WiNRADiO®

G303 Shortwave Receiver

User's Guide

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Printed in Australia

FCC Notice

The WiNRADiO G303 receiver has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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

Caution

To comply with the limits for the Class B digital device, pursuant to Part 15 of the FCC rules, the WiNRADiO card must be installed in computer equipment certified to comply with the Class B limits. Only peripherals certified to comply with the Class B limits may be attached to the computer containing the WiNRADiO receiver. Operation with non-certified peripherals may result in interference to radio and TV reception. Removal of ferrite cores from power or interface cables is prohibited. Only original cables supplied by the manufacturer must be used.

Modifications

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

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

Introduction

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

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

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

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

Welcome to shortwave and welcome to the WiNRADiO G303 receiver. Your new receiver is a world-first in more than one respect. Most importantly, it is the first commercially available ***Software Defined Receiver*** (SDR), where the entire demodulator and the last intermediate frequency stage are performed by software running on a personal computer rather than using conventional hardware circuits, or a dedicated Digital Signal Processor. Your PC probably has more power than even the fastest DSP had only a few years ago. Your new WiNRADiO G303 receiver is now ready to take advantage of that power. Enjoy!

WiNRADiO provides regular upgrades to our application software. Don't forget to register as a WiNRADiO user to receive news about new products, accessories and software upgrades for your WiNRADiO G303 receiver. Use our on-line registration form on ***www.winradio.com/register*** *to take advantage of this free service.*

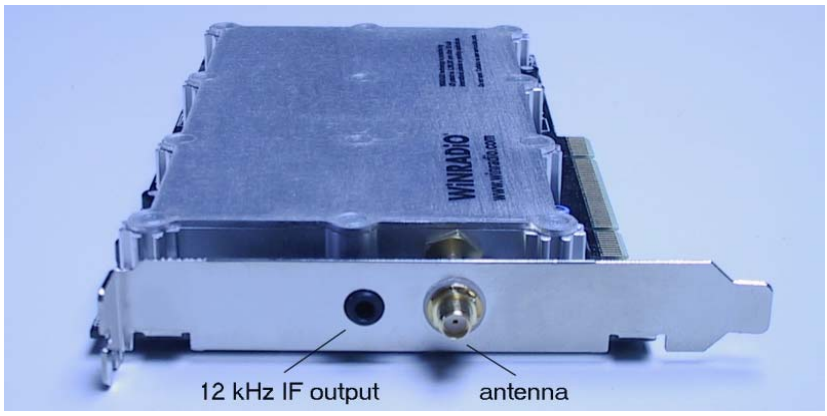
G303 Receiver Models

There are two basic models of the WiNRADiO G303 receiver:

- G303i (PCI card based “internal” model)
- G303e (USB based “external” model)

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

The G303i model has two connectors: the antenna connector (SMA type, 50 ohm) and 12 kHz IF (intermediate frequency) output:



The signal from the 12 kHz IF output is normally connected to the PC sound card, where it is digitized, to be then processed by the PC.

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 12 kHz IF output to the sound card input.

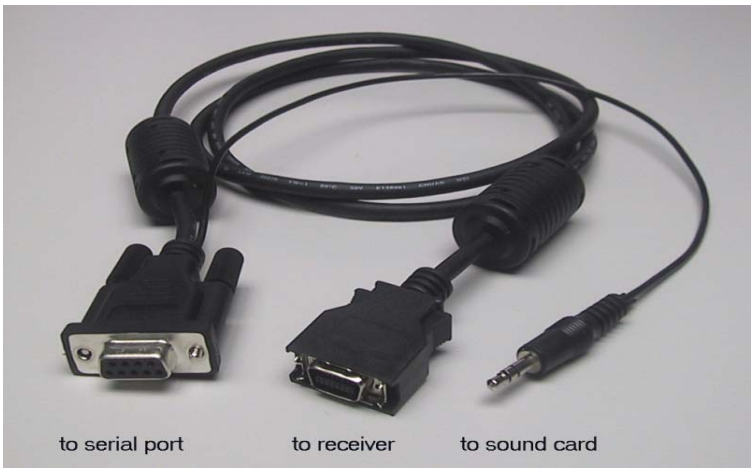
The external G303e model has three connectors:

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 IF output/control connector combines the 12 kHz IF (intermediate frequency output), USB interface and serial interface. Normally, only the USB interface cable is supplied, and the IF signal arrives from the receiver to the PC already digitized, via the USB cable. This method is preferable, because it relies on a high-quality analog-to-digital converter inside the receiver, and guarantees optimum and consistent performance. The installation is also simpler as it does not require adjustment of the 12 kHz IF signal input level (this is set to optimum level inside the receiver).

It is also possible to control the receiver via the serial (RS-232) interface, which necessitates using the PC sound card for digitization of the IF signal. WiNRADiO provides a special “serial interface option” cable which takes care of all the appropriate connections, both to the serial port and the sound card input.



G303e serial interface option

As this interfacing method relies on the sound card to provide the digitization of the 12 kHz IF signal, it requires careful adjustment of the input signal level. The performance will depend on the sound card quality.

It is a suitable method in situations where the receiver needs to be controlled by computer systems without the USB interface.

Did you know?

DRM (Digital Radio Mondiale) is a new digital broadcasting system for medium and short waves. By introducing sophisticated signal coding and compression, this system offers a dramatic improvement in broadcast quality. WiNRADiO has a DRM demodulator available for your G303 receiver. For more details please refer to ***www.winradio.com/drm****.*

Installation

The WiNRADiO package contains the following items:

- WiNRADiO G303i or G303e receiver
- WiNRADiO software on a CD ROM
- Start-up indoor antenna
- Audio cable (G303i model only)
- Power adapter (G303e only)
- Interface cable (G303e 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, full duplex	Creative Sound Blaster, 16 or 32 bit
OS	Windows 98/ME/NT/2000/XP	Windows 2000/XP

Hardware Installation

G303i model (PCI card-based)

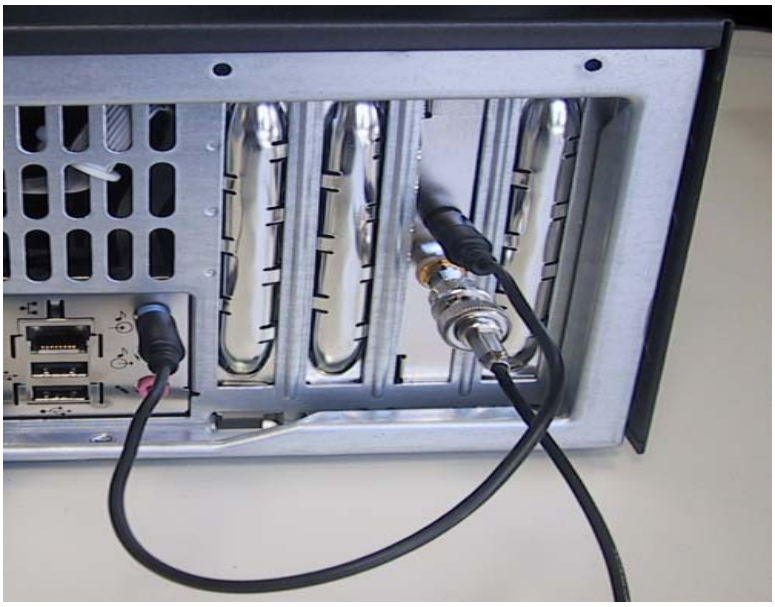
1. Turn off the computer and disconnect the power cord.

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

3. First touch the computer metalwork with your hand to drain any static charge, then carefully insert the card into the vacant slot and push down until it is firmly seated. Screw the metal bracket at the end of the card to the computer case. *(This must be done to provide proper grounding for the card)*.

4. Replace the computer case and reconnect the power cord.

5. Connect the supplied audio lead between the receiver output (a standard audio jack) and the sound card Line Input. *(If there is no Line input on your PC, as is the case with some laptops, you may use alternative inputs, such as the Microphone input. This may be also necessary with certain types of sound cards, such as Creative Audigy 2.)*



G303i receiver installed in a desktop PC

G303e (external) model with standard USB interface

1. Connect the receiver to the USB port using the supplied cable.

2. Plug the supplied power adapter to the power outlet and connect its output to the receiver.

3. Turn the receiver on using the power switch at front of the receiver. The blue LED will blink to indicate that the receiver is ready.

G303e receiver with USB interface

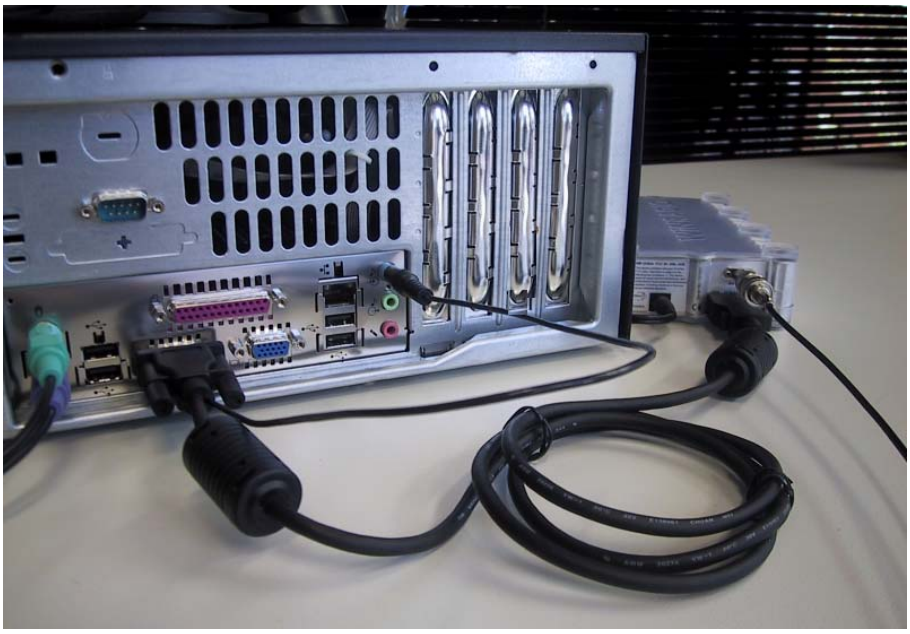
G303e (external) model with optional serial interface

1. Connect the receiver to the serial port using the supplied adapter, which combines both the serial interface and the audio lead in one cable.

2. Connect the audio lead on the PC side to 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. This may be also necessary with certain types of sound cards, such as Creative Audigy 2.)*

3. Plug the supplied power adapter to the power outlet and connect its output to the receiver.

4. Turn the receiver on using the power switch at front of the receiver. The blue LED will blink to indicate that the receiver is ready.



G303e receiver with serial interface

G303e LED status indication

The single blue LED on the front of the WiNRADiO G303e (external) receiver can display a number of different states using various specific flash patterns. Each pattern is repeated once per second.

In the following table, “black” in the pattern indicates that the LED is on in that time interval.

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

Did you know?

The blue LED is a semiconductor that glows blue when electricity is passed through it. Of the three primary colors for light, the red and green LEDs were invented more than 20 years earlier; the blue LED, however, proved to be elusive. In 1993, the blue LED was developed and soon brought to market owing to a new technology devised by Prof. Shuji Nakamura. Its world-wide success in consumer markets has been spectacular – as fascinating as the intensive and mysterious glow of the blue LED itself.

Connecting the Antenna

Your WiNRADiO G303 receiver comes with a start-up antenna consisting of a 3-meter length of coaxial lead-in cable, with an additional 3 meters of insulated wire. The thinner, insulated wire at the end is the actual antenna. The long lead-in cable is necessary for the antenna to be located as far away from the PC as possible, to reduce interference from the PC.

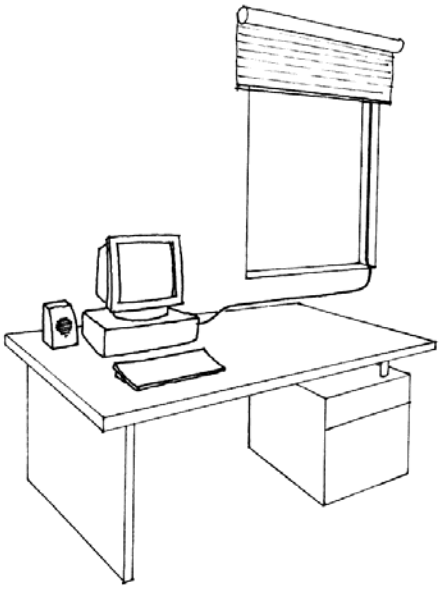
Please note that this start-up antenna is supplied for immediate gratification only and is not intended to replace a good shortwave antenna.

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

Something to consider?

WiNRADiO also manufactures antenna impedance transformers (often referred to as "long-wire baluns"). The WR-LWA-0130 adapter shown on the left can be used to match the impedance of a long wire shortwave antenna to the 50 ohm input impedance of the WR-G303 receiver.

Such impedance matching usually results in a significant signal strength increase compared to the long wire antenna connected directly to the antenna input of the receiver. For more information on this product as well as the WiNRADiO range of antennas, see the WiNRADiO Web site ***www.winradio.com****.*



An example of WiNRADiO start-up antenna placement

No matter how good a radio receiver is, the performance of the entire receiving system will depend on the quality of the antenna. The same applies to a WiNRADiO receiver. To make the most of your WiNRADiO receiver, you should install a proper shortwave antenna.

Check out our antennas

There are many vendors offering shortwave antennas. WiNRADiO with our extensive range of antennas may also be able to assist. Check out especially our low-cost wire antenna AX-05E, which is particularly suitable for the G303i receiver: ***www.winradio.com/home/antennas.htm***

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. *(Note: Windows NT will not automatically detect the receiver, as it does not support Plug and Play.)*

2. After installing the drivers, choose the ***Run*** command from the ***Start*** menu in Windows and type D:\INSTALL (if the CD ROM is the D: drive on your PC).

3. This will run the application installer, which will guide you in the installation process.

4. After all the files have been installed to your hard disk, run the WiNRADiO G303 application.

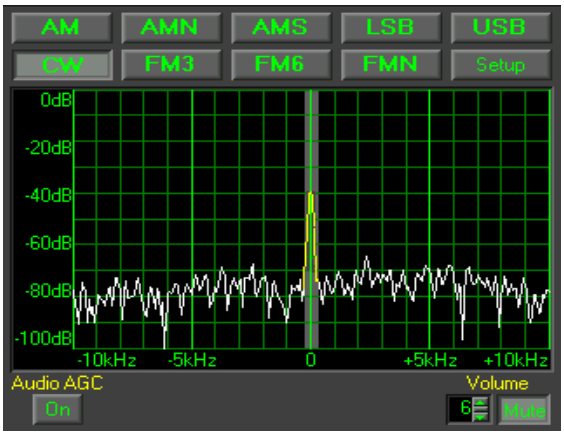
Note: If the receiver is not detected by Windows, you can simply skip the driver installation procedure, insert the CD ROM, and run the installation program, which will also install the drivers.

Setting up the Sound Card

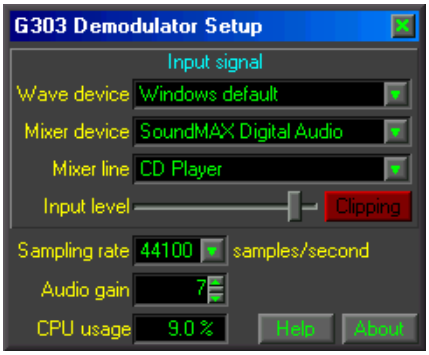
This section refers to the G303i model, or the G303e model with serial interface, only. The G303e model with the standard USB interface does not require this set up and this entire section may be skipped.

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

In computer terminology a sound card is a ***wave device***. A computer may have several such wave devices installed (for example a modem with voice capabilities). That's why you need to select the sound card as the desired wave device first. Start the WiNRADiO G303 application and click on the ***Setup*** button (located below the ***USB*** button) in the ***demodulator panel***:



The demodulator set-up window opens, as shown:



The ***Wave device*** drop-down list shows all the installed wave devices: *Windows default* is the Control Panel setting specified under ***Start*** **|** ***Settings*** **|** ***Control Panel*** **|** ***Multimedia Properties*** **|** ***Audio***. If a sound card is specified in this Control Panel setting for both playback and recording (this is very likely, but not always necessarily so), then you can simply select ***Windows Default*** as the ***wave device*** for the demodulator. Otherwise, the specific name of the sound card should be selected.

The selected sound card ***must support duplex operation*** and the standard 44100 or 48000 samples/second sampling rates, 16 bits per sample, stereo. Most modern sound cards do satisfy all these conditions, but some cards may have a high level of distortion at 48000 samples per second; for such cases, the 44100 samples/second sampling rate is provided.

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

In the drop-down list of sound card inputs, each line is available either as normal, or ***Reversed***. If the reversed line is selected, this means that the left and right channels (of the sound card stereo input) are to be reversed. Normally, you should not need to select any of these reverse inputs. However, there is a very small number of sound cards where the left and right inputs are swapped. Normally, the G303 Demodulator expects the receiver output to be connected to the right sound card input. If it is to be connected to the left input instead, the reverse input line needs to be selected from the drop-down list.

With some laptops, only the ***Microphone*** input may be available and in such case you will need to connect the receiver to the ***Microphone*** input instead, and also select this input in the demodulator ***Setup*** panel. Certain sound cards, in particular ***Creative Audigy 2***, have a design problem which prevents them from using the ***Line*** input in a full duplex mode. In such case, you will also need to use the ***Microphone*** input.

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

The last parameter to set is the ***Input level***. Set it to half the maximum level initially. When you then tune the receiver to your first station, you should return to this, and adjust the ***Input level*** below the point when the ***Clipping indicator*** turns red. If the signal still sounds distorted, reduce the level further down until the distortion disappears.

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

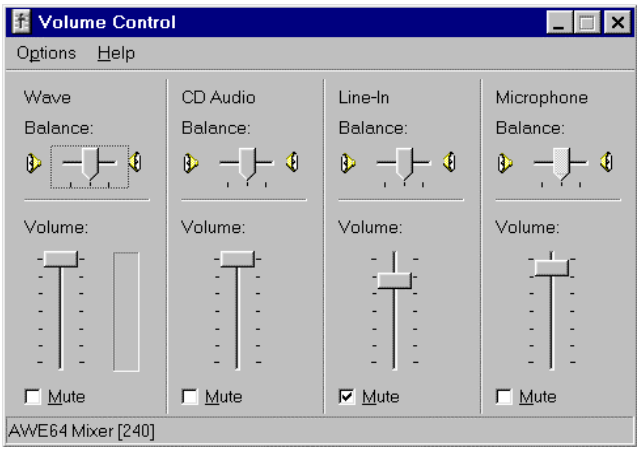
This completes the software installation process. The G303 software then automatically configures the sound card control panel. It may be interesting to describe what it actually does and why:

*Firstly, in the sound card **Playback** volume control panel, the software mutes the sound card input line the receiver is actually connected to. This is the same line as selected in the WiNRADiO G303 demodulator **Setup**, i.e. usually, this will be **Line** or **Microphone** input.*

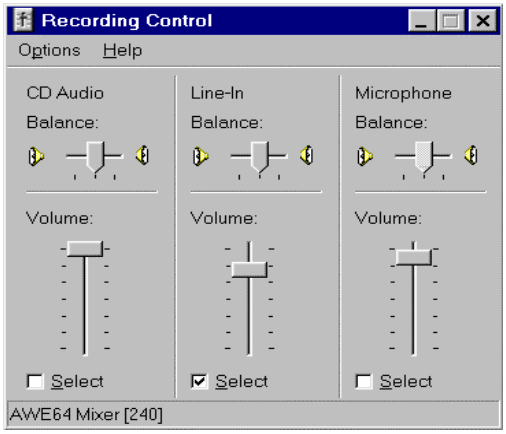
*This may seem a bit unexpected: Why are we muting the input line? This is because the signal coming from the receiver is not an audio signal, but rather the intermediate frequency signal. It needs to be processed (demodulated) by the PC first, before it is output back to the sound card. That's also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

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

*To see how the line is muted, click on the speaker icon in the task bar in the bottom, to bring up the sound card **Volume Control** panel (consult **Appendix B – Sound Card Controls** if you have difficulties locating the sound card settings):*



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



*The **Volume** slider of the **Recording Control** is duplicated in the demodulator **Setup** panel (where it is labeled **Input level**).*

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

- Not selecting the ***Mixer device*** or ***Mixer line*** correctly (which will manifest itself by the absence of any signal appearing in the spectrum scope);

- Failing to adjust the ***Input level*** properly, which may result either in low (or no) audio output, or, on the other hand, distortion if the signal level is too high.

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.

Getting Started

There is often a degree of understandable impatience when exciting new equipment such as a new WiNRADiO receiver is acquired. The following fast-forward introduction makes it possible for you to start using your new acquisition as quickly as possible. Detailed operation is described in the subsequent chapter ***Using WiNRADiO G303 Receiver***. We hope you will return to that chapter, as the WiNRADiO G303 receiver has many fine features which it would be a shame to miss.

Start the WiNRADiO G303 receiver application (double clicking on the WiNRADiO icon). The WiNRADiO G303 receiver control panel will appear as shown below.

WiNRADiO G303 Receiver Control Panel

The WiNRADiO G303 receiver control panel has some elements similar to conventional shortwave receivers, and many additional features as well.

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

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

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

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

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

There are also several other ways to tune the WiNRADiO receiver other than typing the frequency or using the tuning knob. These will be explained in detail in the *Using WiNRADiO G303 Receiver* chapter.

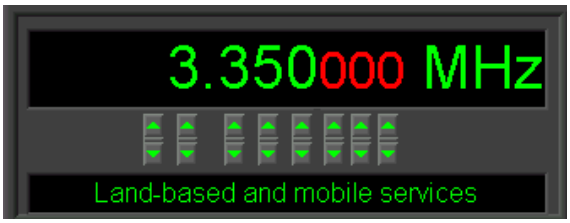
Did you know?

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

Using WiNRADiO G303

Tuning to a Frequency

To change frequency, simply type the new frequency into the keyboard. As soon as you press a digit or decimal point, the frequency display will activate, waiting for a frequency to be typed. You can also click on the display to type in a new frequency. After typing the new frequency, press ***Enter*** and the receiver will instantly retune. To abort, press ***Esc***.
To enter units, such as kHz or MHz, simply press ***H*** for Hz, ***K*** for kHz or ***M*** for MHz after entering the digits. Any invalid keystrokes are ignored. Frequencies outside the receiver limit (9 kHz to 30 MHz) will not be accepted and the display will revert to the previous frequency.



WiNRADiO G303 Receiver Frequency Display

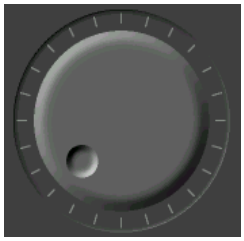
The up and down buttons under the individual digits make it possible to quickly step up or down the frequency in the corresponding positions. (The little slider buttons between the buttons can be used for faster adjustment.)

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

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

Fine Tuning

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



WiNRADiO G303 Receiver Tuning Knob

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

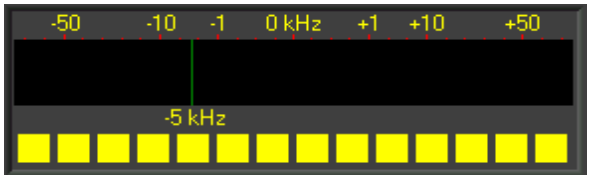
Using the keyboard only, the frequency can be similarly adjusted using the **up/down** cursor keys.

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

Note that the Tuning Knob can also be conveniently rotated using a wheel-equipped mouse, or any other standard Windows-supported pointing device. Taking advantage of this facility, it is possible to emulate the "feel" of a conventionally tuned receiver.

Fast Tuning Pad

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



Fast Tuning Pad

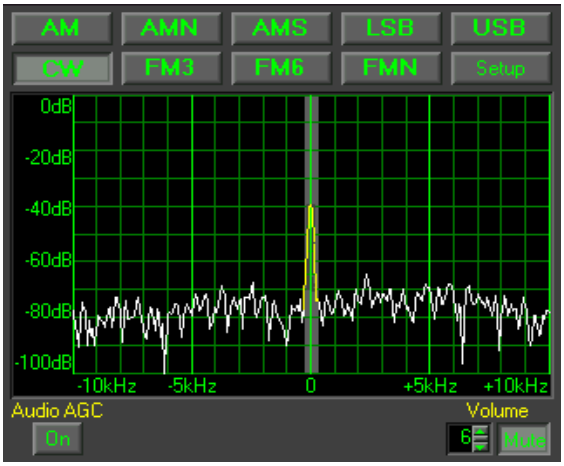
If you place the cursor inside the long horizontal window of the ***Fast Tuning Pad***, you will see a frequency increment displayed, which can vary from 1 Hz to 1 MHz in convenient steps. The value of this increment can be changed quickly by moving the cursor horizontally within the *Fast Tuning Pad*.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

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

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

Setting the Modulation Mode

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

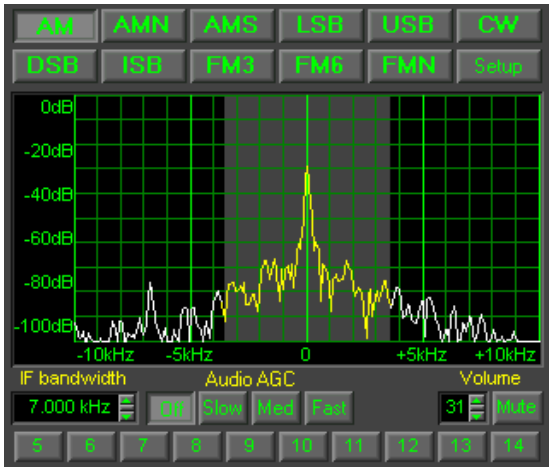


WiNRADiO G303 Standard Demodulator Panel

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

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

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



WiNRADiO G303 Professional Demodulator

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

Volume Control

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

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

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

Mute Control

Next to the ***Volume*** control is the ***Mute*** button, which allows you to switch off 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.

AGC

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

AGC Control

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

The incoming signal can vary in intensity, with changing propagation conditions, and also depending on the modulation type and content. For example, with CW signals (where information is transmitted by keying the transmitter on and off), the signal strength will vary substantially during the transmission. The demodulated signal will then sound better with a slow AGC (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, if the sensitivity appears to be very low, check the AGC setting first.

IF Gain

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. On the other hand, if the gain is too low, it will make the receiver appear “deaf”.

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

Manual IF Gain Control

The ***IF Gain*** control is only enabled when the AGC is switched off. The gain “value” ranges from 0 to 100, where 100 corresponds to maximum gain. The gain can be adjusted in three ways: by typing the value directly in the edit box, or using the up and down arrow buttons, or by dragging up or down the centre slider.

Audio AGC

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

Audio AGC

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

Attenuator

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

Attenuator

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

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

Squelch Control

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

Squelch Control and Squelch Defeat Button

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

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

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

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

Frequency Stepping

The ***Frequency Stepping*** facility makes it possible to specify an arbitrary frequency step size. To change the step size, click on the associated display and enter the required value (from 1 Hz to 1 MHz). You can also use the up 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.

Frequency Stepping Panel

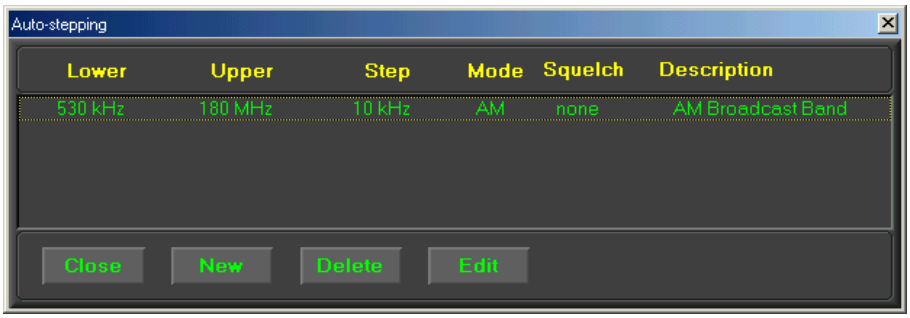
When the step size is selected, you can step up or down from the currently displayed frequency using the left/right arrow buttons under the ***Step*** size display. The double-arrow buttons further down will cause stepping by a step size ten times larger. Stepping can also be done using the keyboard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

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

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

The ***Auto*** button engages ***Auto-stepping***, which provides a significant enhancement over fixed stepping. When properly configured, auto-stepping will automatically set the step size according to the frequency you are tuned to. Auto-stepping can also be 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 ***Lower*** and ***Upper*** ends of the range, ***Step*** size, and optionally ***Mode***, ***Squelch*** and ***Description***. You can specify as many such bands as you like. When done, close the window.

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

Frequency Memory

The WiNRADiO G303 receiver has the ability to store up to one thousand frequencies in one memory file. It also allows you to load and save different memory files for a huge amount of total storage, limited only by the size of your hard disk.

Memory Control Panel

Storing a Frequency into Memory

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

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

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

Did you know?

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

Storing Frequency to Memory

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

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

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

- Most stations have a name or callsign. You can store up to 11 characters in the ***Callsign*** field.

- For quick tuning to your favorite stations, you can assign ***Hotkeys*** (function keys F2 to F12) for up to eleven different frequencies. If you then press a hotkey, the associated frequency will be instantly recalled. Hotkeys which are already assigned will be shown in this dialog box as 'used', however you can overwrite the previous assignment with a new one if you wish.

- User ***Comments*** can also be stored with a frequency. The size of the comments is limited to 31 characters.

- The ***Mode*** and the ***Squelch*** values can also be stored, which will 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***.

Recall Frequency from Memory

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

Editing Memory

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

Deleting a Frequency

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

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

Saving a Memory File

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

When you exit the WiNRADiO G303 application, all memory changes are automatically saved; there is no need to use the Save command before exit.

Opening a Memory File

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

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

Memory Stepping

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

To step through memory frequencies use the left 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/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 G303 application contains a comprehensive set of scan functions to enable the user to search for stations which are currently on the air. There are three basic types of scanning: ***Immediate Scanning*** (Searching), ***Range Scanning*** and ***Memory Scanning***.

The scanning method is selected using the appropriate button in the ***Scanning Control Panel***:

Scanning Control Panel

Immediate Scanning (Searching)

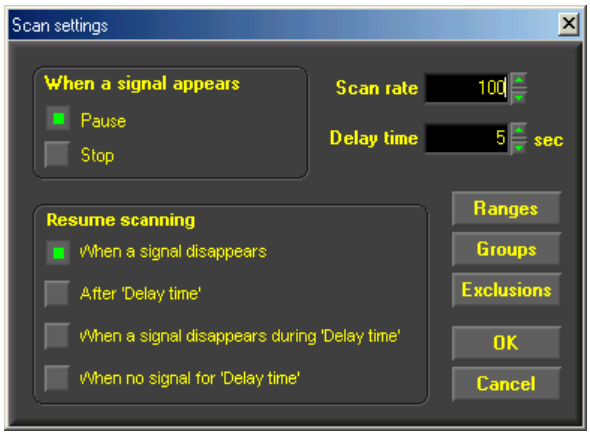
This is the simplest scanning method. Click on the ***Search*** button to select this scanning mode, then use the [**>>**] or [**<<**] buttons to scan either forward or backward from the currently tuned frequency. To stop scanning, press the ***Stop*** button (marked with a green square). To pause, press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

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

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

Scanner Configuration

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



Scan Settings

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

1. When the signal disappears *(i.e. the scanning resumes immediately when the signal disappears)*;

2. After a certain user-defined ***Delay time*** *(i.e. no matter if the signal disappears during this Delay Time or not, the software will always wait for the Delay Time interval, then resume)*;

3. When the signal disappears during ***Delay time*** *(i.e. the scanning will resume after Delay time, or earlier if the signal disappears);*

4. When there is no signal during the ***Delay time*** *(i.e. the scanning will resume if there is a no-signal gap equal to, or longer than, Delay time)*.

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

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

Note that the upper scanning speed limit may be restricted by the 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 later: it serves to restrict *Memory Scanning* to particular memory groups only.

Exclusions

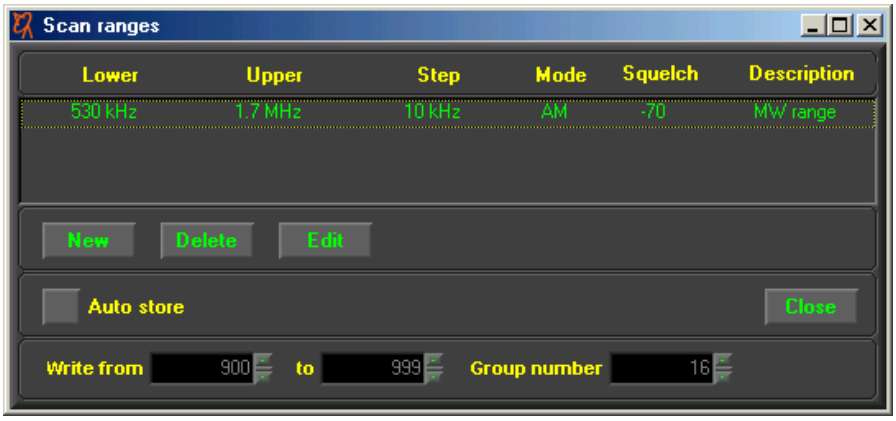
Sometimes it is desirable to exclude certain frequencies from scanning. This means that such specified frequencies should be ignored even if the signal level on these frequencies is higher than the squelch.

The WiNRADiO G303 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.

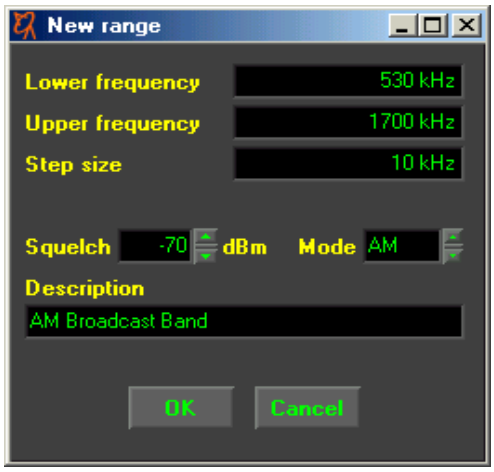
Frequency Range Scanning

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.



Setting up Scan Ranges

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



Adding a New Range

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

Scanning Control Panel

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

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

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

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

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

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

Memory Scanning

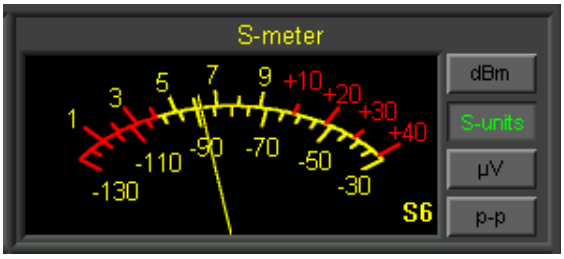
The last scanning method is ***Memory Scanning***. Here the receiver will step through memory frequencies, starting from the first one to the last one, and repeating the loop until a signal is found or until manually stopped.

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

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

S-meter

The WiNRADiO G303 receiver ***Signal Strength Meter*** (***S-meter***) makes it possible to measure signal strength in either *S-units*, *dBm* or *µV* (*microvolts*). The units are selected by correspondingly marked buttons on the right side of the display. In the microvolt mode, the **p-p** button is also enabled, making it possible to select *peak-to-peak* values rather than the default *RMS* (*Root Mean Square*) values.



S-meter

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

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

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

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

Power Switch

The ***On/Off 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 status at exit will be remembered.

Date and Time Displays

The clock display, located under the *Fast Tuning Pad*, indicates the current time and date.

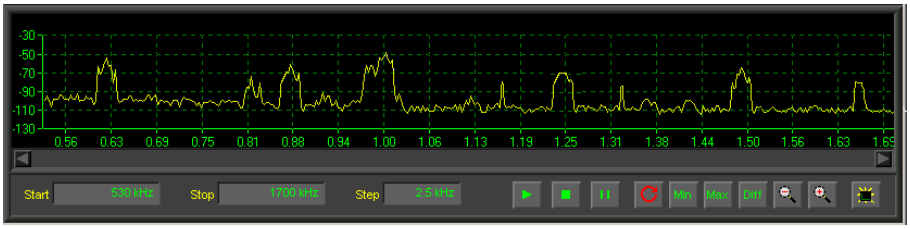
The ***UTC*** clock shows ***Universal Coordinated Time***, formerly called *GMT* (Greenwich Mean Time), which is the standard time used around the world. This is provided because most shortwave stations announce their broadcast times in UTC. Both displays derive their information from the PC clock.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

Spectrum Scope

In addition to the narrow-band ***real-time*** spectrum scope, which is located inside the demodulator panel, the G303 receiver also has a wide-band spectrum scope which operates by fast tuning the receiver across the user-specified frequency range.

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

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



Spectrum Scope

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

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

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

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

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

Did you know?

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

Appendix A - Troubleshooting

Problem (G303i or G303e with serial interface option only): My PC does have a ***Line input***, but there is no such *Line input* shown in the mixer line list in the demodulator set-up window.

Solution: The mixer line list is provided by Windows. It shows all available mixer channels which are capable of full duplex operation. It appears that the Line input of your sound card is not capable of full duplex operation. This is the case with certain sound cards, most notably with *Creative Audigy 2*. You will need to use the ***Microphone*** input instead. *See also the related problem below.*

Problem: I have connected the receiver to the ***Microphone*** input, but the sound is severely distorted.

Solution: You need to disable the microphone ***preamplifier*** – this is located in the sound card control panel (note the button ***Advanced*** under the microphone volume control). *See also the problem below for another possible cause of this problem.*

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

Solution: Check if the ***AGC*** is switched on (i.e. either the ***Slow***, ***Med*** or ***Fast*** buttons are down – typically, the ***Med*** setting is used).

G303i or G303e with serial interface option only: Check the ***Input gain*** in the demodulator set-up panel: it should be set just below the clipping level (sometimes a bit lower if the sound card starts distorting before the clipping is detected). If both settings are correct, try to reduce the sampling rate from 48000 samples/second to 44100 (also in the demodulator set-up). *(Using 48000 samples/second should provide better performance if good quality sound cards are used, but some sound cards are not able to provide good quality sampling at this sampling rate.)*

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

Solution: Engage the ***Audio AGC*** in the demodulator front panel (typically, the ***Med*** setting is used).

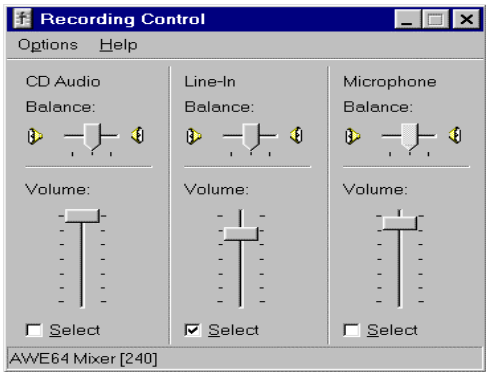
G303i or G303e with serial interface option only: Also check the ***Input gain*** in the demodulator ***Setup*** panel: it should be set as high as possible, just below the clipping level.

Problem (G303i or G303e with serial interface option only): The WiNRADiO application installed OK, but there is no sound coming from the speaker.

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

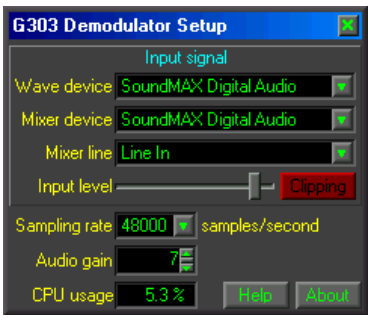
- The receiver output is connected to the sound card ***Line input*** using the supplied cable. (If your PC sound card does not have a Line input, you can use alternative inputs such as ***Microphone*** or ***Aux*** but the software settings need to be changed accordingly.)

- The sound card has been set up correctly. Especially make sure that the ***Recording*** *Line input* has been enabled (you will find this panel under ***Options*** **|** ***Recording*** in your sound card volume control panel – click on the speaker icon in the bottom bar to get to the volume control panel first):

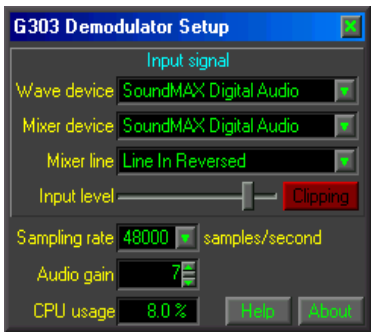


Note: If you have difficulties accessing the sound card control panels (for example if there is no speaker icon), refer to ***Appendix B – Sound Card Controls****.*

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



- The sound card has the left and right inputs reversed. Normally, the G303 Demodulator expects the receiver to be connected to the *Right* input. Using the ***reverse*** input makes the demodulator use the *Left* input instead. *(This is a very rare problem, so use this only when all other possible remedies have been explored.)*



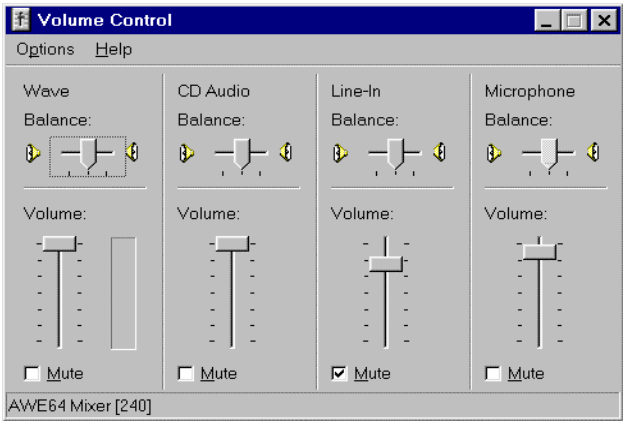
- Make sure the squelch is not activated.

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

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

Problem (G303i or G303e with serial interface option only): I can hear the audio, but it is not a pleasant sound. There is an interfering high pitch tone.

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



Sound Card Volume Control Panel

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

Solution: Close all other simultaneously running programs to reduce the burden on the CPU. If the CPU usage shows consistently more than 80%, this may indicate insufficient CPU resources for the G303 application. (*Check the CPU usage under the Setup button in the demodulator window. The CPU resource meter is at bottom left.)*

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

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

Problem: Reception is obscured with a buzzing interference.

Solution: Check for the sources of interference in your surroundings: it could be fluorescent lights, a lamp dimmer, or some other household appliance. Your PC (especially the monitor) could be also the culprit. Unless you can suppress the interference at the source (which is not always possible), the only solution is to install a better antenna, preferably an outdoor one. Computer networks are especially noisy and if your PC is connected to one, you will almost certainly need an outdoor antenna. If the interference level varies periodically with peaks about 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**.*)

Appendix B – Sound Card Controls

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

WiNRADiO G303 receivers require a full duplex sound card, meaning that the card must be able to simultaneously process signals in two directions (i.e. record and playback) at the same time. The majority of modern Sound Blaster compatible cards are indeed like that. However, some older cards may not be full duplex.

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

For the WiNRADiO G303 application, there is a need to independently control both sound card sections: The Recording section volume needs to be adjusted to provide the correct IF signal level for the demodulation process; the Playback section control is needed to be able to control the speaker volume.

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

If the speaker icon is missing, an alternative way of accessing the ***Recording/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/disable the speaker icon, and how to get to the recording/playback controls from within the Windows control panel. The methods vary depending on the version of Windows you are using.

Windows	*Enable "speaker" icon*	Recording/playback volume controls
NT	*Control Panel* | *Multimedia* *Audio-tab* **Checkbox**: "Show volume control on the taskbar"	Make sure the speaker icon is displayed, then double-click on the speaker icon in task bar to display the **Volume Control** dialog. **Sound Playback**: Select Options | Properties | Playback **Sound Recording**: Select Options | Properties | Recording
98	*Control Panel* | *Multimedia* *Audio-tab* **Checkbox**: "Show volume control on the taskbar"	*Control Panel* | *Multimedia* *Audio-tab* **Sound Playback**: Click on  button **Sound Recording**: 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 **Sound Recording** → **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 **Sound Recording** → **Volume** button
XP	*Control Panel / Sounds and Audio Devices* | *Sounds-tab* **Checkbox**: "Place volume icon in the taskbar"	*Control Panel* | *Sounds and Multimedia* *Audio-tab* **Sound Playback** → **Volume** button **Sound Recording** → **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, welders, fluorescent lights, fax machines, computer networks, etc. Receiving antennas should always be as far away from sources of electromagnetic interference as possible.

One significant source of man-made electromagnetic interference is the personal computer, and the video monitor in particular. Since the WiNRADiO G303 receiver requires a personal computer to operate, this creates a potential paradox. The WiNRADiO receiver itself is designed to be substantially immune to PC interference. However, any receiver needs to be connected to an antenna, and antennas can't discriminate between useful signals and interference. The interference from your PC can either radiate directly to the antenna, or it can be conducted to it along the outer conductor of the lead-in cable. Even in professional radio receiving stations, a lot of care and effort is always needed, if this type of self-interference is to be avoided.

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

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

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

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

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

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

Did you know?

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

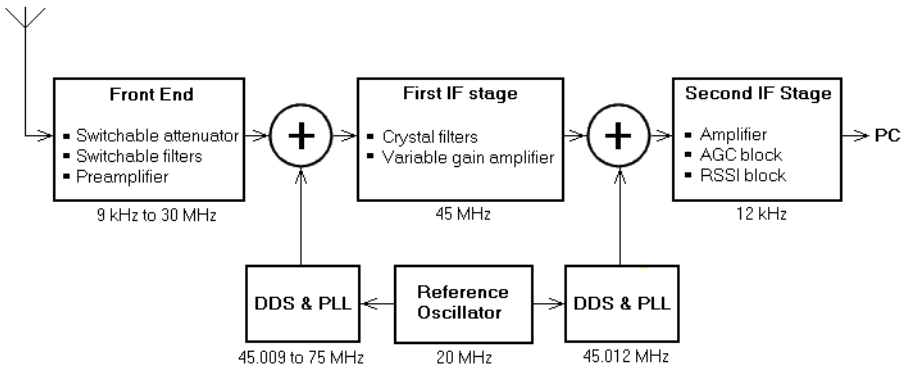
Appendix D - Inside WR-G303

Technically minded users may like to explore the WiNRADiO G303 Receiver and experiment with some of the innovative concepts of *Software Defined Radio*.

The WiNRADiO G303 Receiver is the world's first commercially available *Software Defined Radio*, where the Demodulator function is fully performed in software running on a standard PC. The G303i model is also the world's first shortwave radio on a PCI card, while the G303e model is the first PC-based shortwave radio with the USB interface. The potential for experimentation is therefore substantial. This receiver and its software have been indeed designed to promote and encourage such experimentation.

The WiNRADiO G303 receiver represents only one half of the entire radio. The other half is your PC.

The receiver hardware contains the following functional blocks:



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

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

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

The 12 kHz IF output is then fed to the right channel of the *Line* input of the PC sound card. You can hear what it sounds like if you use the sound card mixer panel to listen directly to this input (rather than using the G303 Demodulator software).

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

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

Did you know?

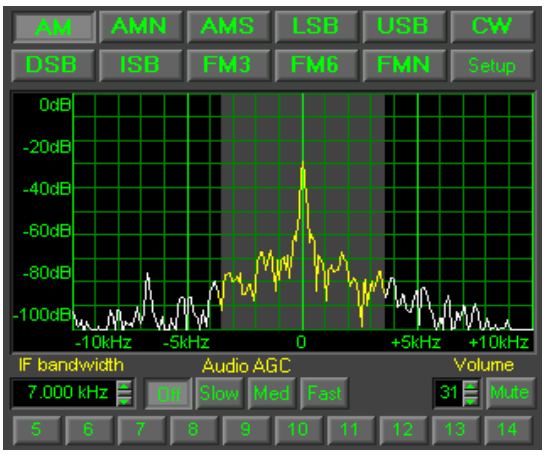
The largest shortwave transmitters nowadays operate with 250,000 – 500,000 Watts of power. Using the CW mode, and in suitable atmospheric conditions, radio amateurs make regular contact around the world with only a very tiny fraction of this power: reports exist of round-the-world communications achieved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

Appendix E – Professional Demodulator

The WiNRADiO G303 receiver has provision for additional demodulators, in place of the supplied standard one. Installed demodulators can be selected via the ***Demodulators*** top bar menu. Check the WiNRADiO Web site ***www.winradio.com*** periodically, for available demodulators.

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

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



WiNRADiO G303 Professional Demodulator

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

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

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

In the real-time spectrum scope, the currently selected IF bandwidth is indicated using a different background color. The portion of the real-time signal spectrum falling within the IF bandwidth is shown in yellow.

Adjusting Demodulator Parameters

Each demodulation mode has its own associated set-up panel, accessible under the ***Setup*** button (located under the ***CW*** mode button). By selecting the mode either using the front panel or the tabs at top-right of the demodulator set-up window, you can see and adjust the filter settings applicable to the selected modes.

The meaning of each filter is best understood looking at the demodulator structure (under the ***View demodulator structure*** button). The cut-off frequencies and lengths of these filters can be adjusted and optimized by the user, either by direct typing in the parameter or using the sliders.

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

upper limit). Starving the system of CPU resources manifests itself by the computer becoming sluggish or possibly "freezing" entirely.

The first parameter, the ***IF bandwidth filter length***, is the length of the first filter in the digital path, which is responsible for much of the receiver selectivity. The factory default length is 63. Reducing this value will decrease the receiver selectivity and make the receiver more prone to interference from nearby strong signals. However, for slower computers it may be necessary to compromise on this figure if the demodulator appears too slow (to the point of the panel "freezing" or drop-outs of audio) because of insufficient CPU resources. If your CPU speed allows it, then we would recommend to set this value to its maximum limit (255):

The ***Post-mixer filter length*** parameter refers to the post-mixer low-pass filter, whose cut-off frequency is automatically related to the currently selected IF bandwidth. For AM, AMN, AMS, CW, DSB, ISB, FM3, FM6 and FMN modes, the post-mixer filters bandwidth is half of the IF bandwidth, while for LSB and USB both bandwidths are equal to the IF bandwidth. Again, if your CPU speed allows it, we would recommend to set this parameter to its maximum value (255).

If you have a preference for particular IF bandwidths, you can associate them with any of the ten preset buttons (located at the bottom of the demodulator front panel) by double clicking the Bandwidth column of the IF bandwidth presets table, and then typing in the numerical bandwidth value in

Hz. The buttons are numbered (1 to 10) from left to right. The factory default values can be restored at any time, by pressing the ***Restore default settings*** button. Each modulation mode has a separate set of IF bandwidth presets.

For the AM, AMN, FM3, FM6 and FMN demodulators, a supplementary low-pass filter is introduced in the audio output path, to reduce harmonic distortion generated in the demodulation process and improve the overall signal-to-noise ratio under bad receiving conditions. This filter's length is adjustable under the ***Audio filter length*** parameter.

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

Finally, all demodulated audio output is scaled up by an ***Audio gain*** factor. The scaled audio signal level is further adjusted with the Volume control in the demodulator main panel. However, when the ***Audio AGC*** is active, the fixed ***Audio gain*** setting is ignored, and the software will automatically adjust the audio level according to the ***AGC reference level*** setting.

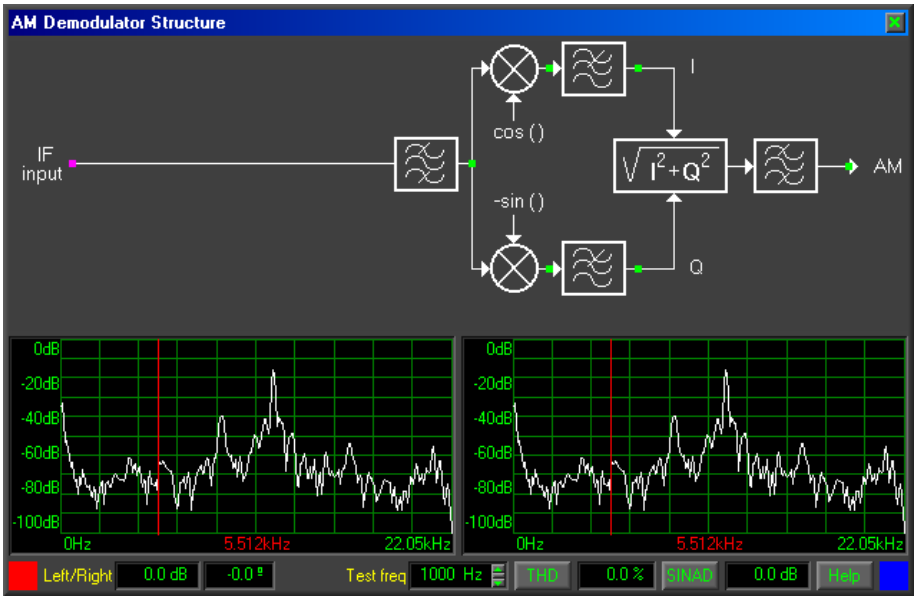
If you are experiencing audio distortion when using the Audio AGC, this is probably because the AGC reference level is set too high.

The attack and decay times for the three possible Audio AGC speeds (slow, medium and fast) can be also configured, under ***AGC Speed Constants*** on the left of the demodulator settings window:

Demodulator Structure

The G303 Professional Demodulator implements the general quadrature representation of all narrow-band modulated signals. Such signals can always be considered as the sum of two amplitude-modulated carriers having a 90 degree offset, usually referred to as *I* and *Q*. Users familiar with *Software Defined Radio* digital signal processing concepts, will find the G303 Professional Demodulator to be a useful tool for experimentation and study, where the effects of various filter settings can be easily observed and optimized.

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



AM Demodulator Structure

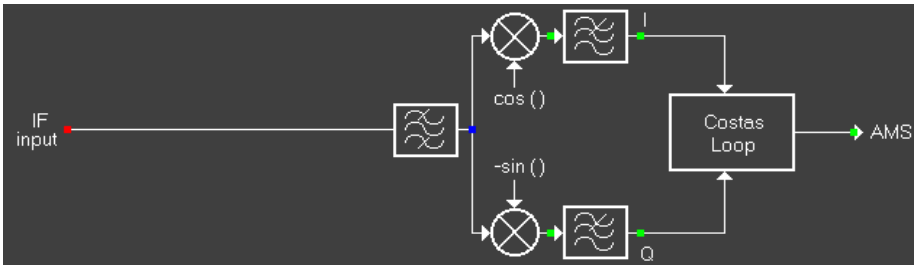
The demodulator structure windows include two spectrum analyzers, making it possible to view signal spectra in real-time. Each analyzer can be "connected" to any of the *test points* shown as green dots in the diagram. To connect the left spectrum analyzer to a particular test point, left-click on the green test point. Its color will change to red. Right-clicking on a dot will connect it to the right analyzer, and the color will change to blue. If both displays are connected to the same test point, the point color will turn magenta.

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

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

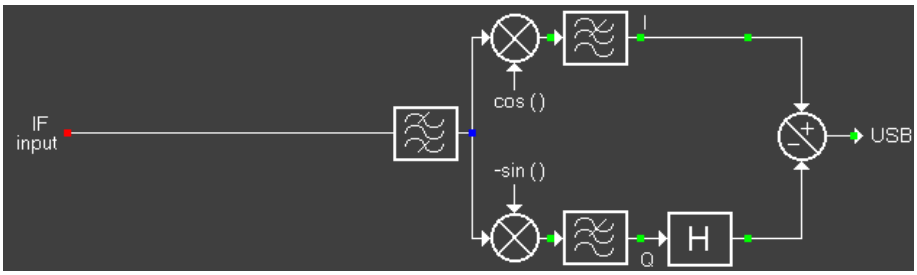
When either of the ***THD*** or ***SINAD*** buttons is activated, the right-hand spectrum display will be automatically connected to the end of the demodulator chain (i.e. right-clicking on any other test points will not work until both the ***THD*** and ***SINAD*** buttons are released).

For synchronous demodulation of amplitude modulated signals (the ***AMS*** mode) without carrier or with a fluctuating one, the G303 Professional Demodulator uses a digital carrier recovery technique based on the so-called ***Costas loop***:



Synchronous AM Demodulator Structure

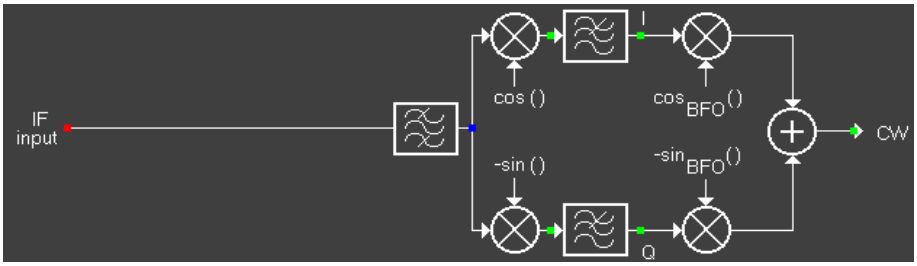
The LSB and USB demodulators have basically the same topology:



USB Demodulator Structure

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.

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

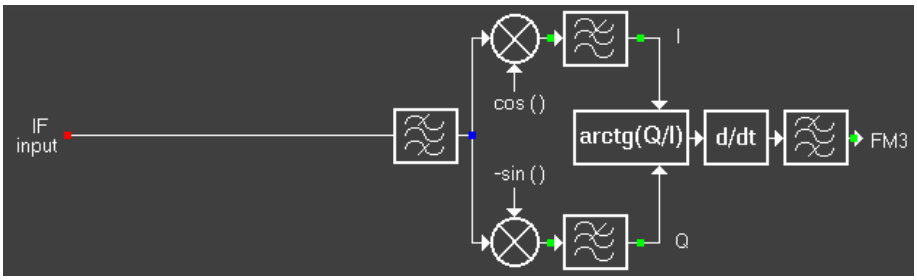


CW Demodulator Structure

Did you know?

The impressive sensitivity of the G303 receiver and the continuous IF bandwidth adjustment facility make it possible to precisely match the bandwidth of the receiver to that of the received signal and extract even the weakest CW signals from background noise.

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



FM Demodulator Structure

Did you know?

All the software-implemented digital filters used in the G303 receiver are of the linear phase FIR (Finite Impulse Response) type, with maximum 255 taps, providing a filter shape far superior to conventional analog hardware filters.

Appendix F - Developer Support

WiNRADiO has always extensively supported third-party software development efforts with all our receivers, and the WiNRADiO G303 receiver is no exception. We provide technical details for developers to be able to develop the following:

1. Third-party applications controlling the WiNRADiO G303 receiver. *We do this by providing API information making it possible to access the receiver hardware from third party software. (See **http://www.winradio.com/home/developer.htm**).*

2. Plug-ins to provide enhanced functionality. *For this, we have developed a special interfacing standard called XRS (Extensible Radio Specification). All our receivers conform to this standard, and many plug-ins are already available for various applications (see **http://xrs.winradio.com**).*

3. New types of demodulators. *The G303 demodulators in fact represent a special type of XRS plug-in. Detailed information is also available at **http://xrs.winradio.com**).*

4. Support under alternative operating systems*. See for example **http://www.linradio.com**.*

5. Support under **Radio Basic,** an easy to use specialized programming language for radio receivers. *See **http://www.rbasic.com**.*

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

Appendix G – Frequency Calibration

The G303 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 **wrg3.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 from the ***About*** box in the G303 application. The reference frequency is the actual frequency of the internal reference oscillator in Hz. This is nominally 20 MHz, i.e. 20000000 Hz.

Each receiver is factory calibrated, so a correction to the nominal 20 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 **wg3.ini** file. To determine the true offset from a perfect tuning, firstly use 20000000 (i.e. the nominal reference frequency in Hz) as the new ***reference_frequency*** parameter. Say your receiver serial number is 02L27011:

```
[ClockCalibration]
02L27011=20000000
```

Open the existing **wrg3.ini** file, add the above two lines, then save the file and start the G303 application. The frequency error will now be much worse because this 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. Typically, this will be a negative number (for example, -652 Hz at 10 MHz).

Then scale the frequency difference to 20 MHz. For example, if the frequency difference is -652 Hz at 10 MHz, it will be -1304 Hz at the 20 MHz reference frequency.

Then subtract the frequency difference from 20000000. In our example, the resulting ***reference_frequency*** will be 20000000-(-1304)=20001304. The entire reference frequency parameter in the **wrg3.ini** file will be then as follows:

```
[ClockCalibration]
02L27011=20001304
```

Save the **wrg3.ini** file, then restart the G303 application and observe the difference.

To return to the original factory frequency calibration, simply delete the inserted two lines in the **wrg3.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 stations which broadcast on 2.5, 5, 10, 15 and 20 MHz, have 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.

Declaration of Conformity

This device, trade name WiNRADiO Communications Receiver, model number WR-G303 complies with Part 15 of the FCC Rules. Operation is subject to the following conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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

Please forward all correspondence related to this matter to:

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