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APPENDIX G

User Manual

WiNRADiO®

G3xx VHF/UHF Receiver

User's Guide

Published by
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Printed in Australia

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This equiment 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 an outlet on a circuit different from that to which the receiver is connected
- 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. Only original cables and power adapters must be used. Operation with non-certified cables, power adapters and peripherals may result in interference to radio and TV reception.

Modifications

Any changes or modifications to the WiNRADiO receiver could void the user's authority to operate this equipment, as well as void the manufacturer's warranty.

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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.

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Introduction

Welcome to the WiNRADiO G3XX receiver. This advanced receiver is the result of a quest to combine many years of accumulated know-how in computer-based radio receivers with the latest advances in components and digital signal processing techniques.

In designing this receiver, we strived to provide the optimum balance of sensitivity, selectivity and dynamic range, yet maintaining low cost and implementing a number of significant features previously available only on receivers significantly more expensive, bulky and far less friendly to the user.

While we attempted to implement many more features and functions than normally would be found on a typical communications receiver, we also strived to keep the control panel streamlined, logical and easy to use.

The WiNRADiO G3XX receivers transform any modern PC desktop into a sophisticated VHF/UHF monitoring station offering surprising power and flexibility, and enjoyment of use.

We hope you will like the spectrum analyzer with a 16 Hz resolution bandwidth, continuous IF bandwidth adjustment in 1 Hz steps, graphical pass-band tuning, graphical notch filter, ultra-sensitive, selective and accurate S-meter, the convenient tuning and scanning facilities, the test and measurement functions, and many other innovative features.

The WiNRADiO G3XX is not designed to be an ordinary radio receiver. It is intended to be an exemplary radio communications instrument, crafted with meticulous care and dedication to excellence.

We wish you much success and many hours of enjoyment in putting it to your good use.

Please don't forget to register as a WiNRADiO user to receive news about new products, accessories and software upgrades for your G3XX receiver. Use our on-line registration form at www.winradio.com/register to take advantage of this free service.

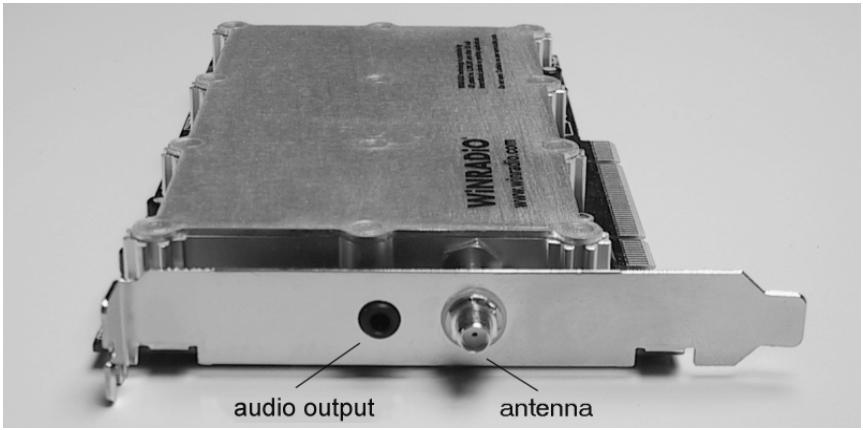
G3XX Receiver Models

There are two basic models of the WiNRADiO G3XX receiver:

- G3XXi (PCI card based "internal" model)
- G3XXe (USB based "external" model)

Both receivers have similar parameters and similar software user interface. This manual covers the installation and operational aspects for both types.

The G3XXi model has two connectors: the antenna connector (SMA type, 50 ohm) and an audio output:



The audio output is compatible with a PC sound card *Line input*, or can be simply connected directly to an amplified multimedia speaker, or any other suitable audio equipment. Standard 3.5mm stereo audio jack is used.

The advantage of this model is that it does not require any external power supply, and does not occupy any additional desk space. The receiver is very well shielded to prevent any interference generated by the PC from entering the receiver. The receiver comes with a suitable "audio lead" to connect the audio output to a sound card input.

The external G3XXe model has three connectors:

The *power jack* accepts 12 V DC (the power adapter must be rated for minimum 500 mA). To minimize interference, a linear-mode power adapter is recommended (as supplied by WiNRADiO).

The *antenna input* is an SMA-type connector with 50 ohm impedance.

The *USB interface* is compatible with both USB 1.0 and 2.0 standards and serves to connect the receiver to a desktop or a laptop computer.

Installation

The WiNRADiO G3XX package contains the following items:

- WiNRADiO G3XXi or G3XXe receiver
- USB interface cable (G3XXe receiver only)
- WiNRADiO software on a CD ROM
- Start-up indoor antenna
- Audio cable (G3XXi receiver only)
- 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	Creative Sound Blaster, 16 or 32 bit
OS	Windows 98/ME/2000/XP	Windows 2000/XP

** Sound card is only required with the G3XXe model (for playback only)*

Do you have any suggestions about how we could further improve our product, or do you wish to tell us of your experiences using this receiver in your application? Please do not hesitate to leave your comments on www.winradio.com/feedback. We always love hearing from you.

Hardware Installation

G3XXi model (PCI card)

1. Turn the computer off 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.)* Or, if you prefer, you can connect the receiver directly to an amplified speaker or other suitable audio equipment.

G3XXe model (external model)

1. Connect the receiver to the USB port.
2. Connect the supplied power adapter to the power outlet on one side and the power lead to the receiver on the other side.
3. Turn the receiver on using the power switch at front of the receiver. The blue LED will first flash slowly, indicating that the receiver is ready. *(The flashing pattern of the blue LED has diagnostic meaning. For more details, see **Appendix J, USB Interface Diagnostics**.)*

With the G3XXe model, the demodulated audio is travelling over the USB interface, so no connection to a sound card is necessary, except, of course, the speaker output.

Finally, connect the supplied start-up antenna to the SMA connector at the rear of the receiver. Extend the antenna so that it is as far away from the computer as possible.

Software Installation

1. If the PC is off, turn it on. Windows will find the receiver and automatically start the usual ***New hardware found*** driver installation routine. Insert the installation CD ROM into the drive, and follow on-screen instructions.

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 G3XX application.

Note: If the receiver 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.

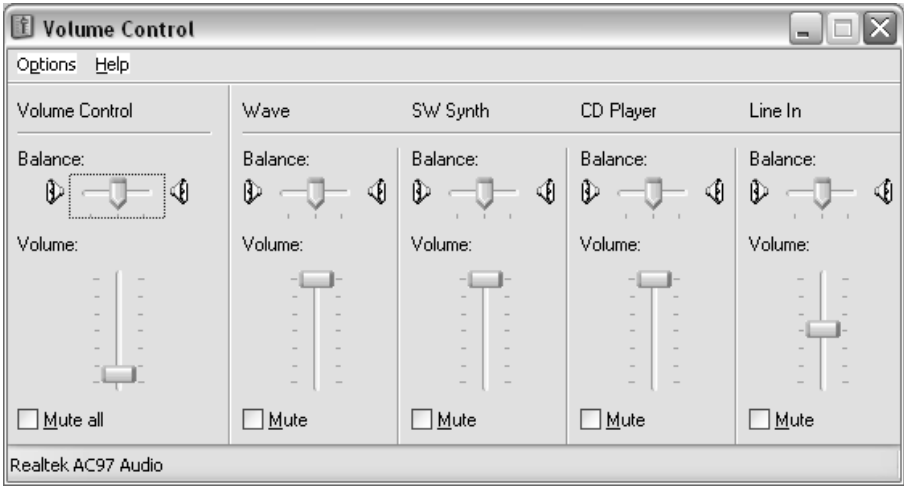
WiNRADiO also manufactures a wide range of antennas and antenna accessories suitable for many applications. The WiNRADiO AX-71C antenna (pictured) is especially suitable for the G3XX receivers. Visit our web site ***www.winradio.com*** *for more information about WiNRADiO range of antennas and antenna accessories.*

Setting up the Sound Card

The G3XXe receiver's audio travels via the USB interface in a digitized form, to be played back by the sound card. The volume can be adjusted using the ***Wave*** volume slider (which must be unmuted) or the master ***Volume Control***.

The G3XXi receiver's audio output is an analog ***Line Output***. You can connect this directly to standard amplified speakers, an external amplifier of your choice, or your PC sound card. If you are using the sound card, the receiver output should be physically connected to the ***Line Input*** of the sound card.

Double click on the speaker icon in the task bar, to bring up the sound card ***Volume Control*** panel:



Make sure the Line Input is not muted, and the volume is set to approximately half, to get started. *(If the maximum volume as set on the receiver panel is not sufficient, you may wish to increase the sound card volume later.)*

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 might result in overloading the sound card and cause distortion.)

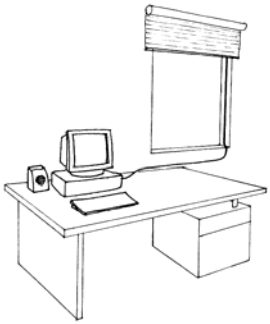
Connecting the Antenna

Unless you already have a proper antenna in place, you might like to take advantage of the supplied start-up antenna which comes with your G3XX receiver.

This antenna consists of a 3-metre length of a coaxial lead-in cable, with an additional 3 metres of insulated wire. The thinner, insulated wire at the end of the coaxial cable is the actual antenna. It is necessary for the lead-in cable to be as far away from the PC as possible, to reduce potential interference from the PC.

Please note that this start-up antenna is supplied for initial tests and *immediate gratification* only. It is not intended to replace a proper 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.



An example of 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 the most of your G3XX receiver, you should install a proper antenna. WiNRADiO may also be able to assist with our wide range of suitable antennas – check our Web page **www.winradio.com**.

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 chapters. We hope you will return to these chapters, as the WiNRADiO G3XX receiver has many fine features which would be a shame to miss.

Start the WiNRADiO G3XX receiver application (by double clicking on the WiNRADiO icon). The WiNRADiO G3XX receiver control panel will appear as shown in the following picture:

WiNRADiO G3XX Receiver Control Panel

The WiNRADiO G3XX receiver control panel has some elements similar to conventional receivers, and many additional features as well.

The quickest way to get started with this receiver is to check its operation on your 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 be able to see the station peak on the real-time spectrum scope, and hear the station.

Adjust the bandwidth for optimum reception using the row of numbered buttons at the bottom of the spectrum scope panel: these represent preset IF bandwidth. To adjust the IF bandwidth smoothly, use the IF bandwidth control at bottom left.

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.)* An alternative way to adjust the volume is by using the left/right arrow keys of the PC keyboard.

Manual tuning can be done in several ways. Let's start with the tuning knob: Place the mouse cursor onto 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 onto the bottom half of the tuning knob, the direction of the rotation will reverse. *(You don't need to move the cursor up or down to change the rotation of the knob, simply press either the left or right mouse button.)*

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 smaller: 50 Hz.

Another way of tuning is to use the up and down arrow keys on the PC keyboard. If your mouse has a wheel, you can also use this: you might find it somewhat similar to using the tuning knob of a conventional receiver.

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

Tuning WiNRADiO G3XX

Manual Frequency Entry

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 in a highlighted field. 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.

Use the ***kHz*** or ***MHz*** buttons to select how you wish the frequency to be displayed.

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.)*

The ***VFO*** buttons make it possible to select from four different VFOs. A VFO is a kind of frequency memory making it possible to quickly switch between several frequencies. For example, if you tune to Frequency 1 using VFO1, and Frequency 2 using VFO2, then you can alter between Frequency 1 and Frequency 2 by simply clicking on the corresponding VFOs.

Under these buttons there is a ***Band description window*.** This window shows the band allocation of the currently tuned frequency. While the displayed band descriptions are specific to the North American standard, they are based on international treaties and therefore are generally applicable worldwide with minor differences, which can be easily edited by the user.

The band descriptions can be overridden with a call sign or a user-defined description of a particular frequency stored in memory. This overrides the band description for a particular frequency only.

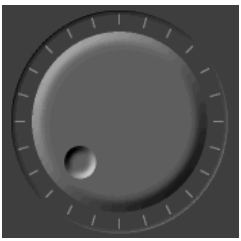
It is also possible to change the naming and frequency allocations for entire frequency bands. This can be done by editing the file called ***bands.csv*** in the WiNRADiO installation folder. (This is a standard "comma-separated-value" format file which can be edited using a spreadsheet application, such as Microsoft Excel.)

Did you know?

VFO stands for Variable Frequency Oscillator. This is a historical term dating back to the era of analog tuned radios. Before digitally tuned receivers were invented, there was no easy way to store and recall frequencies. Professional receivers had switchable oscillators where the oscillators (and their variable capacitors) themselves served as analog frequency memories. The name and the net effect remain, but the principle has changed: There is no need for multiple oscillators in modern receivers to implement this function. The frequency is simply stored in a digital memory.

Tuning Knob

The ***Tuning Knob*** makes it possible to adjust the frequency in fixed 50 Hz, 500 Hz, 5 kHz or 50 kHz steps.



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).

You don't need to move up or down with the cursor to change the rotation of the knob. Simply press either the right or left mouse button.

As the knob rotates, the frequency will change in 500 Hz steps. Holding the mouse button down will accelerate the tuning.

The step size can be changed to 50 Hz, 5 kHz or 50 kHz, using the ***Alt***, ***Shift*** or ***Ctrl*** keys, respectively, while clicking the tuning knob with mouse button.

Note that the Fine Tune Knob can also be conveniently rotated using a wheel of a wheel-equipped mouse, or any other standard Windows-supported pointing device.

Keyboard Tuning

The receiver frequency can also be adjusted using the keyboard cursor control keys (the "arrow" keys): Using the up/down arrow keys, the frequency changes in 10 Hz steps. Pressing the Shift key simultaneously results in 100 Hz steps, while the Ctrl key changes the step size to 1 kHz.

Incremental Tuning Pad

This unique tuning tool is located above the Tuning Knob. If the mouse is positioned above one of the coloured squares, the square lights up and the associated tuning increment value appears:

Clicking on the square with the left mouse button results in increasing the frequency, clicking with the right mouse button will decrease the frequency. There are several convenient tuning increments to choose from: 1 Hz, 10 Hz, 100 Hz, 1 kHz, 5 kHz, 6.25 kHz, 8.33 kHz, 9 kHz, 10 kHz, 12.5 kHz and 25 kHz.

Tune To Peak

The ***Tune to Peak*** function can be invoked by pressing the ***TTP*** button. The receiver will tune to the signal peak (provided the peak falls inside the selected IF bandwidth – the highlighted area of the real-time frequency spectrum).

Depending on the location of the peak and type of signal, it may take several seconds for the receiver to tune in accurately, by a successive approximation process.

In the FM mode, the Tune to Peak function will work correctly, i.e. tune to the centre of the signal, even though the sidebands may be higher than the carrier frequency.

In LSB and USB modes, the success of this facility will depend on the type of modulation signal. It may be useful for certain types of data modulation (fax), but is not usually recommended for voice modulation.

AFC (Automatic Frequency Control)

The ***Automatic Frequency Control*** function is activated by pressing the ***AFC*** button. It will keep the receiver tuned to the selected station if the transmitter frequency drifts.

While this function is active, the receiver will periodically check the received signal and correct the frequency in approximately five-second intervals.

This facility is not recommended for LSB and USB modes with voice modulation.

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 and 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.

When the step size is selected, you can step up or down from the currently displayed frequency using the left or 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*** or ***Pg Down*** keys.

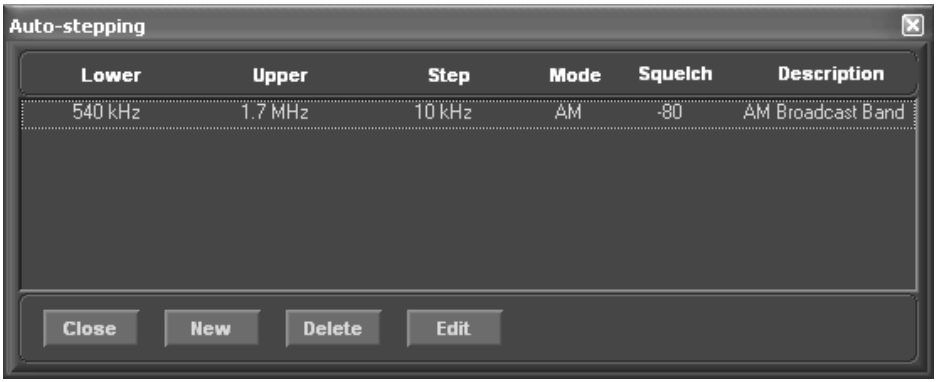
For example, if you wish to browse the AM broadcast band (approx. 530 to 1620 kHz), set the step size to 10 kHz (for North and South America) or 9 kHz (for the rest of the world), which is the channel separation for AM broadcast stations.

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.

The Demodulator

The heart of the G3XX receiver is its demodulator. The demodulator is entirely software-defined, implemented using optimized filtering and quadrature demodulation techniques and executed inside the receiver's on-board DSP. All the functions related to the demodulator, i.e. demodulation mode settings, volume control, IF filter bandwidth, IF shift, RIT, software AGC, AF squelch, notch filter, noise blanker, recorder/playback and real-time spectrum display, are grouped together in an area of the front panel of the receiver which is referred to as the ***Demodulator Panel***. This panel is in fact a separate ***plug-in*** to the main receiver panel, and can be replaced by other demodulators, either developed by WiNRADiO or third parties.

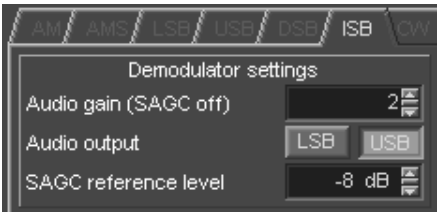
Selecting Demodulation Mode

To select the demodulation mode, click the appropriate mode button in the demodulator panel:

WiNRADiO G3XX Demodulator Panel

In addition to the usual and self-explanatory ***AM***, ***LSB***, ***USB***, ***CW*** and ***FM*** modes, there is also ***AMS*** (synchronous AM), ***DSB*** (dual sideband, suppressed carrier) and ***ISB*** (independent sideband).

For ISB, the audio output can be selected between the lower and upper side bands using two selector USB and LSB buttons accessible under the **Setup** button:



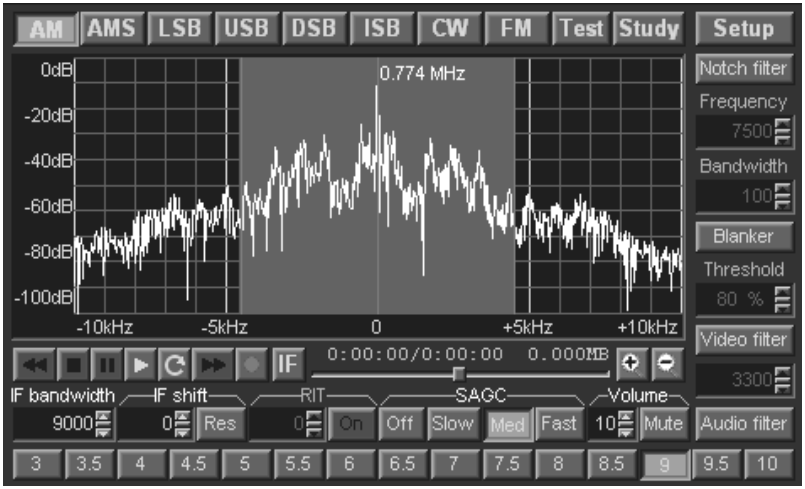
Note: Both channels of the ISB transmission can be recorded simultaneously using the recording facility of the G3XX receiver. (In such case, the LSB and USB signals are recorded as left and right channels of a stereo recording.)

Real-time Spectrum Scope

The real-time spectrum display shows the actual situation within the bandwidth of the receiver. The actual filter bandwidth is 15 kHz, but the spectrum scope shows a somewhat wider area of 20 kHz, hence the sloping edges. 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 by default with the different modulation modes. All these default values can be overridden and finely adjusted.

The ***Video filter*** is a low-pass filter used to smooth the displayed spectrum.

When activated, the smoothness of the spectrum trace increases when the cut-off frequency decreases. The frequency can be adjusted either by direct typing in the edit box, or by clicking the up/down arrow keys, or, more conveniently, by dragging the little slider between the up/down keys.



Spectrum trace without video filter

The same signal with video filter set at 3300 Hz

The zoom in and out buttons change the displayed signal bandwidth in 2 kHz steps, while trying to keep the central red marker as close as possible to the center of the spectrum display. Using the zoom buttons, the displayed bandwidth can be changed from the default 20 kHz down to 4 kHz, making it possible to observe small details of the received spectra less than 20 Hz apart.

Setting and Adjusting IF Bandwidth

The receiver ***IF bandwidth*** can be set in several ways. The quickest way is to use the IF bandwidth presets represented by the row of buttons at the bottom of the demodulator window:

IF bandwidth presets

No.	Bandwidth
1	3000 Hz
2	3.500 kHz
3	4.000 kHz
4	4.500 kHz
5	5.000 kHz
6	5.500 kHz
7	6.000 kHz
8	6.500 kHz
9	7.000 kHz
10	7.500 kHz
11	8.000 kHz
12	8.500 kHz
13	9.000 kHz
14	9.500 kHz
15	10.000 kHz

The numbers on the buttons represent bandwidth in kHz. The preset frequencies change according to the mode selections.

All these frequencies can be changed by the user, for each mode, using a table of ***IF bandwidth presets*** accessible via the demodulator ***Setup*** button.

There are 15 presets, associated with the 15 preset buttons.

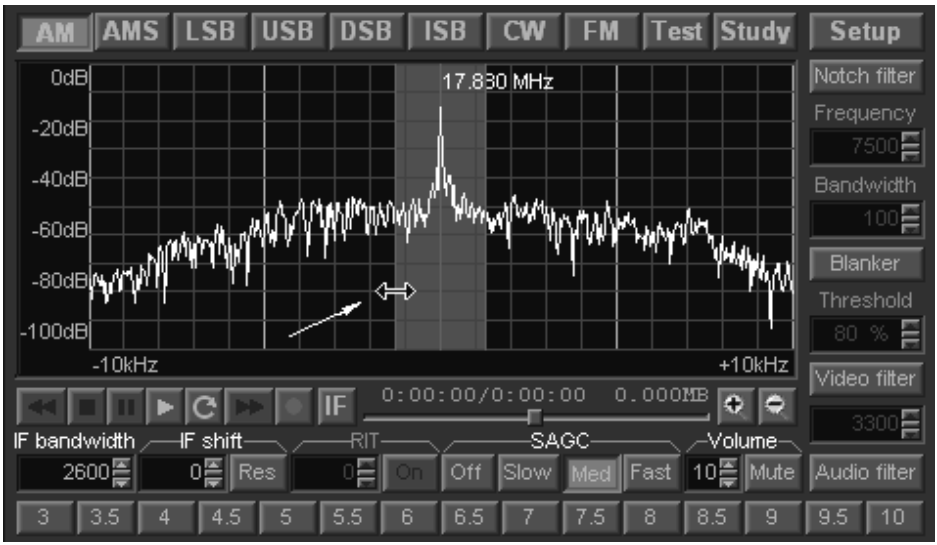
Clicking on the actual number in the ***Bandwidth*** column makes it possible to edit the IF bandwidth value associated with each button. The button label will then also change accordingly. Each modulation mode has its own set of IF bandwidth presets.

To change the IF bandwidth continuously, you can use the IF bandwidth control in the demodulator panel:

There are three ways you can use this control:

- Type the IF bandwidth directly into the edit box, in Hz (type in a number from 1 to 15000, followed by pressing ***Enter***).
- Use the small up/down cursor keys to adjust the frequency by 1 Hz steps.
- Use the small slider located between the up/down cursor keys and move it up or down. This is quite a fast and convenient method.

Another very convenient method is to adjust the IF bandwidth graphically on the real-time spectrum display, by dragging the red line bordering the shaded area representing the IF filter bandwidth:



This method makes it possible to adjust the bandwidth accurately to fit the actual bandwidth of the received signal, obtain the best signal-to-noise ratio and minimize interference from adjacent channels.

IF Shift and Passband Tuning

Dragging the centre red line of the filter passband does not result in the bandwidth change, but rather moves the entire passband. Such ***IF Shift*** makes it possible to tune the receiver to where the actual signal is, by positioning the IF filter passband precisely over the real-time signal spectrum.

To use this feature, drag the red vertical line in the middle of the highlighted filter passband anywhere over a signal peak within the displayed real-time spectrum. Alternatively, you can use the IF Shift control either by typing the IF Shift value manually, or using the up/down arrow buttons, or the small slider between the two buttons: Place the mouse cursor on it and see the cursor shape change, to indicate a 'slider' type of control. To change the IF Shift value, hold down the left mouse button to drag the slider up or down. To reset the value back to zero, press the associated ***Res*** button.

Note that for the USB and LSB modes, only one of the two filter edges can be dragged with the mouse. The other edge, which represents the imaginary "carrier" frequency of the station remains stationary. IF shift is again accomplished by dragging the centre line. The inactive filter edge is shown in a darker color.

The IF Shift facility makes it possible to quickly and visually tune to another station represented by a signal peak in the real-time spectrum. However, it is not very suitable in the AMS, USB, LSB, DSB and ISB modes if you only wish to adjust the filter passband position slightly for the station you are currently receving (for example to avoid interference from an adjacent channel). If you do this, and are, for example, tuned to an AM station using the AMS mode, or an SSB station using the USB or LSB modes, then moving away from the exact carrier frequency will result in a whistle being heard, its pitch being directly proportional to the IF Shift displacement.

To make it possible to move the filter passband only, but still remain tuned to the same frequency, there is also an associated ***Passband Tuning*** mode: This is invoked by dragging the graphical centre of the filter passband with the right mouse button instead of the left one. This makes it possible to finely adjust the filter position in the AMS, LSB, USB, DSB, ISB or CW modes, without the whistle effect. Note that in this mode (indicated by "***PBT***" displayed in the filter passband) it is not possible to move the filter passband to another station - simply revert to the normal IF shift mode using the left mouse button or the ***IF Shift*** control, or press the ***Res*** button, if you need to move to another station peak.

To summarize, there are two ways to shift the real-time spectrum:

1. ***IF Shift*** (without BFO change) which makes it possible to tune the receiver to another frequency by dragging the entire filter passband over a peak of a visible signal. Use the left mouse button for this.

2. ***Passband Tuning*** (with tandem BFO change), making it possible to adjust the filter position in SSB and CW modes without detuning the received station. This is done using the right mouse button.

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. To change the volume, hold down the left mouse button to drag the slider up or down.

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 makes it possible to switch off the 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.

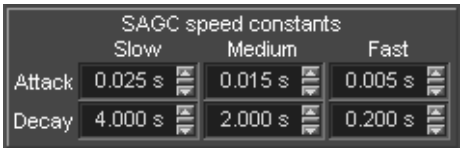
Software AGC

In addition to the usual hardware *AGC* (Automatic Gain Control), the G3XX receiver also has ***Software AGC***.

This facility is used to compensate for audio volume changes when the antenna signals are so weak that the hardware AGC is not yet activated, or when the hardware AGC is disabled and manual IF gain setting is used instead.

Think of the Software AGC as an "Automatic Volume Control", which acts on the demodulated audio signal, while the hardware AGC acts on the undemodulated intermediate frequency signal.

The software AGC 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.

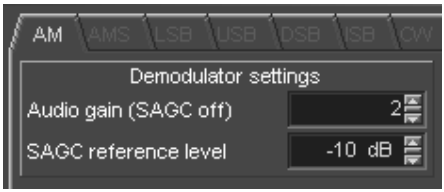


The timing of slow, medium or fast speed settings is user-definable under the **Setup** button:

The attack time (the speed with which the SAGC reacts to a rising signal level) as well as the decay time (the speed with which the SAGC reacts to a lowering signal level) can be adjusted separately.

For most practical applications, the medium setting with its default speed settings is recommended. Slow setting would be used especially with Morse code (CW mode), while fast setting might be appropriate for very noisy signals (where noise bursts might temporarily desensitize the receiver if slow decaying SAGC was employed).

When enabled, SAGC tries to maintain the audio output at a constant level, the ***AGC reference level***. This level is user adjustable under the ***Setup*** button, separately for each demodulation mode:



The higher the AGC reference level, the louder the maximum audio volume (which can be then reduced by the volume control). However, with a high level and strong signal levels there will be a distortion. Decreasing the AGC reference level will result in lower audio levels.

The ***Audio gain*** setting is applicable only when SAGC is turned off, making it possible to set a fixed gain level (i.e. the maximum volume) for each demodulation mode separately.

Note:

1. SAGC is available only in AM, CW and SSB modes. (The FM demodulator audio output is not dependent on the input signal level.)

2. If the receiver volume appears too low (and yet the volume control is all the way up), make sure that SAGC is enabled.

3. If the sound is distorted despite the volume being turned down, make sure that SAGC reference level is not set too high.

4. If the sound is too weak when SAGC is disabled (and yet the volume control is all the way up), use the Audio gain setting to increase the level.

AF Squelch (Audio Filter Squelch)

The ***AF Squelch*** is available only for the FM mode. In the absence of an input signal any FM demodulator produces a strong noise, due to the random phase variations of received atmospheric noise, and its own receiver noise.

The AF squelch implements a special filter to detect such noise and compare its level to a preset threshold. When the noise exceeds this threshold, the receiver audio is muted.

The threshold level can be set in the AF Squelch edit box, either by direct typing, using the up/down arrow buttons, or the little slider between the arrow buttons.

The ***Noise level*** indicator displays the actual noise level in a percentage of white noise contents: zero represents pure signal without any noise, 100 represents pure white noise.

This is useful to establish the background noise level when no signal is received, so that the AF squelch value could be set suitably lower than the background noise. When a frequency-modulated signal is received, the noise should drop below the AF Squelch level, which will activate the audio. Note that the noise level also depends on the ***IF bandwidth*** setting: The wider this setting, the higher the noise level.

Notch Filter

The notch filter is a band-stop filter which can be used to minimize the effects of interference falling inside or near a received station's spectrum. The filter is activated by pressing the Notch Filter button. The centre frequency and the bandwidth can be adjusted using the correspondingly named controls:

For both controls, the same usage rules apply as with the IF bandwidth setting, i.e. the values can be changed by direct manual entry, or finely adjusted by using the up/down cursor keys, or by dragging the slider between them.

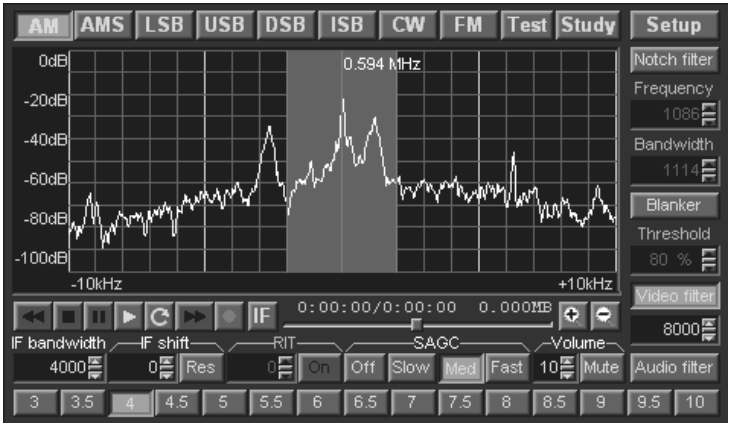
Another way of changing the Notch Filter parameters is by dragging the stopband of the filter (a blue shaded area) with the mouse.

The stopband width can be adjusted by dragging the edges, while the centre frequency can be changed by dragging the centre line, which makes it possible to conveniently position the filter stopband over the interfering signal.

Did you know?

In addition to the above notch filter which operates on the undemodulated intermediate frequency signal, you can also have audio notch filtering (including auto-notch) in the optional Advanced Digital Suite plug-in, available for the G3XX receiver. This also features numerous user-adjustable audio filters and various other signal conditioning, noise-reduction, decoding and analysis facilities. See ***www.winradio.com/ads*** *for more details.*

The following picture shows a signal with a strong interference in the passband (the large peak right of center).



In the resulting audio, typically there would be a strong buzzing sound. After engaging the notch filter and adjusting its center and bandwidth (by dragging the blue area center and edges) to fall exactly over the interference, the situation will look like this:

This results in significantly reduced interference and a much more pleasing sound.

Audio Filter

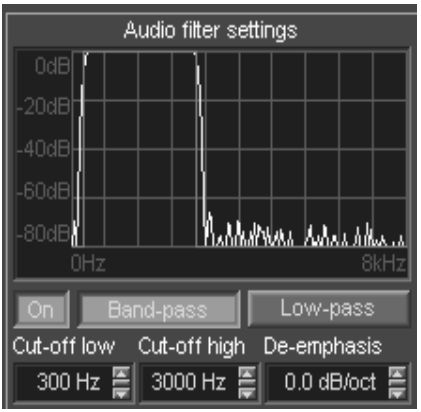
The **Audio filter** makes it possible to apply filtering to the demodulated audio.

This is useful in particular for noisy signals, where intelligibility is improved by emphasizing particular frequencies (usually speech frequencies 300-3000 Hz).

In the FM mode the audio filter is usually necessary to provide de-emphasis of high frequencies.

The Audio filter is activated using a button at bottom right of the demodulator panel:

There two types of filters: band-pass and low-pass, and their parameters can be adjusted under the **Setup** button:



The **Audio filter settings** make it possible to adjust audio filtering parameters separately for each demodulation mode. The **On** button either enables or disables filtering, and is tied to the **Audio filter** button in the demodulator front panel.

The **Band-pass** and **Low-pass** buttons make it possible to select the desired type of filter. The filter cut-off frequencies can be either entered numerically, or the filter edges can be dragged with the mouse. For the band-pass filter, the entire passband may be shifted left or right by dragging the top horizontal red line.

With a band-pass filter, suitable low and high cut off values for good intelligibility of voice communications are 300 and 3000 Hz, respectively.

De-emphasis is usually necessary for FM demodulation only. The typical value is -6dB/octave.

Noise Blanker

The ***Noise Blanker*** is effective for random high-level noise spikes, such as atmospherics.

The Noise Blanker is activated by pressing the ***Blanker*** button. If the instantaneous IF signal level exceeds the specified ***Threshold*** level, those IF samples are replaced with older ones. The threshold level is set as a relative value, a percentage of the maximum possible sample level.

Receiver Incremental Tuning (RIT)

In some other receivers, this is also referred to as the ***Clarifier***. This function is used exclusively for SSB (USB or LSB) modes. It is not available, nor necessary, for other modulation modes.

In effect this is a ***VFO for IF shift****;* a short-term memory for IF shift.

If two communicating SSB stations are not exactly on the same frequency, listening to them may need an adjustment for one of the frequencies, otherwise one of the stations might sound distorted. To spare you from having to quickly tune to the new frequency while listening to the dialogue, the RIT function makes it possible to conveniently adjust the frequency increment by simply engaging or disengaging the ***RIT*** button.

To set up RIT, firstly tune the receiver precisely to one of the stations, until you have perfect sound. Then press the RIT button and adjust the RIT frequency increment (it is shown in Hz) to hear the second station clearly. You can either type the increment value in the edit box (which is a slow way), or use the up/down arrow keys, or the small slider located between the arrow keys, which is the fastest way.

Then simply turn RIT on and off, depending on which station is currently on air.

Recording and Playback

The G3XX receiver's demodulator has integrated recording and playback functions. This facility makes it possible to record and playback the demodulated audio in standard *".wav"* files, as well as the modulated signal at the IF level (***IF recording***).

The IF recording feature can be very useful in situations where the received signal is of some significance and needs to be analyzed. A weak or interference-obscured signal can be thus "re-received" with different bandwidths, notch filter and noise blanker settings, to arrive at the best possible demodulated audio.

Recording starts when the ***Recording*** button (with red dot) is engaged, and stops when the ***Stop*** button (green square) is pressed. The ***Pause*** button (two green vertical lines) is also available.

Playback is done by pressing the ***Play*** button (green arrow), and the ***Fast Backward*** and ***Fast Forward*** buttons complement the recording controls.

When the ***IF*** button is engaged, the recorder will record on the IF level instead of audio. The recorded files will have the extension "*.if.wav*".

The round arrow button, when engaged, causes an infinite looping when playing either audio or the IF signal: When the recorded signal reaches the end, the playback will restart immediately again from the beginning. This is particularly useful when you are playing back an IF signal and experimenting with different settings of filters for the best possible audio quality.

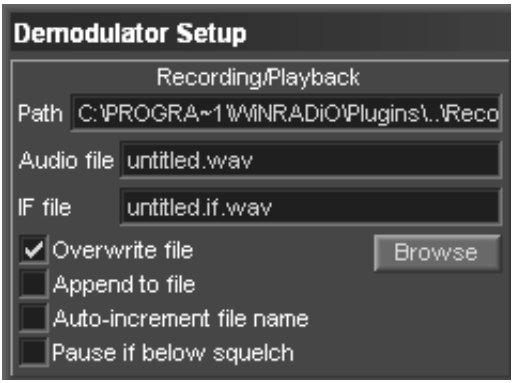
The recorder uses fixed "*wav*" file formats:

1. For audio recording (except in ISB mode): 16 kHz sampling rate, 16-bit mono

2. For audio recording in the ISB mode: 16 kHz sampling rate, 16-bit stereo

3. For IF recording: 64 kHz sampling rate, 16-bit, mono

The recording/playback set-up is done using a dedicated section in the Demodulator settings (under the ***Setup*** button):



The recorded file path can be set up using the ***Path*** edit box. The default file names for recording/playback can be set up using the ***Audio file*** and ***IF file*** edit boxes, for Audio files and IF files, separately. The directory ***Browse*** button can be used to advantage, instead of typing the path and file names.

The audio and IF file names are related; the only difference is the "*.if*" used before the "*.wav*" extension for the IF files.

For recording, there are three possible options to choose from:

Overwrite file - the file, if it exists, is completely overwritten with new samples.

Append to file - the new samples are appended to the file, if it already exists.

Auto-increment file name - each time the record button is pressed, a number just before the ".wav" extension, and ".if" for IF files, is incremented; if there is no initial number, 1 is automatically used first.

Normally, the recording does not depend on the squelch. However, if the option ***Pause if below squelch*** is activated, the recording will pause accordingly.

The path and the file names for audio and IF recording can be both manually edited or configured using a dedicated dialog box shown by clicking on the **Browse** button. The audio and IF file names are correlated, the only difference being the "**.if**" used before the "**.wav**" extension.

The file names can contain "wildcards" which make it possible to include date, time, frequency, etc., inside the name of the file. The following wildcards are supported:

#D - system date (in YYYYMMDD format)
#T - system time (in HHMMSS format)
#F - frequency in MHz (6 decimals)
#M - mode - ("AM","AMN","AMS","DSB","USB","LSB","ISB","CW","FMN")
#N - serial number of the receiver

For example, the following is an acceptable file name, where the date, time and frequency will be included:

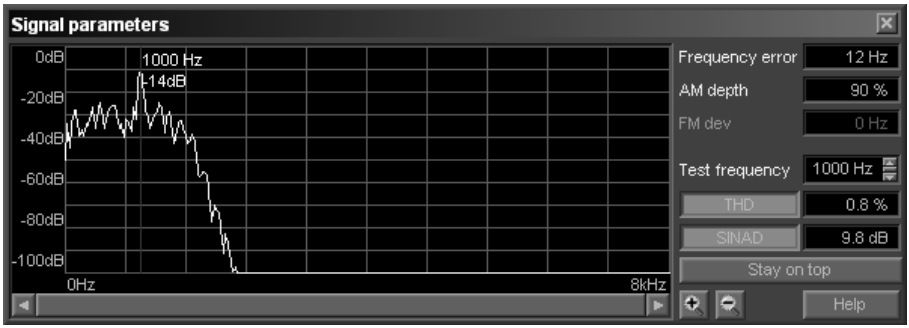
```
myfile #d #t #f.wav
```

Recoding is also possible while the receiver is scanning and searching for stations. To take advantage of this feature, enable ***Pause if below squelch***, set up a file name which includes the #F frequency wildcard, and start scanning. Depending on the scanning parameters, the receiver will then record the intercepted station audio or IF samples to "wav" files. For example, if ***Pause if signal appears*** is enabled, and the ***Pause delay*** is set to 10 seconds, then samples of 10 seconds each will be recorded – see the ***Scanner Configuration*** chapter for more information.

Test and Measurement

The ***Test and Measurement*** function of the G3XX receiver is invoked by pressing the ***Test*** button:

This causes an instrumentation window to open which contains several facilities to assist with analysis and measurement of the received signal:



The real-time ***Audio Spectrum Analyzer*** on the left of the window makes it possible to observe properties of the demodulated signal with a 5 Hz resolution.

The red marker can be dragged with the mouse and the associated frequency and level observed at the top of the marker. To zoom the spectrum graph in and out, use the zoom buttons on the left of the ***Help*** button.

The ***Frequency error*** display indicates the frequency error of the received signal (presuming the receiver is tuned to the correct frequency).

The ***AM depth*** display measures depth of amplitude modulated signals.

The ***FM deviation*** display shows frequency deviation of frequency modulated signals.

The THD and SINAD buttons enable the measurement of Total Harmonic Distortion and SINAD (signal-plus-noise-plus-distortion to noise-plus-distortion ratio), respectively. The test frequency for these two functions (which should be equal to the modulating audio frequency applied to the RF test signal connected to the antenna) can be adjusted using the Test frequency edit box.

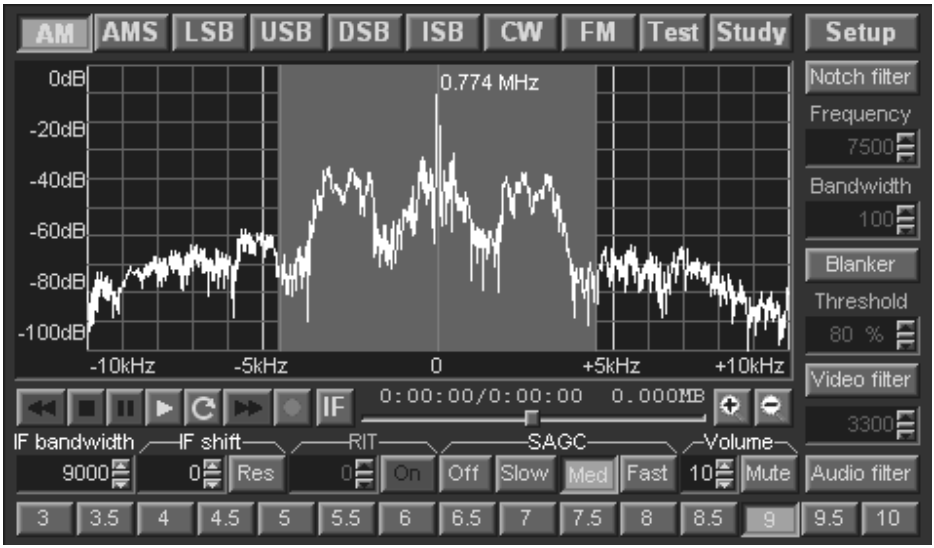
The Stay on Top button can be used whenever it is convenient for the test and measurement window to remain on top of all other windows.

Did you know?

Using the SINAD measurement facility and a calibrated signal generator, you can measure the receiver sensitivity very easily. For example, to measure AM sensitivity, connect the signal generator to the antenna input and turn on AM modulation (the modulation depth is usually set to 30%, although some manufacturers prefer to quote sensitivity figures at higher modulation depths, for example 60 or 80%). Set the Test frequency equal to the modulating frequency (typically 400 Hz or 1 kHz). Adjust the IF bandwidth for the maximum SINAD. Then gradually keep reducing the generator output level to the point when SINAD drops to 10 dB. The receiver sensitivity is then equal to the generator level at this point. Measuring AM sensitivity using SINAD rather than the conventionally used S+N/N is quite appropriate as SINAD also includes distortion, which is as much an impediment to intelligible reception as noise, and therefore provides a more practical result. Even though in theory using SINAD should result in the sensitivity figures being somewhat worse than if S+N/N is used, in practice, with a good receiver such as the WR-G3XX, there is not a noticeable difference.

Demodulator Structure

The structure of the G3XX demodulator can be accessed and explored using the ***Study*** button:



The study button reveals the internal structure of the currently selected demodulator, with additional measurement facilities.

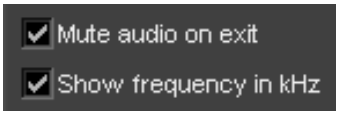
This function is intended for users wishing to acquaint themselves more deeply with ***Software Defined Radio*** principles. It is described in greater detail in ***Appendix E – Inside G3XX Demodulator***.

Did you know?

The award-winning WiNRADiO G303i receiver was the world's first software-defined commercially available receiver.

Other Demodulator Settings

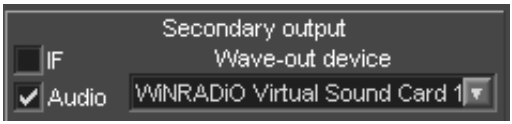
Amongst the last remaining demodulator settings are ***Mute audio on exit*** and ***Show frequency in kHz,*** located at the bottom left of the demodulator ***Setup*** panel***.***



As all critical demodulation functions are performed inside the on-board DSP, the receiver can continue playing audio even when the application is closed, as long as power is supplied to the board. Check the ***Mute audio on exit*** checkbox if you wish for the audio to be muted when the application is closed. This facility is available only on the internal (G3XXi) model; with the G3XXe model, the audio cannot continue once the application is closed.

Show frequency in kHz applies to the frequency displayed next to the marker in the demodulator real-time spectrum display. If this is unchecked, the frequency will be displayed in MHz. This is independent from the main frequency display, which is governed by the ***kHz*** and ***MHz*** buttons located next to the main display.

The ***Secondary output*** can be applied to IF or audio signal. It is intended for third-party applications that require access to the digitized IF or audio samples for further signal decoding. The IF samples are passed at 48 kHz sampling rate, two channels. Audio samples are passed at 16 kHz, one channel.



The Secondary output can be used to advantage by the optional ***WiNRADiO Virtual Sound Card*** software, which makes it possible to pass the digitized signals from the receiver directly to a third-party application without any intervening re-digitization process and therefore without introducing any additional distortion to the received signal. Alternatively, it is also possible to use this feature to provide an output to a secondary (real) sound card.

Receiver Gain Control

There are three hardware controls related to the receiver gain: ***AGC***, ***Manual IF Gain*** and ***Attenuator***.

AGC

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. This can be done automatically using ***AGC*** (Automatic Gain Control) or manually, using manual ***IF Gain*** control.

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 (as the receiver will not have time to increase the gain during the “off” intervals, and 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.

It is easy to forget that AGC has been disabled. If the signal sounds distorted, or, on the other hand, sensitivity appears to be very low, check the AGC setting first.

IF Gain Control

The AGC can be turned off using the AGC ***Off*** button. The receiver gain must then be adjusted manually. This is done using the ***IF Gain*** control.

Note that by setting an excessive gain, the receiver will overload and the demodulated signal will be distorted, which can be very easily observed in the real-time spectrum scope. On the other hand, if the gain is too low, it will make the receiver appear "deaf".

Manual IF Gain setting is very useful when hunting for very weak signals buried in noise. The IF Gain control is only enabled when the AGC is switched off.

The gain can be adjusted in three ways: by typing the value directly in the edit box, by using the up and down buttons, or by dragging up or down the centre slider button.

RF Gain Control

The ***Attenuator***, when enabled, makes it possible to reduce the receiver sensitivity by 18 dB. The ***Preamplifier***, when disabled, reduces front-end gain by further 12 dB.

By attenuating the input signal and/or reducing the front-end preamplifier gain, the sensitivity of the receiver is reduced to avoid overloading by strong signals (e.g. from local broadcast stations).

If sensitivity appears poor, please make sure that the attenuator is disabled and the preamplifier is enabled.

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.

There are two types of squelch in the G3XX receiver: ***Signal level squelch*** (selected by the ***Level*** button) and ***Audio noise squelch*** (selected by the ***Noise*** button).

The ***Level*** squelch setting controls the signal level (in dBm) at which muting occurs. Muting will occur when the signal level drops below the preset squelch value. When a signal of a higher level returns, the sound will be restored immediately.

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.

The ***Noise*** setting makes it possible to mute the receiver depending on the contents of noise in the demodulated signal, and is typically only used in the FM mode. As the FM demodulator produces strong noise when no signal si being received, a special filter is used to detect such noise and its level compared to the specified value. When the noise exceeds this specified value, the audio is muted. The Noise value is entered as a percentage of white noise: Zero value signifies a clean signal, while 100% corresponds to pure white noise (no useful signal). The actual noise level is displayed in the demodulator panel, alongside the ***AF Squelch*** control:

While both the main panel ***Noise Squelch*** and the demodulator ***AF Squelch*** act upon the same signal, their usage is slightly different: If the main panel Noise Squelch is set, this also automatically sets the demodulator AF Squelch. On the other hand, when the demodulator AF Squelch is set, this does not automatically set the main panel Noise Squelch. This is because the main panel squelch is also used for scanning purposes, while the demodulator AF Squelch can only mute or un-mute the audio. So, it is possible for the scanning to be controlled by the Level Squelch, but the audio muted by the demodulator's AF Squelch.

Note that the noise level also depends on the ***IF bandwidth*** setting: The wider this setting, the higher the noise level. A typical Noise Squelch value for scanning of point to point communications is approximately 30-50%.

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.

Did you know?

Squelch can be also controlled by the signal contents. For example, the CTCSS (Continuous Tone Coded Squelch System) is also supported by the optional WiNRADiO Advanced Digital Suite (see ***www.winradio.com/ads****).*

Memory

The WiNRADiO G3XX receiver has the ability to store up to ten thousand frequencies in one memory file. It makes it possible to load and save different memory files for a huge amount of total storage, limited only by the size of the PCs hard disk.

Storing a Frequency into Memory

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

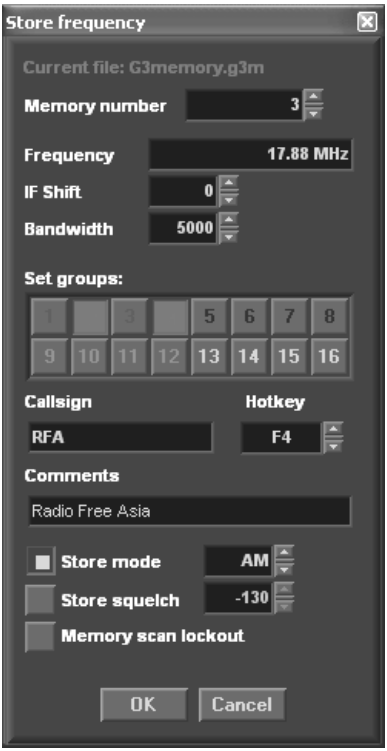
To store a frequency into memory, the receiver must first be tuned to that frequency (and the appropriate mode must be selected if you also wish to store the mode). Next click on the ***S*** button in the Memory Control Panel as shown above.

A ***Store frequency*** dialog box will pop up, making it possible to assign a memory number to the current frequency.

*Note: The default memory file is called **G3memory.wgm** and resides in the same path as the WiNRADiO receiver application, i.e. usually in the **C:/Program files/WiNRADiO/G3XX/** folder.*

Did you know?

*There are a number of WiNRADiO utilties and plug-ins dedicated to processing and manipulation of memory files. In addition to storing frequencies in memory files, you can also have databases, which are suitable for a larger number of frequencies. For more details of available applications related to memories and databases, please refer to **www.winradio.com/software**.*



At the top of the dialog box is the current memory file name into which you are storing (you can have as many different files as you like). The next line shows the allocated memory number. You can change this to another memory number if you wish (including one which is already allocated).

Then follow the current frequency, IF shift and bandwidth parameters. You can alter these if you wish.

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 particular 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 call sign. You can store up to 11 characters in the ***Call sign*** 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 ***Squelch*** values can also be stored, which will then be 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*** or ***down cursor keys*** to choose the frequency and press ***Enter***.

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 G3XX application, all memory changes are automatically saved; there is no need to use the Save command before exit.

Opening a Memory File

When the WiNRADiO receiver application 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 or 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 or 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 G3XX 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***:

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).

If you are using the ***Signal level*** type of squelch, then a signal is considered 'found' when the signal level becomes *higher* than the squelch level. If you set the squelch level too low, scanning will stop even if there is no signal (the background noise peaks will exceed 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. Correct setting of the squelch value is therefore essential for scanning. 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).

With ***Noise squelch*** (which is especially recommended for use in FM mode), the signal will be 'found' if the receiver finds a channel where the audio is less noisy, i.e. when the audio has been quietened by receiving an FM modulated signal and the noise level has fallen *under* the preset limit. The optimum setting varies, depending on the IF bandwidth (the wider the bandwidth, the higher will be the setting, because the noise on an unoccupied channel will be also stronger).

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.

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:

- When the signal disappears (i.e. the scanning resumes immediately when the signal disappears);
- After a 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 scanning);
- 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);*
- 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 scanning speed is determined by the scanning step size. The scanner tunes the receiver in increments of 10 kHz and uses 10 kHz wide "chunks" of the IF spectrum to search for a signal. If the step size is 10 kHz, the typical scanning speed will be approximately 40 channels per second. If the step size is 5 kHz, then the scanner only needs to retune the receiver once per every two steps, which results in a nearly double the effective scanning speed. For 1 kHz steps, the effective scanning speed will be approximately 400 channels per second.

Note that the maximum scanning speed may be limited by the actually available CPU resources of your computer.

When a 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 in detail later: it serves to restrict Memory Scanning to particular memory groups only.

Exclusions

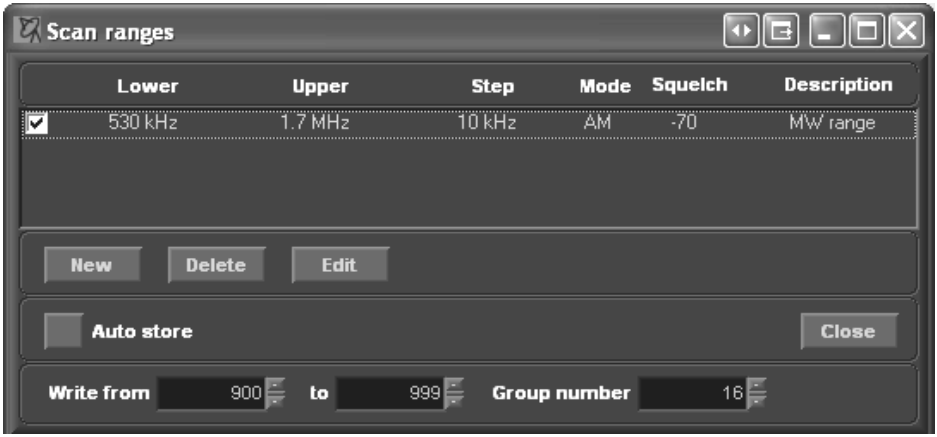
Sometimes it is desirable to exclude certain frequencies from scanning. This means that such specified frequencies should be ignored, even if the signal level on these frequencies is higher than the squelch.

The WiNRADiO G3XX 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.

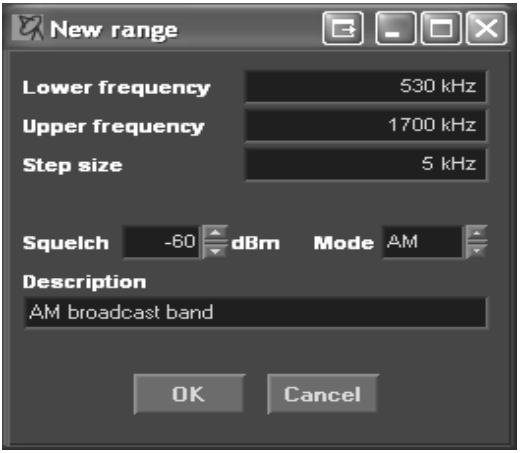


Note the check box at the start of a range. This is useful in situations where you may have several ranges defined, and you wish to enable only one or several from the list, without the need to redefine the whole range list each time you want to make change in one range only. Use the checkbox to select the particular range(s) you wish to include in range scanning.

A very 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 ***Auto Store*** and specify the memory number 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 in ***Scan Settings*** to take effect when the signal is found. For example, ***Pause when signal appears***, 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.*

To create a new range, click the ***New*** button. This will open a dialog box, where you can specify lower and upper limit frequencies of the range, the step size, modulation mode, squelch level, and, optionally, a description. You can enter as many such ranges as you like.



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

Memory Scanning

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

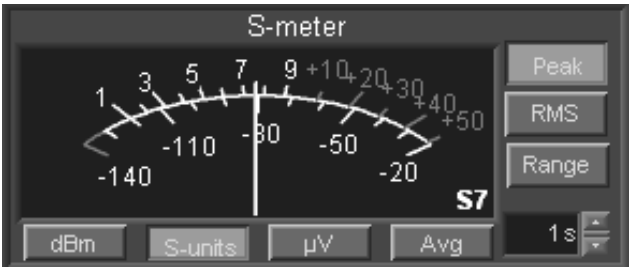
If a squelch value is stored with a memory, this value will then be used to compare with the current signal level. If there is no value stored, the current squelch value will be used as the scanning threshold.

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.

Note: Typical scanning speed for memory scanning is 40 channels/second. This can be significantly reduced for frequencies which are close to each other. For example, if the next frequency is closer than 10 kHz to the previous one, and the specified bandwidth also falls within this 10 kHz distance, then the receiver will not need to tune its hardware to the new frequency. Instead, it will tune to the new frequency by software processing of the received spectrum. This will result in tuning to the new frequency much faster. If scanning speed is important, it is also advisable to sort the memories by frequency, because the larger the tuning step, the longer it takes for the receiver to settle on the new frequency.

S-meter

The WiNRADiO G3XX receiver is equipped with a very sensitive and selective ***Signal Strength Meter*** (*S-meter*) which makes it possible to measure peak or RMS signal level dBm, µV or S-units, within the IF filter passband. The measurement units are selected by appropriately marked buttons at the bottom of the display.

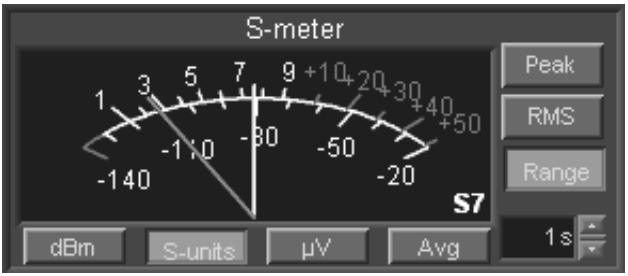


The S-meter also shows the currently selected value of the squelch (the red section at the bottom side of the scale). When the signal strength falls under the squelch level (i.e. the needle falls in the red region and turns red also), the receiver audio will be muted.

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

The ***Peak*** and ***RMS*** buttons select between peak and RMS values (calibrated for sine wave modulation).

The S-meter is very selective, and acts only upon signals within the actually selected IF bandwidth (shaded area in the real-time spectrum display). The ***Range*** button splits the S-meter "needle" into two, and makes it possible to observe the dynamic range of the input signal (i.e. the minimum and the maximum values within the signal bandwidth):



The **Avg** button, when activated, shows the S-meter level value as a floating average within the preset time interval (settable from 1 to 99 seconds). This is used to smooth the S-meter movements. Any change which may affect the S-meter value (such as tuning the receiver to a new frequency or changing the attenuator setting), resets the averaging interval, so that the S-meter may react immediately to such change.

Note: The S-meter relies on the AGC for its proper operation. Therefore, if the AGC is switched off and manual IF gain is used instead, the S-meter is also disabled.

Did you know?

There are no exact definitions for S-units, merely recommendations. Historically, the S-units referred to subjectively perceived signal strength as follows:

S1… faint signals, barely perceptible

S2… very weak signals

S3… weak signals

S4… fair signals

S5… fairly good signals

S6… good signals

S7 …moderately strong signals

S8 …strong signals

S9… extremely strong signals

Nowadays, most manufacturers, including WiNRADiO, usually implement the ARRL recommendation where the S-units are spaced 6 dB apart and S9 corresponds to 50 µV at a 50 ohm antenna input, or -73 dBm (on HF bands).

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 through the speaker or headphones.

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

Date and Time Displays

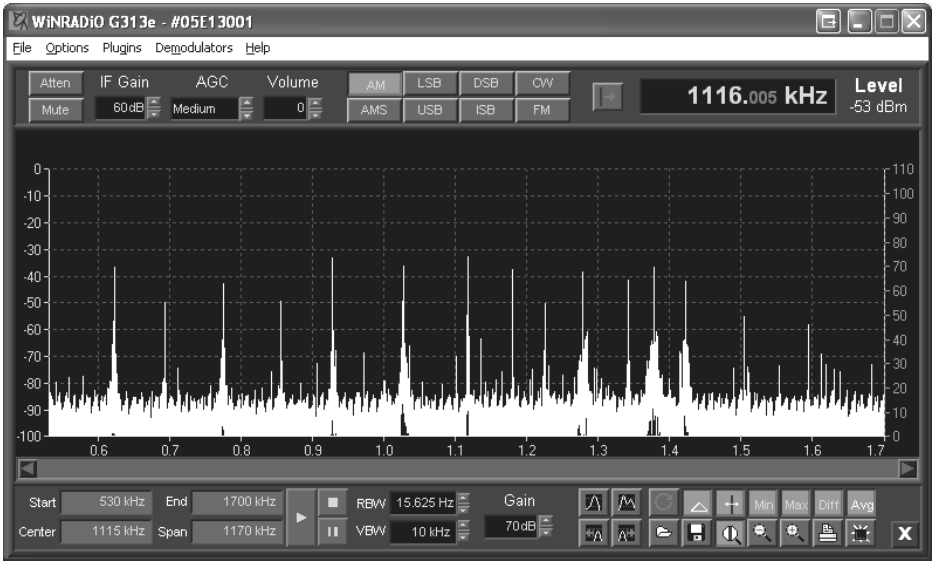
The clock display indicates the current time and date.

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 Analyzer

There are two different versions of a ***Spectrum Analyzer*** in the G3XX receiver software. These are selectable by clicking one of the yellow triangle buttons on the left of the On/Off switch. The Spectrum Analyzer display will slide out.

If the upward pointing arrow button is pressed, the large sized ***full-screen*** spectrum scope will slide out upwards, entirely obscuring the receiver main control panel:



If the downward pointing button is activated, the spectrum analyzer will slide downwards, and will remain attached to the bottom of the receiver control panel, without obscuring it:

This smaller version of the spectrum analyzer window can be resized to a convenient size by dragging the bottom edge up or down.

The bottom parts of both spectrum analyzer windows are exactly the same. The full-screen version also contains a basic set of the receiver controls at the top, so that the user does not need to go back to the receiver panel to change mode, volume, attenuator, etc.

Unlike the spectrum scope inside the demodulator panel, which is real-time and narrow band, the Spectrum Analyzer is wide-band and the graph is created by fast tuning the receiver across the specified frequency range in smaller "chunks" of IF spectra, which are joined together.

To set up spectrum sweeping, enter the ***Start*** and ***End*** frequencies to specify the start and end of the sweeping range, respectively. Alternatively, you may enter the ***Center*** and ***Span*** frequencies.

Next select the ***RBW*** (Resolution Bandwidth), which determines how detailed the spectrum will be (the lower the RBW, the finer the detail). The finest RBW is 15.625 Hz. The RBW has a proportional effect on the spectrum sweeping speed, i.e. the greater the RBW, the faster speed, but at the expense of detail.

The ***VBW*** (Video Bandwidth) is a low-pass filter which is applied to the resulting "video" trace of the signal and makes it possible to smooth the trace. The lower the VBW, the smoother the trace. This setting has the same effect as the Video Filter in the demodulator panel.

The spectrum analyzer, when activated, disables the AGC. This is in order to have a uniform gain for the entire scanning range – if the gain was changing due to the AGC action, the spectrum trace would be distorted (stronger signals would appear weaker, and weaker signals would appear stronger). The ***Gain*** control (adjustable from 0 to 99 dB) is used to set the IF gain for the spectrum analyzer.

Note that if the gain is set too high, the receiver may overload in the presence of strong signals and the trace will be distorted around these signals. On the other hand, if the gain is too low, some weak signal peaks may be missed.

The sweeping is controlled using a set of buttons similar to an audio recorder: The ***Start*** button (with a triangle) starts sweeping. The ***Stop*** button (with a square) stops sweeping, while the ***Pause*** button (with two vertical lines) pauses it:

The button with a red round arrow selects ***continuous sweeping mode***, 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. If this button is disengaged, the spectrum analyzer will be in a *single shot* sweeping mode:

When the mouse cursor is positioned over the spectrum graph, a red cursor will appear. 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.

The frequency corresponding to the cursor position, as well as the corresponding signal level will be shown above the spectrum graph. In addition to the frequency and level, minimum, maximum and their difference values are also shown. These are values obtained throughout the entire time that the spectrum analyzer is sweeping. Note that if the spectrum analyzer is in the single-shot mode, the min and max values will be equal upon the termination of the sweep.

Right-clicking on the spectrum graph will cause a stationary blue vertical line, the "marker" to appear over the graph. The marker can be either dragged using the mouse, or repositioned by simply right-clicking on a new location. The marker can be made invisible by disengaging the ***Show Marker*** button:

The Show marker button gets activated automatically upon right-clicking on the spectrum graph.

When the marker is activated, marker frequency and the associated trace values will be displayed under the cursor values. If the marker delta mode is activated using the ***Marker Delta Mode*** button, these values will become differential with respect to values associated with the current position of the cursor:

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 investigating 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.

Note that it is also possible to save a spectrum graph and then load it later to perform a new sweep to show differences from the old graph, to see what has changed on the band in the meantime.

The G3XX Spectrum Analyzer also contains special function buttons to locate peaks in the displayed frequency spectrum:

The ***Find Maximum Peak*** button (top left of the four) locates the maximum peak of the entire spectrum and positions the marker over the peak. The ***Find Next Peak*** (top right) find the next tallest peak. The two buttons below, ***Find Peak Left*** and ***Find Peak Right***, locate the next tallest peaks in the respective direction.

The ***Averaging*** button enables ***trace averaging***. With trace averaging enabled, the displayed trace is not the actual currently swept trace, but rather an average of the currently swept trace and the previous trace:

There are also three ***zoom-related buttons***:

The first button centers the zooming action around the marker (if the marker position has been set) - if this button is disabled then zooming will be done with respect to the center of the screen. The next two buttons perform the actual zooming in and out functions.

To hide the Spectrum Analyzer, use the yellow X button at bottom right:

The larger of the two versions of the spectrum scope contains basic controls of the receiver, which are self-explanatory:

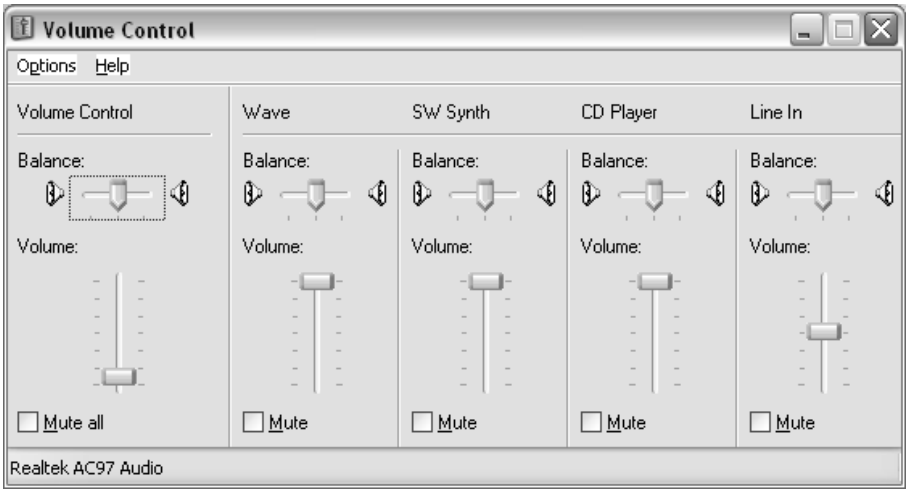
The only additional feature is the ***Tune to marker*** button. This is a momentary button which tunes the receiver to the current marker frequency, if the marker is enabled:

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). When you tune to a station, you should be able to see a peak on the real-time spectrum scope. If you can't see any peak, please make sure your antenna is properly connected. If you can see a peak but there is no sound coming from the speaker, please check the following:

- The ***Mute*** button in the demodulator panel is disengaged and the volume is set to a medium level (say 15).
- ***SAGC*** is set to medium.
- The squelch is set below the current signal level, or disabled using the ***Defeat*** (squelch defeat) button.
- The ***Attenuator*** is off, ***Preamp*** is on, and ***AGC*** is set to medium.
- With G3XXi receiver, the receiver audio output is connected either to an amplified speaker (a standard PC multimedia speaker with stereo input cable), or 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***.)
- If the receiver is connected directly to amplified speakers, make sure they are turned on, and the volume is set to approximately one half. If you are using the sound card for the audio output, check that the input to which the receiver is connected to is not muted in the sound card control panel and the volume is also set to approximately one half:



*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**.*

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 pressed – usually the medium setting should be used). Also set **SAGC** to **Med**. In the demodulator **Setup**, adjust the SAGC reference level down.*

Problem: The sound is OK in AM mode, but FM mode sounds distorted.

Solution: Ensure that the **Audio filter** in on, and set to **Bandpass** in the demodulator **Setup**, with de-emphasis set to -6dB/oct. Also try to reduce **Audio gain** under **Demodulator settings**.

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: Presuming the volume is set to the maximum level (31) in the demodulator panel, you can adjust the volume also in the sound card control panel, or on the amplified speakers you are using. Also, if ***SAGC*** function is turned off, turn it on by clicking the ***Med*** button:

You can increase the volume when SAGC is on by adjusting the ***AGC reference level*** under ***Setup*** (excessive level will cause distortion). If you prefer to keep SAGC off, you can increase the volume under ***Setup***, by adjusting the ***Audio gain*** level.

Problem: I can hear the audio and tune the receiver, but the spectrum scope display is very sluggish, sometimes it even freezes.

Solution: Close all other simultaneously running programs to reduce the burden on the CPU. This may indicate insufficient CPU resources in your PC. Perhaps you have too many programs running in the background?

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 and the ***Preamp*** is on. 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 perhaps the antenna is picking up too much ambient noise. Try to improve the antenna, or move it further away from the PC. (*For additional noise-defeating measures 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 other household appliances. Your PC (especially the monitor) could be the culprit. Unless you are able to suppress the interference at the source, 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 30-100 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***.)

Problem: I managed to drag the spectrum scope window down to the point where the bottom is now obscured, so that I can't drag it back (and the top is as high at the top of the screen as I could go).

Solution: Windows allows you to resize any window up to the height of the desktop. This problem can happen after resizing almost any resizeable windows.

You can resize or move the taskbar (just like any other window) to reveal the bottom of G3XX panel. Make sure that ***Lock the Taskbar*** is not checked in the pop-up menu (right-click on an empty space on the taskbar). If the taskbar is locked, you can't resize or move it. If you prefer to move the taskbar to the left side of the desktop, just hold the mouse on the empty space and drag it.

Another way to solve this problem is to close the G3XX application and manually edit the ***wrG3XXni*** file in the Windows directory. For example, you will see values similar to these:

```
[Scope-03E27014]

Visible=1

Height=300
```

where 03E27014 is the serial number of your receiver. Your 'Height' value is probably greater, but you should change it to a reasonable value (about 200).

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.

The G3XXe receiver requires that the sound card ***Wave*** input is unmuted. The volume can be then adjusted using the Wave slider and the master ***Volume Control***.

The G3XXi receiver does not require a sound card as the output is already a converted analog ***Line Output***. You can connect this directly to standard amplified multimedia speakers or an external amplifier of your choice. You can also connect it to a sound card.

If you wish to connect your G3XXi receiver to a sound card, you can simply use the supplied audio cable and connect it to the Line input (alternatively to ***Microphone*** input, if the ***Line*** input is not available). The output volume is controlled by the ***Playback*** volume control of the sound card.

Typically, you would access the Playback volume control panel by clicking the speaker icon in the Windows Task Bar.

If the speaker icon is missing, an alternate way to accessing the Playback controls is via the Windows Control Panel. Here you can also enable or disable the speaker icon.

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

Did you know?

The ubiquitous PC sound card was invented in Singapore by Sim Wong Hoo, engineer and entrepreneur, who founded the Creative Technology company in 1981. His first product, an Apple computer clone, did not take off. However, his second product, the PC sound card, hit its target well: More than 120 million sound cards have been shipped by Creative Technology, mostly under the Sound Blaster brand.

Windows	Enable "speaker" icon	Recording/playback volume controls
98	*Control Panel* | *Multimedia Audio-tab* **Checkbox**: "Show volume control on the taskbar"	*Control Panel* | *Multimedia Audio-tab* **Sound Playback**: Click on  button
ME	*Control Panel* | *Sounds and Multimedia Sounds-tab* **Checkbox**: "Show volume control on the taskbar"	*Control Panel* | *Sounds and Multimedia Audio-tab* **Sound Playback** → **Volume** button
2000	*Control Panel* | *Sounds and Multimedia Sounds-tab* **Checkbox**: "Show volume control on the taskbar"	*Control Panel* | *Sounds and Multimedia Audio-tab* **Sound Playback** → **Volume** button
XP	*Control Panel* | *Sounds and Multimedia* | *Sounds-tab* **Checkbox**: "Place volume icon in the taskbar"	*Control Panel* | *Sounds and Multimedia Audio-tab* **Sound Playback** → **Volume** 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, electrical welding equipment, 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 G3XX 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. If the interference still exists 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.

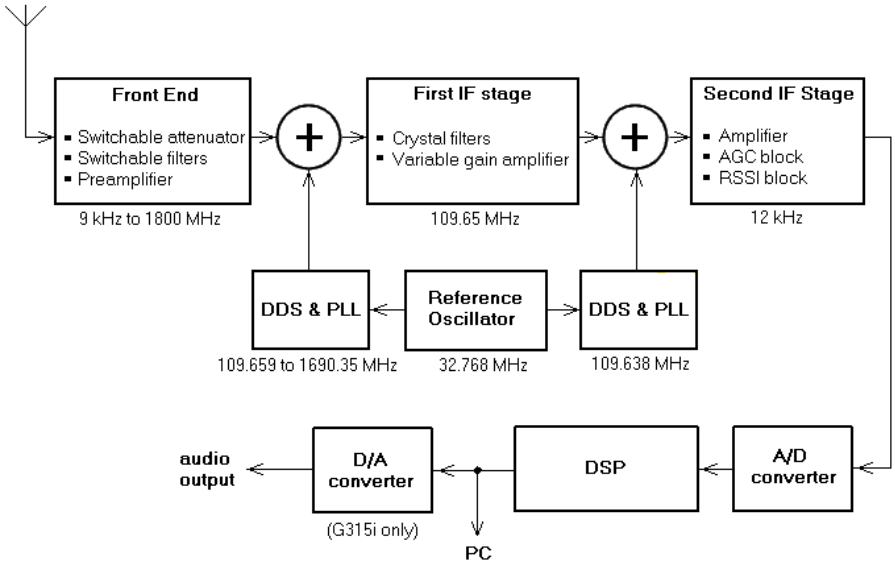
If you live very close to a strong local transmitter, these measures may be insufficient. In such case, you should be able to eliminate intermodulation by fitting a special filter to your antenna, to reduce the level of the signals causing the interference. The design and application of such filters falls beyond the scope of this user's guide. However, broadcast frequency filters and tunable ***preselectors*** are standard items and can be obtained from good radio equipment suppliers.

Appendix D – Inside WR-G3XX Hardware

Technically minded users may like to explore the WiNRADiO G3XX Receiver and experiment with some of the innovative concepts of this ***Software Defined Radio***.

The WiNRADiO G3XX Receiver is one of the first commercially available Software Defined Radios, where the Demodulator function is fully performed in software.

The receiver hardware contains the following functional blocks:



The incoming signal from the antenna (in the 9 kHz to 1800 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 109.65 MHz intermediate frequency is filtered using two 4-pole 109.65 MHz crystal filters with an IF bandwidth of 15 kHz, and then amplified.

The second mixer again uses a DDS with a PLL to mix the 109.65 MHz signal down to the last intermediate frequency, which is 12 kHz (the last IF frequencies may be selected within a range of 12 to 22 kHz, to suit various special applications).

The receiver's internal reference frequency for both DDS circuits is 16.384 MHz, which is derived from a precise 32.768 MHz oscillator.

The 12 kHz centered output of the second IF stage is fed to a 16-bit A/D converter sampling at 64 kHz. This digitized signal is processed by a DSP which performs digital filtering (responsible for the variable IF bandwidth) and demodulation. Additional digital signal processing (for example FFT functions related to the real-time spectrum scope and selective S-meter) is performed on the host PC.

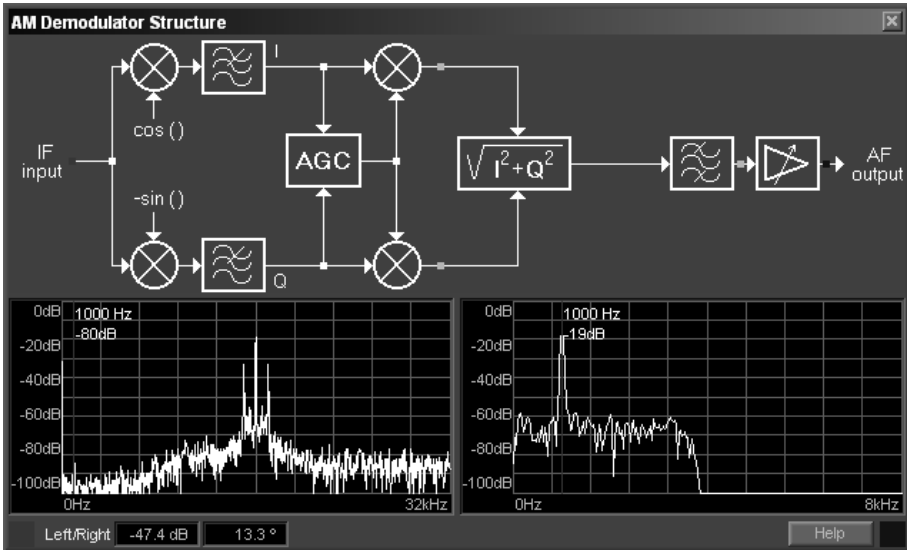
The AGC is performed in the first IF stage, based on the level of the last IF output. The AGC action is delayed until the dynamic range of the first IF stage is fully utilized – this is in order to prevent desensitization of the receiver in the presence of neighbouring strong signals, falling within the 15 kHz IF bandwidth. The resulting variation in audio output is then compensated in software, using the ***Software AGC*** facility of the demodulator.

Note: Such a mixed arrangement, where the critical analog-to-digital sampling and processing are done by the on-board DSP while the rest is performed by the PC (rather than all processing being done on the PC), has the advantage of providing consistently high performance by eliminating performance variations caused by poor quality or incorrectly set up PC sound cards. A higher quality analog-to-digital converter used in the G3XX receiver makes also a higher sampling rate possible than is available on a standard PC sound card, which results in a further improved performance. With the time-critical demodulation code running on the DSP, this also makes it possible for a single PC to support several receivers running simultaneously without burdening the CPU resources.

Appendix E – Inside WR-G3XX Demodulator

The internal structure of the G3XX demodulator is easily accessible by pressing the ***Study*** button in the demodulator panel.

The G3XX Demodulator relies on a general quadrature representation of the incoming 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 & Q***.

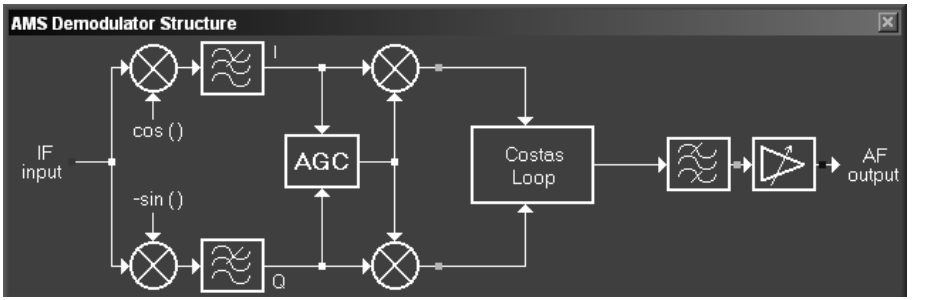


AM Demodulator Structure

The demodulator structure windows include two spectrum analyzers making it possible to view signal spectra in real-time. Each analyzer can be associated with 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.

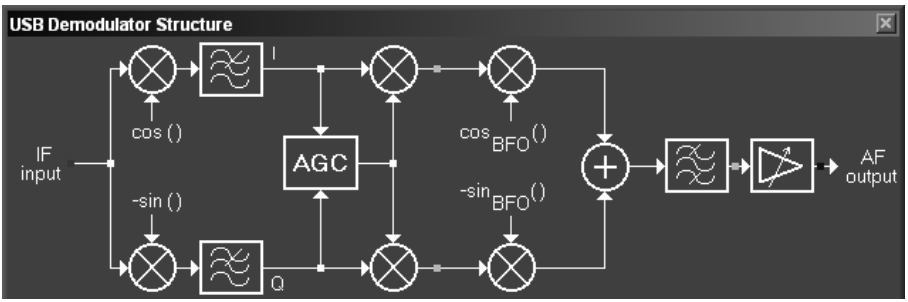
Within the displayed spectra, a red color frequency cursor can be manually dragged, using the left mouse button, over a particular spectral component. The two ***Vector Voltmeter*** displays labelled Left/Right indicate the relative amplitude and phase difference between the two spectral components at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

For synchronous demodulation of amplitude modulated signals (the *AMS* mode) without carrier or with a fluctuating one, the G3XX demodulator uses a PLL carrier recovery technique based on the ***Costas loop***:



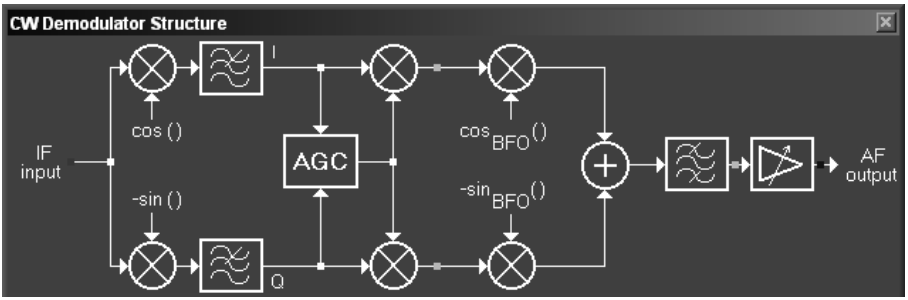
Synchronous AM Demodulator Structure

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.



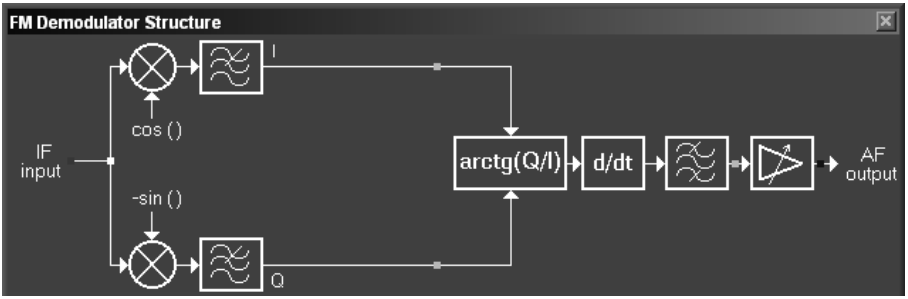
USB Demodulator Structure

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 setup.



CW Demodulator Structure

Finally, the frequency demodulator performs a time derivative function on arctangent of Q over I, to arrive at amplitude-independent frequency demodulation of the input signal:



Appendix F – Developer Support

WiNRADiO has always extensively supported third-party software development efforts with all our receivers, and the WiNRADiO G3XX receiver is no exception. We provide technical details for developers to be able to develop the following:

- Third-party applications controlling the WiNRADiO G3XX 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**).
- 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**).*
- New types of demodulators. *The G3XX demodulators in fact represent a special type of XRS plug-in. Detailed information is also available at **http://xrs.winradio.com**).*
- Support under alternative operating systems*. See for example **http://www.linradio.com**.*
- 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 w**ww.winradio.com/register** to take advantage of this free service.*

Appendix G – Wide-band FM Option

"WFM" option makes it possible to receive wide-band modulated signals ("broadcast FM") on the G3XX receivers. On the standard G3XX receiver, the wide-band FM capability is not included, because it is not possible to provide this within the constraints of the 15 kHz instantaneous bandwidth of the digitized IF signal and the DSP software processing power.

The WFM option is in fact a self-contained "hardware-defined" receiver. The user can receive wide FM broadcasts, but cannot see the entire 230 kHz bandwidth in real time. Instead, the real-time spectrum panel shows demodulated audio spectrum. It is also not possible to perform IF recording, but it is of course possible to make audio recording.

Appendix H – Frequency Calibration

The G3XX receiver series features an excellent frequency accuracy and stability for a receiver of its class. It is however possible to improve this accuracy yet further, by individual calibration.

The receiver calibration is accomplished by inserting a reference frequency parameter in the ***wrG3XX.ini*** file which resides in the Windows directory. The reference frequency parameter consists of two lines of the following format:

```
[ClockCalibration]
receiver_serial_number=reference_frequency
```

The receiver serial number can be obtained for example from the ***About*** box in the G3XX application. The reference frequency is the actual frequency of the internal reference oscillator in Hz. This is normally 16.384 MHz, i.e. 16384000 Hz.

Each receiver is factory calibrated, so a fundamental correction to the nominal 16.384 MHz reference frequency already exists and is stored in the receiver's internal memory. This correction can be overridden by the new parameter in the ***wrG3XX.ini*** file. To determine the true offset from a perfect tuning, firstly use 16384000 (i.e. the nominal reference frequency in Hz) as the ***reference_frequency*** parameter. Say your receiver serial number is 02L27011:

```
[ClockCalibration]
02L27011=16384000
```

Save the ***wrG3XX.ini*** file with this value, then start the G3XX application. The frequency error will be now much worse because the new parameter overrides the original factory calibration. Then tune the receiver to a known frequency standard. A high-accuracy signal generator can be used, or one of the WWV Time and Frequency Standard stations. Observe the peak with the spectrum scope and listen to the beat frequency in the CW mode with a minimum IF bandwidth. Then note down the frequency difference. (For example, -152 Hz at 10 MHz).

Then scale the frequency difference to 16.384 MHz. For example, if the frequency difference is -152 Hz at 10 MHz, it will be -249 Hz at the 16.384 MHz reference frequency.

To arrive at the corrected reference frequency, subtract the frequency difference from 16384000. In our example, 16384000-(-249)=16384249. The entire reference frequency parameter in the ***wrG3XX.ini*** file will be then as follows:

```
[ClockCalibration]
02L27011=16384249
```

Save the ***wrG3XX.ini*** file, then restart the G3XX application and observe the difference.

To return to the original factory frequency calibration, simply delete the inserted two lines in the ***wrG3XX.ini*** file. You can also delete the entire file (which will however result in losing all current receiver settings and return to factory defaults for all of them).

Did you know?

The WWV Time and Frequency Standard station which broadcasts on 2.5, 5, 10, 15 and 20 MHz, has a long history that dates back to the very beginning of radio broadcasting. The call letters WWV were assigned to the US National Institute of Standards and Technology (then called the National Bureau of Standards) in October 1919. By December 1922, it was decided that the station's purpose would be the transmission of standard frequency signals. The accuracy of the transmitted frequency was quoted as being better than 0.3 per cent. Nowadays the station frequency is controlled within one part in 10^{13}, which represents frequency accuracy thirty billion times better.

Appendix I – S-meter Calibration

The G3XX receiver series features a uniquely accurate and powerful S-meter. However, it is possible to improve this accuracy yet further, by individual calibration.

The receiver S-meter calibration is done using a special ***S-meter Calibrator*** application, which can be downloaded from WiNRADiO Web page

www.winradio.com/home/calibrator.htm.

The S-meter Calibrator alters the factory-supplied default data in the receiver calibration file ***wrG3XX.cal*** which resides in the receiver application folder (i.e. typically ***C:/Program files/WiNRADiO/G3XX***).

The S-meter Calibrator requires the use of a precisely calibrated synthesized signal generator to generate calibration levels in the frequency range of interest. It possible to create calibration tables for as many frequency points as required, and interpolate between these tables to arrive at absolute calibration values for any arbitrary frequency the receiver is tuned to.

The S-meter Calibrator includes special commands to create, edit and manipulate calibration tables, interpolate between individual calibration points within a particular table as well as between entire tables, view calibration graphs for individual frequencies, and other useful facilities.

The S-meter Calibrator is provided as an *"as is"* complimentary tool for WiNRADiO receiver users. The calibration procedures should not be attempted by persons without a deeper understanding of the underlying concepts, as WiNRADiO can only provide a limited technical support for this application, and can accept no responsibility for any difficulties arising from its use.

To restore the original factory calibration, simply delete the ***wrG3XX.cal*** file and reinstall the G3XX application.

Appendix J – USB Interface Diagnostics

The flashing pattern of the blue LED on the external G3XXe model has a diagnostics meaning. Normally, when the receiver is powered up and the application running, the blue LED should flash in a dih-dah pattern (i.e. a short flash followed by a long one).

A complete list of the flashing patterns and their meaning is as follows:

Pattern	Description	Mode
	Off	No power
–	Long flash, equal gap	No connection to computer
. .	Two short flashes	USB connected, driver installed, application running, radio off
. –	One short flash, followed by a long one	USB connected, driver installed, application running, radio on
. . –	Two short flashes followed by a long one	USB connected, but driver not installed
. . .	Three short flashes	USB connected, driver installed, application not running