Wolfwave Manual

Getting Started and Advanced Menus

Connections

Input
Connect an audio input to your *Wolfwave* (left hand side) using the supplied cable. Typically, this will be the headphone output of your radio.

In some circumstances, such as powering your Wolfwave and radio from the same DC supply, a line-isolator may be required in series with the audio input lead.

Output
Connect a loudspeaker or headphones to the connectors on the right hand side. You can connect one or both.

The *Wolfwave* loudspeaker output is a stereo socket with the following connections:

Socket	Wolfwave output
Tip	Positive
Ring	Negative
Sleeve	Floating, not connected

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A mono plug can be used for the loudspeaker. If a stereo plug is used with a mono loudspeaker., the loudspeaker connections should be to the tip and ring of the plug. NOTE: the loudspeaker connections must not be grounded as *Wolfwave* uses a high-efficiency Class D audio amplifier, the output of which is not centred on ground.

The headphone output is a standard stereo output.

Power

Your *Wolfwave* can be powered in two ways; via USB or via a DC supply. We supply a USB lead which can be used to get you going. Any clean USB supply will work.

For best quality audio output, we recommend using a DC supply of at least 7V via the 2.1mm DC connector on the right hand side of your *Wolfwave*

This will allow a larger maximum speaker output power than if your *Wolfwave* is powered by USB.
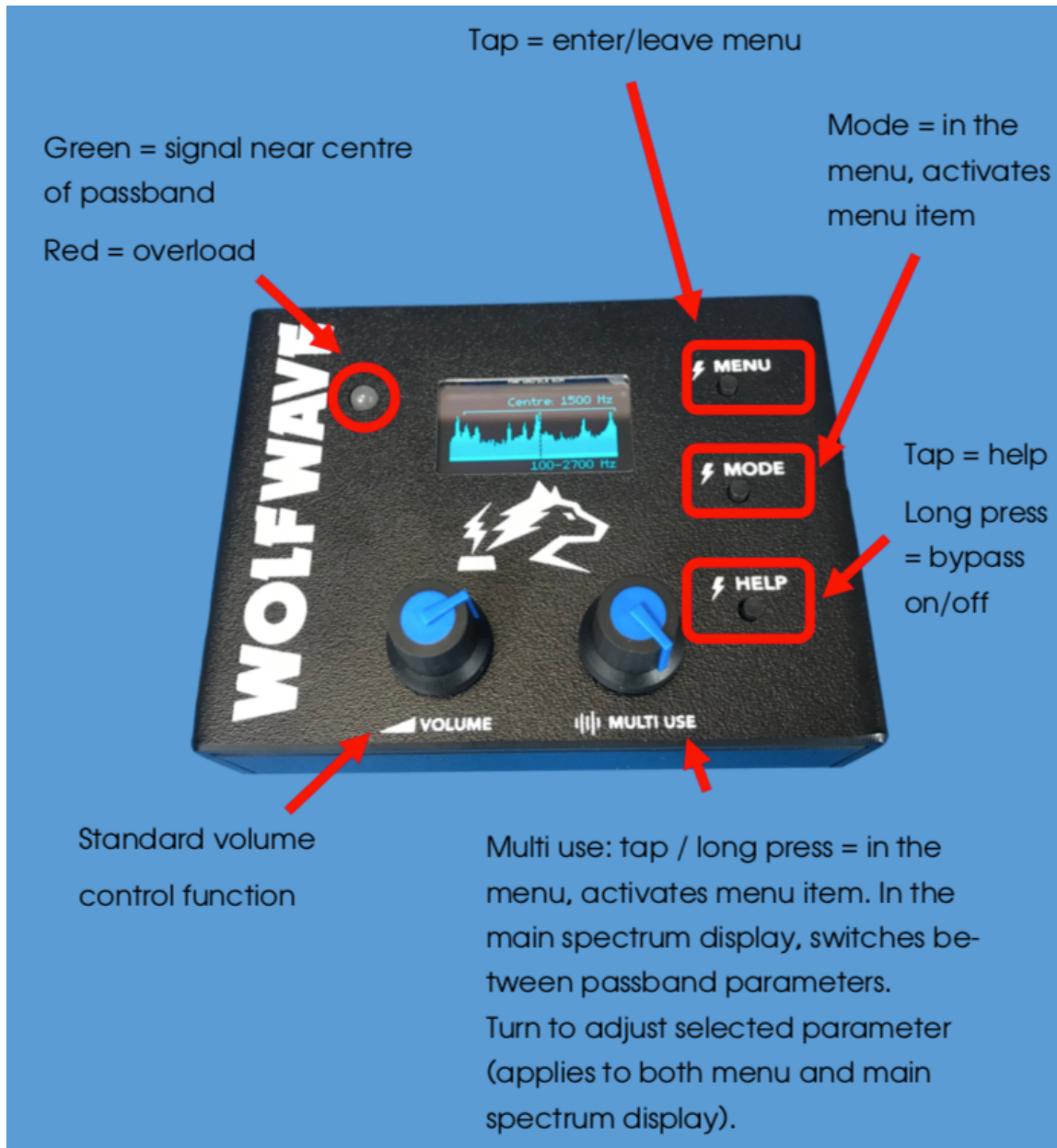
DC supply voltage range: 5.5 – 18V.
Use at least 7V for maximum speaker output power.

The headphones output should work equally well with USB, or with any DC voltage in the range 5.5 - 18V.

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Controls

Tap = enter/leave menu

Mode = in the menu, activates menu item

Green = signal near centre of passband

Red = overload

MENU

Centre: 1500 Hz

100-2700 Hz

MODE

Tap = help

Long press = bypass on/off

HELP

VOLUME

MULTI USE

Standard volume control function

Multi use: tap / long press = in the menu, activates menu item. In the main spectrum display, switches between passband parameters. Turn to adjust selected parameter (applies to both menu and main spectrum display).

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Volume control
Standard volume control, turn clockwise to increase the volume.

Multi use control
When in the menu, pressing it activates or deactivates the currently selected menu item.
When in the main spectrum display, pressing it switches between passband parameters.
Turning it is used to either scroll, or to adjust the currently selected value.

Menu button
Enter or leave the menu.

Mode button
When in the menu, activates or deactivates the currently selected menu item (same as pressing the multi use knob).
When in the main spectrum display or morse decoder display, switches between the main spectrum display and the morse decoder display.

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Morse Decoder

Wolfwave incorporates a morse decoder. To access it, go to the main screen which shows the current audio spectrum and bandpass filter settings, then press the mode button to switch between bandpass filter and morse decoder mode.

On the left is the most recent decoded text. On the right is part of the audio spectrum, centred on the detection frequency.

Decoding and signal detection

The morse decoder is driven from the same CW signal detection as the signal LED and CW regeneration. The detection frequency is always in sync with the centre frequency of the bandpass filter - changing detection frequency changes bandpass centre frequency and vice versa. This allows you to go straight from narrowing in on a signal using bandpass, to decoding it.

In the morse decoder screen, turn the multi use knob to adjust the detection frequency. The detection frequency is shown as a dashed line on the spectrum and as text in the bottom right corner. The detection threshold can be set in the menu.

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Morse decoding is active when the morse decoder screen is visible, and for 30 seconds afterwards. This means that decoding will start when the mode button is pressed to switch to the morse decoder screen, and will continue happening in the background for a short time if, for example, you briefly access the menu to change some settings.

Scrollback

The decoded text can be scrolled, so that recent decoded text can be viewed even after it has disappeared off the screen.

Press the multi use knob to switch between adjusting the frequency and scrolling. To stop scrollback and go back to tracking the most recent text, scroll down to the most recent text, then scroll down further until "Auto scrolling" is displayed again.

Up to the last 200 characters will be stored. The oldest line of text will be trimmed whenever this limit is exceeded. While in scrollback mode, decoding will continue for up to another 100 characters, with no trimming of old text. Decoding will then be paused until you exit the scrollback.

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Additional settings

The following settings are adjustable in the "Morse decoder" submenu:

- Signal threshold. If noise is being falsely detected as a signal, increase this to make detection less sensitive. This is shared with CW regeneration and appears in both submenus.
- Min and max speed. This is the expected range of morse code speeds in words per minute - the speed will be auto detected within this range. The default range of 5-40 wpm should be fine for receiving most transmissions, but may need adjusting for particularly fast or slow morse code. If the speed is within the current range but is not correctly detected, try adjusting the range to exclude the incorrect speed estimates. The speed determines what lengths of on and off pulses correspond to dots, dashes, inter-character and inter-word spaces, so if the speed estimate is too far out then the decoded text will be wrong.
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Standby Mode

Press and hold to enter standby mode.

To enter standby mode, press and hold the mode button for a couple of seconds. The display and audio hardware

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will be powered off, and the processor will enter low power mode. Press the mode button again to power back on.

All settings are currently reset to power-on defaults when resuming from standby.

Typical current draw in standby mode is a few milliamps.

Help button
Short tap: shows or exits context-sensitive help.
Long press: toggles the bypass function.

LED
The LED will light up green if a signal is detected near the centre of the passband.
The LED will light up red if clipping is detected at the input or output (turn the *Wolfwave* and/or audio input volume down).

Basic usage

Menu

The *Wolfwave* has a number of options and advanced features accessible through the menu system.

To show or hide the menu, press the menu button. Turn the multi-use control to scroll through menu options. A

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short press of the multi-use control or of the mode button selects the option.

Most settings are edited directly in the menu. After selecting a menu item, turn the multi-use control to adjust it, then press multi-use or mode again to deselect it.

All changes to settings will only last until your *Wolfwave* is next turned off and on again, unless you specifically save the current settings as the new power on defaults using "Other settings > Save defaults".

Settings can be reset to factory default values by using "Other settings > Factory reset all" to reset all settings. Or use the "Factory reset" item available in some of the submenus, such as noise reduction and CW regeneration, to only reset the values in that submenu.

As with other changes made to settings, the reset values will only last until your *Wolfwave* is next turned off and on again, unless you specifically save them.

Firmware

Once your *Wolfwave* boots up, the first thing that you will want to do is to check that you have the latest firmware running. *Wolfwave* firmware is regularly updated to add new features and to fix bugs. These instructions will always relate to the latest firmware version.

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To check the firmware version on your *Wolfwave* navigate in the menu to "Utilities > Firmware version".

Then go to www.wolfwave.co.uk/firmware to find the latest version and for instructions on how to load and install it.

Spectrum display (bandpass mode)

When you power on your *Wolfwave*, the first screen will show the audio spectrum.

The text below the spectrum indicates the horizontal range of the spectrum. This will automatically change to fit the upper edge of the passband.

The horizontal line above the spectrum indicates the current passband of the bandpass filter.

The vertical dashed line indicates the centre of the passband, which is also the frequency used by signal detection for CW regeneration, and for the LED. The LED will light up green when a signal is detected near this frequency.

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The text in the top right corner shows the current passband parameter being adjusted by the multi-use knob. Turn the knob to adjust the value.

A long press on the multi-use knob switches between centre+width and upper+lower edge adjustment modes. A short tap switches between the parameters in the current adjustment mode – so between centre and width, or between lower and upper edge.

The vertical range of the spectrum can be adjusted to fit the input signal more closely by going to "Other settings > Spectrum range" in the menu.

Bypass

To help you hear the effects of the filtering, the *Wolfwave* has a bypass function. This can be toggled either in the menu, or with the help button.
A long press on the help button bypasses the *Wolfwave*, and another long press re-engages the *Wolfwave*.

When bypassed, no digital filtering is performed, the only change made to the audio data is to amplify or attenuate it based on the volume control.

When the Bypass function is engaged it is indicated by a flashing "Byp" indicator in the lower left corner of the screen.

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Other modes

From the bandpass screen, press the mode button repeatedly to cycle through display modes for other features, which are currently:
- [Bandpass filtering](#)
- [Morse decoder](#)
- [Bandstop filtering](#)

Most features do not have a separate display mode, they are controlled entirely through the menu.

Only features which might be frequently accessed and which do not fit well in the menu system have their own display mode - specifically, the spectrum displays for bandpass and bandstop filtering, and the decoded text for the morse decoder. Only the most important settings are shown directly in these modes, additional settings for these features are available in the menu.

Advanced usage

Bandpass Filtering

See next page

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Adjusting the passband

When you power on your Wolfwave, the first screen will show the spectrum of the audio input. The horizontal line above the spectrum indicates the current passband.

The vertical dashed line indicates the centre of the passband, which is also the frequency used by signal detection for CW regeneration, and for the LED. The LED will light up green when a signal is detected near this frequency.

The text in the top right corner shows the current passband parameter being adjusted by the multi-use knob. Turn the knob to adjust the value.

A long press on the multi-use knob switches between centre+width and upper+lower edge adjustment modes. A short tap switches between the parameters in the current adjustment mode – so between centre and width, or between lower and upper edge.

The text below the spectrum indicates the horizontal range of the spectrum. This will automatically change to fit the upper edge of the passband.

The edges of the passband are limited to 100-5000 Hz, and the minimum bandwidth is 50 Hz.

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Presets and memory

Your Wolfwave has 4 presets to allow you to quickly change to one of the following passbands:
- Voice wide: 300-2700 Hz
- Voice narrow: 300-2400 Hz
- CW/data wide: 300-1300 Hz
- CW/data narrow: 450-750 Hz

These can be accessed through the menu, by going to "Bandpass filter > Load bandpass" and scrolling to the bottom. These 4 presets are constant and cannot be changed.

The Wolfwave also has 10 memory slots which you can use for saving and loading your own passband settings. To save the current passband, go to "Bandpass filter > Save bandpass" in the menu and select a slot to save it in. To load a saved passband, go to "Bandpass filter > Load bandpass" and select a slot. The lower and upper edges of the saved passband for each slot are displayed in the menu.

Enable/disable bandpass filtering
Bandpass filtering can be enabled or disabled, by selecting the "Bandpass filtering > Bandpass filtering" menu item.

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Disabling bandpass filtering is equivalent to setting it to the maximum range (100-5000 Hz).

Bandstop Filtering.

The *Wolfwave* has 10 individually adjustable *stopbands,* which can be used to block out interfering signals that cannot be eliminated using the bandpass filter (for example, if they are in the middle of the desired SSB signal). Each *stopband* can be toggled on or off, and the centre frequency and width adjusted.

The parameters of each *stopband* can be adjusted from the bandstop screen. To access this, start from the bandpass filtering screen shown when the *Wolfwave.* powers on, and press the mode button repeatedly until the bandstop screen is shown.

The controls in the bandstop screen are very similar to those used in the menu. Turn the multi use knob to change which setting is selected. Then press the multi use knob to start or stop editing that setting. In edit mode, turn the knob to adjust the value of the current setting.

The settings for the currently selected *stopband* are displayed at the top of the screen:

Slot: which *stopband* is currently being adjusted. Change this to switch between *stopbands.*

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State: toggle the *stopband* on or off

Centre: the frequency on which the *stopband* is centred. If using a *stopband* to notch out a single signal, this should normally be set to the frequency of the interfering signal. This is displayed on the spectrum with a dashed vertical line.

Width: width of the *stopband*. This is the approximate distance between -3dB points. For best results, this should be at least 100Hz. Narrower widths will give poorer attenuation at the centre frequency.

Below the settings text is a spectrum display showing the input signal. At the top of the spectrum display, there is a visual representation of the currently selected *stopband*, and of the filter shape resulting from the current bandpass and enabled bandstop settings combined.

The text below the spectrum indicates the horizontal range of the spectrum. This will automatically change to fit the upper edge of the passband.

There is also a bandstop section in the menu:

Bandstop filtering: enable or disable all bandstop filtering. If enabled, the on/off settings for individual

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stopbands are used. If disabled, all *stopbands* act as though turned off and have no effect on filtering.

Quick toggle: shows a summary of stopband settings. Pressing the mode button or the multi use knob in this submenu toggles the highlighted stopband on or off.

Load defaults: reset the *stopband* settings to the default values used at power on.

Save defaults: save the current *stopband* settings to be used as the new power on defaults.

Factory reset: reset the *stopband* settings to the original values the *Wolfwave* was supplied with. Note that these are not automatically saved as the new power on defaults, "Save defaults" must be used afterwards to do that.

Note that the save/load/reset items do not affect the main bandstop filtering toggle, only the *stopband* settings. To save all settings including the main bandstop filtering toggle, go back to the main menu, then use "Other settings > Save defaults".

The number of *stopbands* enabled does not alter the latency or significantly change the power consumption of the *Wolfwave*

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Noise Reduction

Noise reduction will reduce the background noise. There will be an optimum setting depending on the type of noise that you are encountering. For example, there may be different requirements for SSB, AM or FM.

Noise reduction can be turned on or off by selecting "Noise reduction > Noise reduction" in the menu.

Settings

The noise reduction level can be adjusted with the "Noise reduction > Reduction lvl" item in the menu. Larger values will reduce the noise more, but values that are too large will distort the signal and make it harder to understand (since some of the signal will be classified as noise and removed). A value of around 50 is often a good starting point. Values much above 80 are likely to distort speech too much, but may be useful for CW.

"Tone reduction": if this is turned on, then tones that are constant for more than a couple of seconds will also be reduced. This should be used if there are interfering constant tones in the input that cannot be removed by adjusting the bandpass filter. Otherwise, the output is often clearer with this turned off.

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Discontinuous tones such as Morse code will not be removed by the tone reduction feature.

Advanced settings

"Noise percentile": this setting is related to how the Wolfwave estimates the noise level in the input signal. If this is incorrect, then possible effects include:

- noise reduction may be much stronger or weaker than it should be for a given "Reduction level" setting
- noise reduction may not adapt correctly to changes in input level caused by the radio's AGC
- if it is too high, signals may be distorted or suppressed
-

The correct noise percentile to use depends on the passband of the input to the *Wolfwave* (i.e. the passband of the radio that is connected to the input, not the passband of the *Wolfwave's* bandpass filter).
It can be estimated with: noise percentile = 100 - bandwidth x 90 / 5000

For example, a radio output bandwidth of 700Hz means the noise percentile should be set to around 87%.
The default value is 50%, which should be about right for a radio passband suitable for SSB signals.

"Time constant": the estimate of the noise level in the input signal is averaged over time. This setting controls the

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time constant for the averaging and hence how fast it adapts to changes in noise level. The time constant should be short enough to keep up with the radio's AGC. If it is too large, then the noise reduction will be worse (noise not reduced enough, or signal reduced as well as noise) for a short time after each AGC gain change, such as when someone starts or stops speaking.

CW Regenerator

The CW regenerator is an experimental function that we are actively developing, which works on the CW (Morse) signal in the centre of the passband. It detects the dots and dashes and regenerates the CW with a clean sine-wave.

The detection frequency is the same as the centre frequency of the bandpass filter. So to change that frequency, change the centre frequency of the bandpass filter.

The following parameters are adjustable in the "CW regen" submenu:

- Toggle CW regenerator on or off.
- Detection threshold. If noise is being falsely detected as a signal, increase this to make detection less sensitive.

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- Output frequency can be set to either a user defined constant value, or to follow the detection frequency.
- Output volume. Turning the volume knob still affects the volume, this setting acts in combination with it. This allows the volume of the regenerated tone to be adjusted to be close to the original audio, to avoid sudden changes in volume when toggling CW regeneration.
- Toggle split stereo mode, where the regenerated signal is sent to the left headphone output and to the speaker, and the original signal to the right headphone output

Binaural Mode

Binaural mode only works with stereo headphones, not with the speaker output. It makes tones sound as though they are coming from different positions based on their frequency.

Settings for this can be found in the "Binaural mode" section of the menu.

The centre frequency and bandwidth settings control the frequency range over which the position varies. Tones outside this range stay in a single position and do not move based on frequency. For example, in low-high mode, all frequencies below the lower edge stay fully on the left,

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and all frequencies above the upper edge stay fully on the right.

There are three modes:

Low-high mode: lower frequency tones are on the left and higher frequency on the right.

Near-far mode: tones near the centre frequency are on the left, tones further away from it are on the right.

Narrow-wide mode: tones less than half the bandwidth from the centre frequency are fully on the left, other tones are fully on the right. Like near-far mode but with a sharp cutoff at the edges, instead of a smooth change over the entire bandwidth.

The "linear amplitude scale" setting alters the way in which the amplitude is adjusted:

On: amplitude is linearly scaled between mute and normal in each headphone, based on frequency.
Off: even when positioned fully to one side, tones are still audible (but quieter) in the other headphone.
The default value of 'off' is closer to real life so should give a more accurate 3D effect, but 'on' may be worth experimenting with. For example, with near-far or narrow-wide mode focused on a narrow bandwidth around a single CW signal, turning linear amplitude on means the

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desired signal will be audible in the left ear only, and all other stations audible in the right ear only.

By default, the speaker output runs off the same data as the left headphone, so will be affected if binaural mode is on, but will not give any impression of varying sound locations. The speaker output can be switched to run off the same data as the right headphone in the "Output settings > Speaker channel" setting.

There are 6 memory slots available, plus a power-on defaults slot, where binaural settings can be saved and loaded in order to quickly switch between them.There are also a few presets with recommended values to try for CW. However, the settings that work best will vary depending on operating mode, band conditions, and personal preference, so do try adjusting them.
To adjust the relative volume of left and right audio, or to swap left and right, use the "L/R balance" or "Swap L/R" options in the "Output settings" menu.

Hearing Loss Compensation

The age-related hearing loss compensation function applies a frequency dependent gain, based on median hearing thresholds published by the International Standards Organisation (ISO 7029). This boosts the higher audio frequencies that become more difficult to hear with age.

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The compensation will not be perfectly accurate, because these are median values instead of tailored specifically to the listener, and because of non-linearities in human hearing, but should be a useful first approximation.

To use this, go to the "Hearing loss comp" submenu to set your age and gender and to toggle this feature on or off.

If you use a hearing aid, this should already apply the relevant compensation and so the *Wolfwave* hearing loss feature should not be required.

Output Settings

The *Wolfwave* has a volume knob to control the output volume, plus a setting for adding a fixed gain/attenuation to this (i.e. adjusting the output volume produced when the volume knob is turned to max).

There are also settings for more fine tuned control of output volume and output mixing:
- The gain of the headphones and speaker outputs can be adjusted independently, which can be a useful way of limiting the maximum output power to a comfortable level.
- The relative volume of left and right headphone channels ("L/R balance")

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- Which channel the speaker is connected to. The headphones output is stereo, but the speaker output is mono. By default, the speaker uses the same audio as the left headphones channel. This can be changed with the "Speaker channel" setting. In most cases the audio data for left and right is the same, except if binaural mode is on, L/R balance is not zero, or CW regen with stereo split is on.
- Swap left and right channels ("Swap L/R").

The output settings can be found in the menu under "Other settings > Output settings".

Audio Signal Generator

Wolfwave incorporates a handy low-distortion audio signal generator, which can be accessed through "Utilities > Generate tone" in the menu. The signal is generated for as long as the "Generate tone" screen is displayed. To exit back to the menu and stop the signal generator, press the menu button.

Available signal shapes are sine, square, triangular, and two tone.

All signals have adjustable frequency (100-5000 Hz) and amplitude.

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Two tone mode generates two simultaneous sine waves added together, which can be used for transmitter testing. The adjustable parameters are frequency and amplitude of one of the tones, and frequency and amplitude of the other tone relative to the first one.