-hand spectrum display will be automatically connected to the end of the demodulator chain (i.e. right-clicking on any other test points will not work until both the **THD** and **SINAD** buttons are released).

For synchronous demodulation of amplitude modulated signals (the *AMS* mode) without carrier or with a fluctuating one, the G3 SERIES Professional Demodulator uses a PLL carrier recovery technique based on the Costas loop:



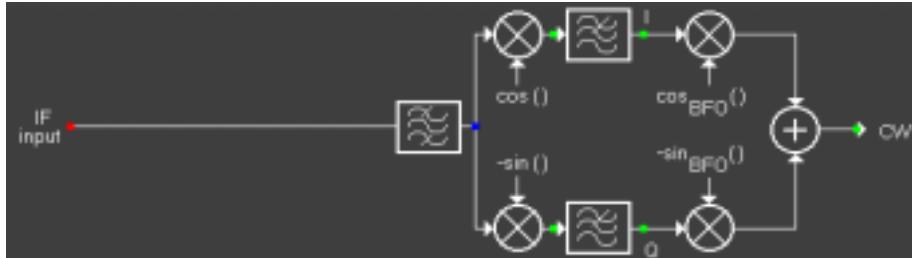
Synchronous AM Demodulator Structure

The LSB and USB demodulators have basically the same topology. ISB can be thought of as a combination of LSB and USB, where each of the sound card channels is used for one of the independent side bands.



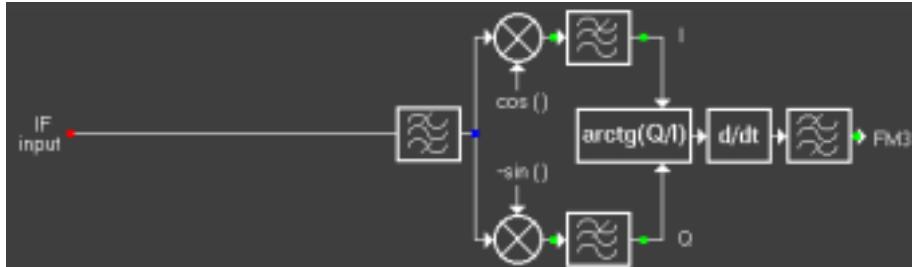
USB Demodulator Structure

The CW received signals are first down-converted to zero Hz, and then, after additional channel filtering, up-converted to a convenient audio frequency. This frequency (a *digital BFO*) is user-adjustable, by changing the value of the *CW tone frequency* parameter in the demodulator set-up.



CW Demodulator Structure

Finally, all frequency demodulators have the same block diagram. The only differences between these demodulators are the bandwidth values of the input IF filter and the two post-mixer filters:



FM Demodulator Structure

Appendix F - Developer Support

WiNRADiO has always extensively supported third-party software development efforts with all our receivers, and the WiNRADiO G3 SERIES receiver is no exception. We provide technical details for developers to be able to develop the following:

1. Third-party applications controlling the WiNRADiO G3 SERIES receiver. *We do this by providing API information making it possible to access the receiver hardware from third party software. (See <http://www.winradio.com/home/developer.htm>).*
2. Plug-ins to provide enhanced functionality. *For this, we have developed a special interfacing standard called XRS (Extensible Radio Specification). All our receivers conform to this standard, and many plug-ins are already available for various applications (see <http://xrs.winradio.com>).*
3. New types of demodulators. *The G3 SERIES demodulators in fact represent a special type of XRS plug-in. Detailed information is also available at <http://xrs.winradio.com>.*
4. Support under alternative operating systems. See for example <http://www.linradio.com>.
5. Support under **Radio Basic**, an easy to use specialized programming language for radio receivers. See <http://www.rbasic.com>.

Have you registered yet? WiNRADiO provides regular upgrades to our application software. Use our on-line registration form on www.winradio.com/register to take advantage of this free service.

Declaration of Conformity

This device, trade name WiNRADiO Communications Receiver, model number WR-G3 SERIES complies with Part 15 of the FCC Rules. Operation is subject to the following conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

I have determined and warrant that the above described device has been shown to comply with the requirements of the FCC Part 15, by having a device tested at an accredited testing laboratory. Each unit marked is identical to the device as tested. Compliance assumes no unauthorized changes will be made to the equipment and it will be maintained and operated properly. A test report has been generated. A technical file containing the test report will be maintained for a period of at least 2 years after manufacturing ceases. It is also understood that characteristics of this equipment will require retesting.



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