

SONUUS[®]

Wahoo
Owner's Manual

**Analogue Dual-Filter/Wah
Stomp Box for Guitar and Bass**

Version 1.00

Safety — read this first!

Important safety information. Read the following information carefully and keep all instructions for future reference.

⚠ Do not open any part of the **Wahoo** case other than the battery compartment. There are no user-serviceable parts in the **Wahoo**.

⚠ Do not expose the **Wahoo** to rain, liquids or moisture of any kind. If this occurs, disconnect the **Wahoo** from your computer, power supply, and from your musical instrument and remove any batteries then allow the unit to dry out completely before using it again. If any liquid has entered the unit, it may need to be serviced by a **sonuus** engineer or authorised repair centre.

⚠ When the **Wahoo** has been stored in a cold environment (*e.g.*, a car) then exposed to a warmer environment (*e.g.*, a warm room), condensation can form on the outside and inside of the **Wahoo**. In such cases the **Wahoo** should be allowed to warm up to room temperature before use to ensure any such condensation has evaporated.

⚠ Avoid getting anything, *e.g.*, an instrument cable, trapped under the footpedal—this will cause damage to the **Wahoo** footpedal sensor.

⚠ Only use the correct type of power supply (see “Powering the **Wahoo**” on page 8). The **Wahoo** must never be connected directly to mains electricity.

⚠ Do not drop the **Wahoo** or expose it to excessive shock or vibration. This may cause damage to the electronics inside the unit.

⚠ Do not put excessive weight onto the footpedal of the **Wahoo**. It is designed to be foot-operated, but not to bear excessive loads. Do not allow your foot to press on the control panel area because this may damage it. The **Wahoo** has protection bars to prevent your feet from accidentally pressing this area but this cannot provide complete protection—you must still take reasonable care when using the product.



RoHS



Quick start

This manual is a comprehensive guide to the **Wahoo**. To start using it as quickly as possible, follow this short guide. Please refer to the rest of the manual for detailed operating instructions.

- ① Connect your guitar/bass to the **IN** jack of the **Wahoo**.
- ② Connect your amplifier to the **OUT** jack of the **Wahoo**.
- ③ Set the **LOCK** switch to the locked position (this lets you select presets without worrying about editing them by mistake).
- ④ Connect a suitable power supply: 9VDC, USB or batteries (see “Powering the **Wahoo**” on page 8).
- ⑤ Select the first factory preset by pressing the ▼ button until **F00** is shown on the numeric display.
- ⑥ Tap the footswitch to enable the effect. The footswitch LED will light up.
- ⑦ Rock the footpedal back and forward while you are playing to obtain the classic Wah effect. In the “toe-down” position high frequencies will be enhanced. In the “heel-down” position, low frequencies will be enhanced and high-frequencies will be muffled.

Next, start exploring other presets using the ▲ and ▼ buttons. There are 100 factory presets labelled as **F00–F99**, then 100 user presets labelled **P00–P99**. If you press and hold ▲ or ▼ you can increment or decrement in steps of 10 so you can quickly select the preset you want.

To get started, we suggest you select from the following:

Preset (guitar)	Description
F00	Classic wah pedal
F10	Vocal wah pedal
F20	Touch wah (not pedal)
F42	Phasor-like dual-filter (Pedal controls tempo)
F50	Stepped LFO, arpeggiator-like (Pedal controls tempo)
F61	LFO beat, with saw-up LFO (Pedal controls tempo)

Preset (bass)	Description
F03	Classic bass wah pedal
F34	Funky bass envelope
F81	Bubbly envelope
F40	Vocal dual-filter LFO (Pedal controls tempo)
F53	Stepped LFO (low-pass) (Pedal controls tempo)
F63	LFO beat, with funk (Pedal controls tempo)

Welcome

Thank you for purchasing a **sonuus Wahoo**. Like all **sonuus** products, the **Wahoo** is the culmination of ground-breaking innovation and considerable technical expertise. We are delighted that you have chosen to purchase a **sonuus Wahoo** and we anticipate that it will greatly enhance your music making. This manual is a comprehensive guide to the **Wahoo** but if you have any questions, we offer attentive customer support via our on-line user forum:

www.sonuus.com/forum

The **Wahoo** is a dual analogue filter stomp box. It is packed with innovations from the **sonuus** Research Team.

Analogue signal path with digital control

The **Wahoo**'s fully analogue signal path is based on vintage synthesizer filters, and gives the warm organic tone that is possible with only analogue electronics. We have combined the analogue signal path with digital control for precision and configurability.

Dual analogue filter design

The **Wahoo** has two analogue filters, each of which can be configured as low-pass or band-pass and can operate independently in wah pedal, LFO, envelope and pitch-tracking modes. The dual filter output can be configured to give evolving textures and tonal depths that cannot be achieved with a single filter.

Ground-breaking pitch-tracking effects

The **Wahoo** uses **sonuus'** proven, and highly acclaimed, pitch-tracking technology to create unique pitch-bend and pitch-tracking effects—effects that have never been available before.

Unique patent-pending pedal sensor

Most wah pedals operate using a potentiometer (a pot) which wears out quickly resulting in the effect becoming scratchy. These also have mechanical couplings which limit fine control and let dirt inside the unit, so compromising reliability.

Some other wah pedals use optical methods which are susceptible to dirt and interference from stage lighting, and these also have mechanical couplings.

For the **Wahoo**, we designed a brand new type of position sensor that allows super-fine precision control with no mechanical couplings. As a result, the pedal control on the **Wahoo** won't get scratchy and will never wear out!

For guitar and bass

The **Wahoo** is designed from the ground up to be perfect for guitar and bass. We know that many musicians play both instruments and don't want to compromise when an effect is designed for the

higher or lower frequencies of these instrument: the range of the **Wahoo** parameters can perfectly match guitar and bass, and you can save and switch between instrument-specific set-ups.

Of course, the **Wahoo** can also be used on other instruments such as keyboards. You don't need to restrict your creativity to guitar and bass!

Transparent-true-bypass

True-bypass means that the effect is completely switched out of your signal chain when bypassed to preserve the integrity of your guitar/bass signal. This is typically done by mechanical switches but these cause clicks or pops when switching.

For the **Wahoo**, we designed a silent-switching true-bypass circuit so you get the benefits of true-bypass without the associated switching noise. What's more: if the power to the **Wahoo** is interrupted, the unit will automatically switch back to the bypassed state so you don't lose your instrument's signal.

Stage-ready

The **Wahoo** is designed to be ideal for gigging on stage:

- Heavy-duty cast aluminium case that will stand up to years of heavy use.
- The pedal won't decide to get scratchy just before a crucial gig!
- Variety of power sources: any polarity 9V for maximum convenience, USB and high-capacity AA batteries.
- Foot-operated preset selection.
- **LOCK** switch to prevent accidental changes to settings or presets.

Presets

The **Wahoo** comes ready-to-play with 100 factory presets which include traditional wah effects, touch-wah, bass envelope filters, auto-wah, bubbly funk, vocal sounds and extreme synth-like special effects. Without making any adjustments, the **Wahoo** is ready to play, straight out of the box.

The 100 factory presets is just the starting place! By tweaking these presets you can explore different sounds and create your own effects—there are 100 user presets where you can store your own set-ups.

www.sonusus.com

We recommend that you visit our web site and register your new **Wahoo**. This is required for direct warranty support. Once you have registered, you have access to firmware updates and you can opt to receive updates and news from **sonuus**:

register.sonusus.com

To get assistance or to share your experiences with other **Wahoo** users, register on our user forum:

www.sonusus.com/forum

Using the Wahoo

In the rest of this manual, we cover everything you need to know about the **Wahoo** from how to connect it to your rig, to how to power it and how to delve in and create your own presets.

Consult the photo of the **Wahoo** shown below to familiarise yourself with the controls and displays.



Cancel an edit / selecting preset mode

If you move or press a knob or touch the **FILTER** button, the **Wahoo** will leave Preset Select mode and enter Preset Edit mode. (Now the ▲▼ buttons won't let you select presets.)

The button named **save** has dual functionality. When held for 2s, it acts as a cancel button. This lets you undo any preset editing you have done and takes you back into Preset Select mode.

Connecting the Wahoo



The simplest way of connecting the **Wahoo** is between your guitar and amp: connect the output of your guitar to the input (IN) of the **Wahoo**. Connect the output (OUT) of the **Wahoo** to your amp's input.

When using other effects in your signal chain, there is no right or wrong effect order—experiment to see what you can do, and be creative.

Typically, time-based effects such as reverb and delay are placed after the **Wahoo** so that these effects are applied to the **Wahoo**'s sound.

When using distortion, the effect of connecting this before or after the **Wahoo** are very different. When distortion is used after the **Wahoo**, the effect can be quite subtle, and any noise from the **Wahoo** can be enhanced (particularly with high-gain distortion effects). When distortion is placed before the **Wahoo**, the **Wahoo** is able to shape the harmonically-rich signal from the distortion to get more sonic variation. This also has the advantage of not boosting any noise produced by the **Wahoo**.

You can also connect the **Wahoo** to the effects loop of your amp: connect the output of your guitar to the input of your amp, then connect the “send” of your amp to the **Wahoo** IN, and the OUT of the **Wahoo** back to the “return” of your amp. Depending on your amp this can give rise to excessive noise if the signal level in the effects loop is too small. If you try this, it is best to set the effects loop level to +4dBu if you have that option.

Powering the Wahoo

The **Wahoo** can be powered by batteries, by a 9V DC power supply (neither of these is supplied), or by USB. Select one of the following:

- insert 4 AA batteries (alkaline can be used, but we recommend rechargeable NiMH batteries) into the battery compartment in the base of the **Wahoo**. WARNING: observe correct polarity!
- plug the output of a 9V DC power supply into the port labelled DC on the back of the **Wahoo**. The 9V DC power supply that you use should be capable of providing 500mA and have a 2.1mm centre pin connector. Note that the **Wahoo** has been designed so that either polarity (tip-positive or tip-negative) can be used.
- plug a USB cable connected to your computer or a USB power supply into the port labelled USB on the back of the **Wahoo**. If a USB hub is used, it may need to be a powered hub to ensure it can provide enough current to the **Wahoo**.

Note that there is no problem if you connect all three power sources at once. The DC supply takes priority, then USB, then the batteries. This ensures your batteries are not drained when they are not needed and allows you to connect via USB without using USB power when a DC supply is present.

Top Tip: If you are using the **Wahoo** on stage, use a DC power supply and batteries. That way, if the DC power supply is pulled out for any reason, the **Wahoo** will switch to batteries and you will, in effect, have an un-interruptible power supply.

The **Wahoo** is switched on when you connect USB or DC. When running from batteries, the **Wahoo** is switched on when an instrument cable is connected to IN. To prolong battery life, disconnect the cable from IN when the **Wahoo** is not being used.

Enabling and bypassing the Wahoo

The main footswitch LED shows the status of the **Wahoo** effect.

When this LED is off, the effect is completely bypassed and the input (IN) is directly connected to the output (OUT). This connection is known as a true-bypass connection because in this state none of the **Wahoo** electronics are connected to the signal which keeps your original guitar/bass signal as pure as possible.

When this LED is on, the signal is passed through the **Wahoo** and the output (OUT) is the effected (filtered) signal.

The effect is enabled and disabled by briefly pressing the footswitch. Alternatively, when the footpedal is moved to the toe-down position, the effect will automatically enable. This emulates the behaviour of a classic Wah pedal which has a footswitch placed under the footpedal. Note that this feature can be turned off using the custom settings (page 27).

Note that if this LED is flashing, it means the **Wahoo** is in foot-operated preset selection mode (see page 11).

Footswitch LED

- Off: Effect is completely bypassed (the **Wahoo** has no effect on your sound).
- On: Effect is active and the **Wahoo** will affect your sound.
- Flash: Foot-operated preset selection mode is active. The bypassed/enabled state of the **Wahoo** does not change in this mode but remains in whichever state it was in before this mode was activated.

Selecting a factory preset

There are 100 factory presets in the **Wahoo**. They configure the **Wahoo** into a variety of set-ups, from traditional wah to **sonuus'** unique pitch tracking filter effects. A summary of factory presets is at the back of this manual (page 31).

The **Wahoo** has two modes: Preset Select mode and Preset Edit mode. By default, it is in Preset Select mode and the display alternates between the 3-character preset name and the preset number: either **F00–F99** for factory presets 0 to 99 or **P00–P99** for user presets 0 to 99.

If the display does not periodically show **F/P00–99**, then to enter preset mode do the following.

Enter Preset Select mode

If the display is not showing a factory or user preset (**F00–F99** or **P00–P99**), the **Wahoo** is in Preset Edit mode: exit this mode by pressing and holding the **save** button for 2 s.

Alternatively, slide the **LOCK** switch to the locked position (the **Wahoo** is always in Preset Select mode when locked).

Once the **Wahoo** is in Preset Select mode, select a preset using the **▲▼** buttons. A single press on either button will increment/decrement the preset number by one. If you press and hold either button, the preset number will increment/decrement in tens.

Top Tip: Envelope effects have been designed for an instrument with a standard output level. If your instrument has an unusually high or low output the presets may not sound correct—either too responsive or not responsive enough. Use the custom **SEn** parameter to adjust the sensitivity of your **Wahoo** (see page 27).

Your **Wahoo** is now ready to play. Select different presets and experiment with the wide variety of sounds that are possible.

For pedal effects (**F00–F19**), as you play move the footpedal in time to the music to create the wah sound. For envelope (touch) effects (**F20–F39**) the wah effect is controlled by how hard to play. For LFO (auto) effects (**F40–F59**) the filters will move on their own, but the footpedal can be used to control their tempo between preset limits. See “Factory presets” on page 31 for a summary of the factory presets.

While you are playing, you may accidentally bump a switch or button which will take you into Preset Edit mode. To prevent this, and stay in Preset Select mode, you can slide the **LOCK** switch to the locked position. Alternatively, just re-enter Preset Select mode as described above.

LOCK switch

On the back panel of the **Wahoo** there is a slide switch labelled **LOCK**. When this switch is in the locked position, the **Wahoo** is in Preset Select mode and none of the parameters can be edited or saved: the only thing that you can do is change between presets. If you try to make a change when locked, **LoC** is shown briefly on the numeric display.

LOCK mode is ideal for gigging, when you want to switch from one preset to another but be sure that you won't accidentally make changes to your set-up. When the **LOCK** switch is in the unlocked position, you can tweak the **Wahoo** settings and save new presets.

Foot-operated preset selection

Preset selection using the ▲▼ buttons and the **save** button was described in “Selecting a factory preset” on page 9. There is an alternative method of preset selection using the footswitch and the footpedal. This has been specially designed to make it easy to change presets when you are gigging. Using this method, you don't have to bend down and select presets using your hands.

Preset selection using the footswitch and footpedal

Enter preset mode by pressing and holding the footswitch until the footswitch LED flashes. The time you have to hold for has a default value of 2 s, however this is a custom parameter that you can change (see “Custom settings” on page 27).

To increase the preset number, put the footpedal in toe down position (the ▲ button LED flashes to show that the preset number will increase) then tap (press and release) the footswitch the desired number of times until you reach the preset number you want. To decrease the preset number, move the footpedal to heel down position (the ▼ button LED now flashes) then tap the footswitch until you reach the preset you want.

When you have reached the preset number you want, you can play and even change presets while playing. However, while in preset select mode you can't enable or bypass the effect: to do this you have to exit preset mode by pressing and holding the footswitch until the footswitch LED stops flashing. The hold time to exit preset mode is the same as the hold time to enter it.

Note 1: In foot-operated preset selection mode, you can only step through the presets one at a time (not in tens as you can if you use the ▲ ▼ and **save** buttons). We therefore recommend that for a gig, you make sure that you save the presets you want to use close in number to one another.

Note 2: In foot-operated preset selection mode, you can still use the ▲ ▼ buttons as normal to select presets, and to increment/decrement in 10s if required.

Creating your own presets

You can create and store up to 100 user presets on the **Wahoo**. The steps for creating a preset are straight-forward.

Creating and saving a user preset

Ensure that the **LOCK** switch is in the unlocked position. Starting from any preset (factory or user), adjust the **Wahoo** settings using the **LEVEL**, **FILTER** and **MODE** knobs to get the desired musical effect. These settings are discussed in detail later.

Save the preset. Press the **save** button. Use the **▲▼** buttons to select a user preset number (**P00–P99**) where you would like to store your preset. The name of the existing preset (if any) flashes alternately with the preset number to help you select either an unused preset or a preset to overwrite. Press the **save** button again when you have selected your preset number. You can now edit the three-character preset name. Using any one of the three knobs (**LEVEL**, **FILTER** or **MODE**) turn the knob to cycle through A-Z, 0-9 and press a knob to advance to the next of the three characters in the preset name. Finally, press the **save** button to write your preset to the chosen location.

The **save** button flashes while this save process is in progress. To abandon the save at any time, and revert to Preset Select mode, press and hold the **save** button for 2 seconds.

Selecting and changing parameters

When you press the **FILTER** button, or press or move a knob (**LEVEL**, **FILTER** or **MODE**), the **Wahoo** will enter Preset Edit mode. The flashing LED shows which parameter is being displayed on the numeric display. Pressing a knob will let you select another parameter to be edited. For example, successive presses on the **LEVEL** knob will cycle between editing **drive**, **filt mix 1/2**, **dry/wet** and **output**.

Change the value of a parameter by turning the knob next the that parameter's LED. When you have the value that you want for that parameter, select another parameter to edit. When you have completed your editing, you can save your setup as described previously.

Some parameters have sub-parameters. For these, the **▲▼** buttons will also flash. Cycle round the sub-parameters using the **▲▼** buttons. The name of the sub-parameters is shown on the display to make it clear what is being selected for editing. Turn the knob to change the value of the sub-parameter that is being edited.

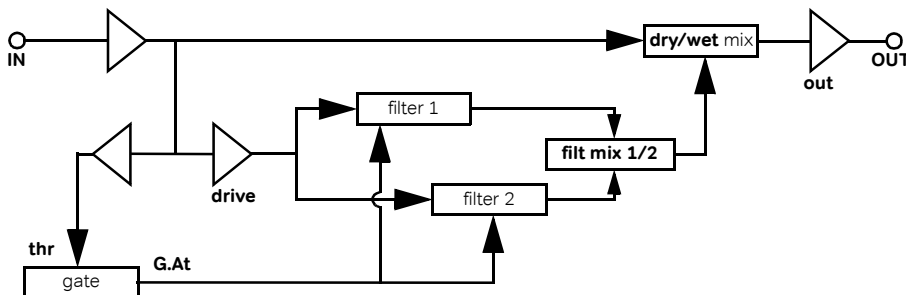
All of the filter parameters and the mode parameters can be set independently for each of the two filters. Select which filter to edit by using the **FILTER** button to switch between filter 1 and filter 2. The filter whose settings are being altered is indicated by the illuminated filter LED (**1** or **2**).

Adjusting LEVEL

The level parameters apply to the input and output of the **Wahoo** rather than to the individual filters.

Parameter	Sub-parameter	Range	Description
drive		0–100	Gain of pre-amp feeding the filters.
filt mix 1/2		0–100	Proportion of filter 1 and filter 2 that form output signal 0 gives 100% filter 1; 100 gives 100% filter 2.
dry/wet		0–100	Proportion of original instrument signal that is mixed into the output of the Wahoo .
output	out	0–100	Signal level at the output jack.
	thr	0–200	Threshold: noise gate threshold. 0 means the noise gate is inactive, increasing the value increases the signal level at which the noise gate becomes active.

The **Wahoo** signal chain is shown below.



LEVEL drive. The **Wahoo** uses warm-sounding analogue filters. As the signal feeding the filters is increased, the filter sound begins to distort and add pleasing harmonics to the signal. Turn the drive down for the cleanest sound, but if the drive is too low the signal will become noisy. Turn the drive up for lower noise, and warmer sounds; but if it is turned up too high the sound will become fuzzy, which can itself be a desirable effect.

LEVEL filt mix 1/2. This controls the filter mixer: the proportion of filter 1 and filter 2 that form the output of the **Wahoo**. 0 gives 100% filter 1, 100 gives 100% filter 2. Note that, to make editing simpler, the active filter will automatically switch to **1** or **2** when 100% of that filter is selected.

LEVEL dry/wet. This lets you mix the unaffected instrument's signal into the effected output of the **Wahoo**. 0 (dry) means that the output of the **Wahoo** is entirely the thru' signal, *i.e.*, the output is

unaffected by the **Wahoo** filters. 100 (wet) means only the filtered sound is present in the output. This parameter be used to retain some of the sonic character of the original instrument sound. For example, for bass envelope filtering it is common to retain some dry signal to ensure the initial attack of notes is retained.

LEVEL output (out). Typically you adjust the output level so there is a good balance between the original sound (when the effect is bypassed) and the effected sound. It is possible to increase the output level to boost the signal beyond the level of the original instrument level which can be useful, for example, to overdrive the input stage of a valve amplifier. Note that at high output settings, the output stage will start to soft-saturate. This lets you achieve louder sounds without worrying about unpleasant clipping, regardless of how hard you play.

LEVEL output (thr). Some presets, depending on the resonant filter setup (see the next section for a discussion on filters), have an audible output with no input signal. If you want to remove this, you can do so by adjusting the output threshold, **thr**, sub-parameter until the sound disappears. The threshold sub-parameter acts like a noise gate by moving the filter cutoff frequency to a lower-than-audible frequency when the input level is below the threshold you set. Because this is not a true noise gate, you may hear a frequency sweep as the frequency moves when the signal level falls to below the threshold you set. Note that gate attack is a global setting (see “Custom settings” on page 27).

Adjusting FILTER

All of the filter parameters apply individually to each of the two filters. You can select the parameter to edit, then switch between filter 1 and filter 2, or you can select a filter and then cycle through all the parameters for that filter, or you can do a combination of these—the order in which you edit is flexible.

Parameter	Sub-parameter	Range	Description
Q-hi		0–100	Q of the filter at freq-hi .
Q-lo		0–100	Q of the filter at freq-lo .
freq-hi		10–4.00	Cutoff frequency of the filter in Hz (kHz).
freq-lo		10–4.00	Cutoff frequency of the filter in Hz (kHz).
shape	Cur	Lo9–Lo1, Lin, hi1–hi9	Curve: controls how the filter cutoff control is mapped onto the filter's cutoff frequency.
	Shp	Lo bnd	Filter type: low-pass band-pass

FILTER freq-hi, freq-lo. The cutoff frequency of the filter can be set by entering the value in Hz. The cutoff can range from 10Hz (which is lower than you can hear) up to 4000Hz. Values above 999Hz are shown in kHz (*i.e.*, 2500Hz is shown as “2.50”).

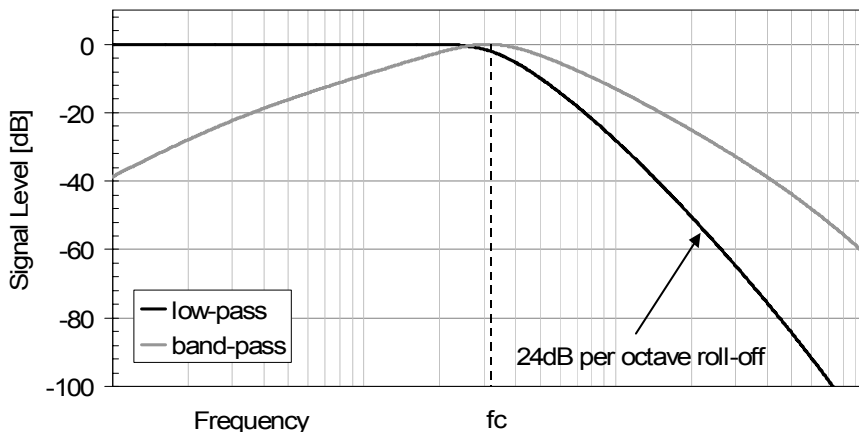
Reverse filter sweeps

It is simple on the **Wahoo** to create reverse (inverted) filter sweeps: simply set **freq-hi** to be smaller than **freq-lo**.

“hi” and “lo” refer to the modulator position: when the footpedal is in toe-down position (or the envelope follower is at a maximum), the value **freq-hi** is used, whether this is greater than, or smaller than, **freq-lo**.

FILTER shape. A musical sound contains many frequencies. A filter is used to remove some of these frequencies and to enhance other frequencies. The simplest filter to understand is a low-pass filter. It is named after the part of the frequency spectrum that remains after the filtering has happened. A low-pass filter filters out (removes) high frequencies and allows low frequencies to remain (to pass). The frequency above which the high frequencies are removed is called the cutoff frequency, f_c .

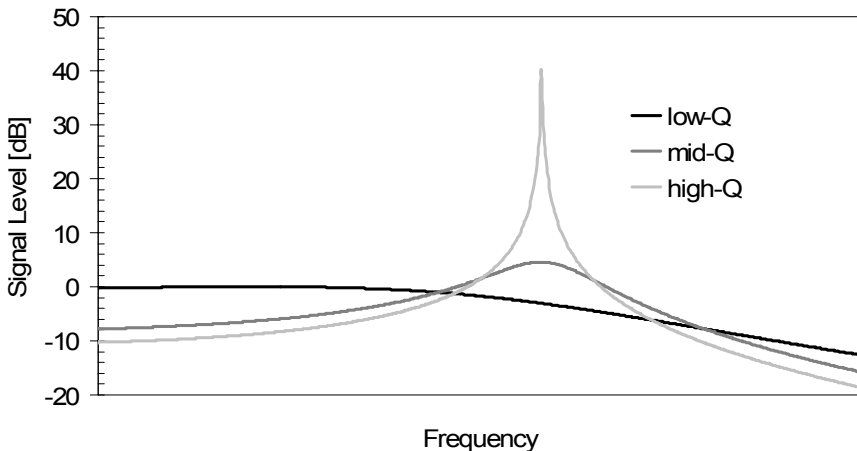
The **Wahoo** filters can be configured as low-pass or band-pass filters. A band-pass filter removes frequencies above and below a specified frequency and only allows those frequencies in the specified band to pass. The diagram below shows the frequency response of a low-pass and of a band-pass filter. The centre frequency, rather than the cutoff frequency, is defined for a band-pass filter, both are shown as f_c .



Note that frequencies above the cutoff frequency do not immediately fall to zero. The slope of the curve beyond the cutoff frequency is called the filter roll-off and is a characteristic of the filter. The roll-off is measured in dB per octave and the low-pass filter in the **Wahoo** has a roll-off of 24 dB per octave. The band-pass filter has a roll-off of 12 dB per octave on each side of f_c . Note that this means the low-pass filter is more effective at removing frequencies above f_c than the band-pass filter.

The shape of the filter around the cutoff frequency is another characteristic of the filter and is represented by the parameter Q (or resonance). A high value of Q is associated with a “peaky” filter which has high gain at the cutoff frequency. At maximum Q the **Wahoo** filters will self-oscillate at f_c even with no input signal.

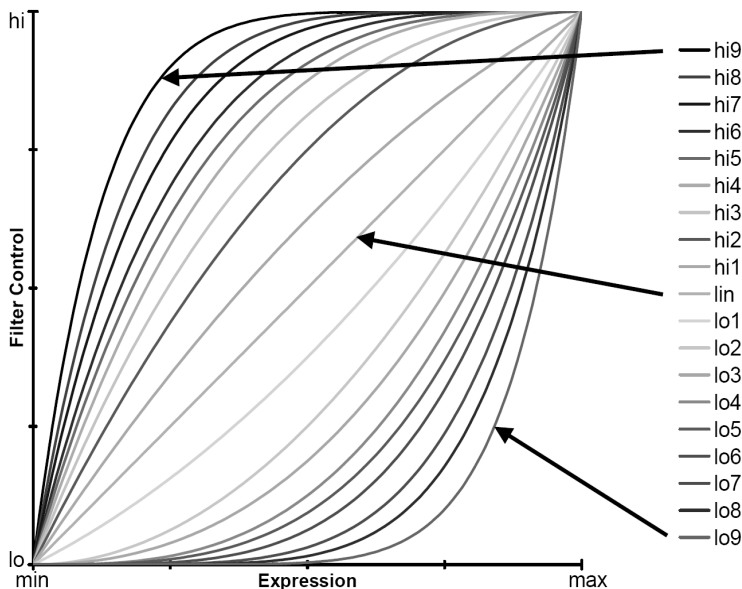
Unlike other filter effects, the **Wahoo** lets you dynamically change the filter Q as the cutoff frequency changes by using the **Q-hi** and **Q-lo** parameters. This gives you enhanced control of the sonic character of the filter and makes it easier to emulate vintage filter effects.



Different effects are achieved using low-pass and band-pass filtering. Low-pass filtering will retain more of the original signal's low end, whereas band-pass filtering can often introduce more character into the sound.

FILTER CURVE. Changing the curve lets you adjust the “feel” of the footpedal, or the response of the envelope tracker. Take the example of using the footpedal to control the cutoff frequency of the filter. Normally the filter cutoff, from **freq-lo** to **freq-hi**, is mapped linearly to the output via the position of the footpedal. The minimum filter cutoff is usually achieved with the footpedal in heel down position and the maximum with the footpedal in toe down position. The filter cutoff is controlled linearly by the position of the footpedal when the footpedal is between its two extreme positions.

The **Wahoo** allows you to change this mapping from linear to the curves shown below.



This allows you to have more control and configurability of analogue filters than has ever been possible before. If you select one of the lo curves, the filter cutoff changes more rapidly towards the end of the travel of footpedal towards the toe down position. The hi curves change the filter cutoff more rapidly at the start of the travel of the footpedal from the heel down position.

If this seems a little complicated, the best way of remembering how lo and hi work is that a lo curve spends more time near **freq-lo**, while a hi curve spends more time near **freq-hi**. The higher the number *i.e.*, **Lo9** rather than **Lo1**, the more pronounced the effect.

For simplicity, we started with the example of how the footpedal controls the filter cutoff. However, in LFO, envelope and pitch modes, the same principle holds. Don't worry too much about how this parameter works—simply adjust **Cur** to get the sound you want!

Vocal sounds

To get very vocal-sounding filter effects, you must use both **Wahoo** filters working together (*i.e.*, operating in the same mode so that they track each other). Doing this lets you approximate the pairs of dominant resonances that are present in the vocal tract when forming vowel sounds. See “Creating vowel sounds” on page 25 for a table of which cutoff frequencies to set to get various vowel-like sounds from the **Wahoo**.

Adjusting MODE

The **MODE** controls of the **Wahoo** work slightly differently from the **LEVEL** and **FILTER** controls described above. Each of the two filters has one mode, selected from **pedal**, **LFO**, **envelope** or **pitch**, and the mode for each filter can be different. Configure each filter separately, switching between them using the **FILTER** button. For each filter, press the **MODE** knob to cycle through the modes, stopping on the operating mode you want for this filter. Use the **▲▼** buttons to cycle through the sub-parameters for this mode and turn the **MODE** knob to change the values of the sub-parameters. You do not need to set up values for the sub-parameters of the other modes for this filter—you only set up the single mode that you have selected for this filter.

When both filters are in the same mode they can work together to create thick, vocal tones. When the filters are in different modes you can get new interesting effects.

Note: the custom parameters are covered later in this manual (see “Custom settings” on page 27). They operate separately from the four modes described above.

Pedal mode

If you select **pedal** mode for a filter, you can select standard wah pedal operation or MIDI-controlled operation by setting the value of the **pedal** parameter as described in the following table. For details on MIDI operation, refer to “MIDI operation” on page 25.

Pedal parameter value	Description
PEd	pedal: The Wahoo footpedal controls the filter: standard wah pedal mode.
CtL	control: MIDI expression controller (14-bit) controls the filter.
rEM	remote: MIDI cut-off and resonance controllers (7-bit) control the filter.
not	note: MIDI note controls the filter.

LFO mode

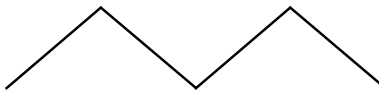
In LFO mode, an internal low-frequency-oscillator (LFO) controls the filter cutoff. The speed of the LFO can be controlled precisely and can even be synchronised with a sequencer using MIDI ("MIDI operation" on page 25). The following sub-parameters configure the LFO.

LFO sub-parameter	Range	Description
tyP	tPo -F1 tAP PEd Syn	Type of LFO clock: tempo in bpm derived from filter 1's LFO (only available for filter 2) pedal is used to tap a tempo pedal controls max (bP.h) and min (bP.L) bpm sync'd to MIDI clock
bPM	10–999	Sets LFO tempo in bpm. Only available if tyP is set to tPo .
bP.h	10–999	bpm high: bpm when footpedal is in toe down position. Only available when tyP is set to PEd . bpm is interpolated between bpm-high and bpm-low depending on the position of the footpedal.
bP.L	10–999	bpm low: bpm when footpedal is in heel down position. Only available when tyP is set to PEd .
div	16, 8, 6, 4, 3, 2, 1, $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$	Clock multiplier. For example, if the clock is 120bpm and div is set to $\frac{1}{2}$, the LFO clock will run at 60bpm.
ShP	Sin tri Sqr S.uP S.dn trP rnd	Shape of LFO waveform: sinusoid triangle square saw up saw down trapezoid random
StE	oFF , 1–16	Step: quantizes the LFO output to this number of steps.
r.uP	0–100	Ramp up: only available for trapezoid. See below for details on how trapezoids are set up.
r.dn	0–100	Ramp down: only available for trapezoid.
PhA	0–63	Phase: controls the phase of filter 2 relative to filter 1. Only available when tyP is -F1 , <i>i.e.</i> , filter 2 is sync'd to filter 1.

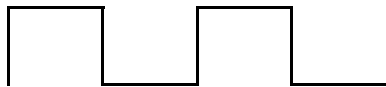
The diagram below shows examples of the different shapes of waveforms, selected using the **ShP** sub-parameter. The random waveform takes a different random value every cycle (the cycle is defined by the **bPM** and **div** sub-parameters).



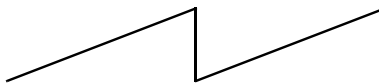
sinusoid



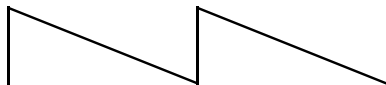
triangular



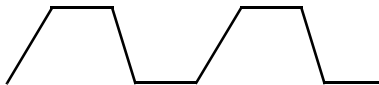
square



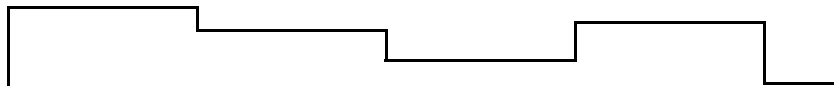
saw up



saw down

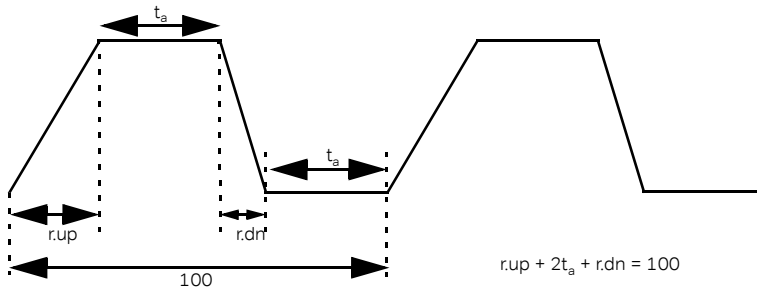


trapezoid



example of random

The trapezoidal waveform is highly configurable: examples of trapezoidal waveforms are shown below. In the **Wahoo**, the shape of the trapezoid is controlled by the parameters ramp up and ramp down, referring to the left and right sides of the waveforms shown. One cycle of the trapezoid waveform is represented by 100 time units. The sum of ramp up and ramp down cannot exceed 100. If the sum of ramp up and ramp down is less than 100, the remaining time is split evenly between t_a and t_b shown below.

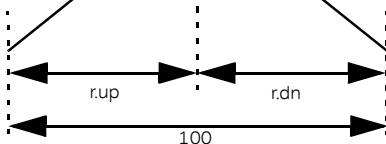


Using the trapezoid waveform, you can generate a square wave (ramp up = ramp down = 0), a triangular wave (ramp up = ramp down = 50), a saw-up wave (ramp up = 100, ramp down = 0) and a saw-down wave (ramp up = 0, ramp down = 100) in addition to trapezoidal waveforms.

triangular wave

$t_a = 0, r.up = r.dn = 50$

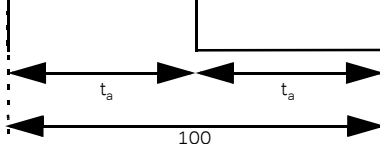
$r.up + r.dn = 100$



square wave

$r.up = r.dn = 0, t_a = 50$

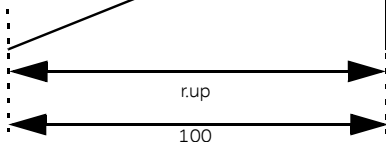
$2 t_a = 100$



saw-up wave

$t_a = 0, r.up = 100, r.dn = 0$

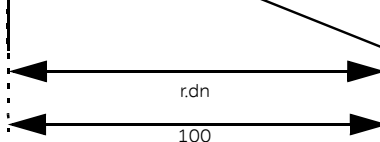
$r.up + r.dn = 100$



saw-down wave

$t_a = 0, r.up = 0, r.dn = 100$

$r.up + r.dn = 100$

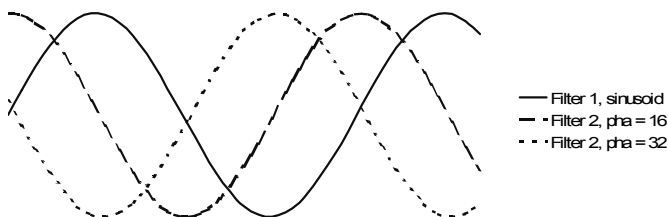


The sub-parameter **tyP**, lets you select the LFO clock type. The options for the clock are: it can be set as a tempo (**tPo**) using the **bPM** sub-parameter; for filter 2 it can be sync'd to filter 1's clock (**-F1**); tempo can be tapped using the footpedal (**tAP**); tempo can be controlled by the footpedal position

(**PEd**), where the extremes of the footpedal position have bpm values **bP.h** and **bP.L**; or the clock can be sync'd (**Syn**) to external MIDI clock.

The tempo is in beats per minute, bpm. The sub-parameters **bPM**, **bP.h** and **bP.L** have a range between 10 and 999. To achieve slower and faster tempos, the **div** sub-parameter multiplies the value of the tempo set by the **tyP** clock source. As an example, if filter 1 **tyP** is **tPo**, **bPM** is 120bpm and **div** is 2, and filter 2 **tyP** is **-F1** and **div** is $\frac{1}{2}$, then filter 1 has tempo of 240bpm and filter 2 has tempo equal to $\frac{1}{2}$ of 120, *i.e.*, 60bpm.

If filter 2 is sync'd to filter 1 (**tyP** is **-F1**), then the **PhA** parameter is used to control the phase offset between the filters. **PhA** set to 0 means that the filters are in-phase; **PhA** set to 32 means that the filters are out-of-phase, and settings in-between give degrees of out-of-phasesness. The figure below shows a sinusoid and two examples of different values of the phase offset, **PhA**.



Envelope mode

In envelope tracking mode, the following sub-parameters are used:

Envelope sub-parameter	Range	Description
SEn	0–999	Sensitivity: how sensitively the filter follows the envelope.
Att	0–200	Attack: how quickly the filter follows an increase in signal.
dEC	0–200	Decay: how quickly the filter follows a decrease in signal.

In envelope tracking mode, the filter cutoff control follows the signal level. The cutoff control increases and decreases as the signal becomes louder and quieter. **SEn**, the sensitivity sub-parameter, controls how sensitively the filter follows the signal envelope—a high value means that the filter will move easily with gently playing; a low value means that you will have to play hard to get the filter to move much. **Att** and **dEC** control how quickly the follower reacts to an increase and decrease in signal loudness, respectively.

Note that the sensitivity can also be used to tweak the envelope tracker for different musical instruments: for example, a high output bass and a low output bass may need different values of sensitivity to get the same feel. However, we recommend that the global **SEn** parameter in custom (see “Custom settings” on page 27) is used instead to adjust for instrument characteristics so that it is easier to switch between different instruments and to make it easier to exchange presets with other users.

Pitch mode

If a filter is in pitch mode, the following sub-parameters are used:

Pitch sub-parameter	Range	Description
tyP	bEn trA	Pitch-bend or pitch-track: bend track
Att	0–200	Attack: how fast the filter follows pitch changes.
S.tn	1–36	Semitones: maximum pitch bend in semi-tones. (Only available if tyP is bEn .)
rEF	bot Ctr toP	Pitch bend reference: defines whether the starting point of a bend is (only available if tyP is bEn): bottom centre top
FrE	–99–99	Frequency: pitch tracking frequency offset (tone). (Only available if tyP is trA)

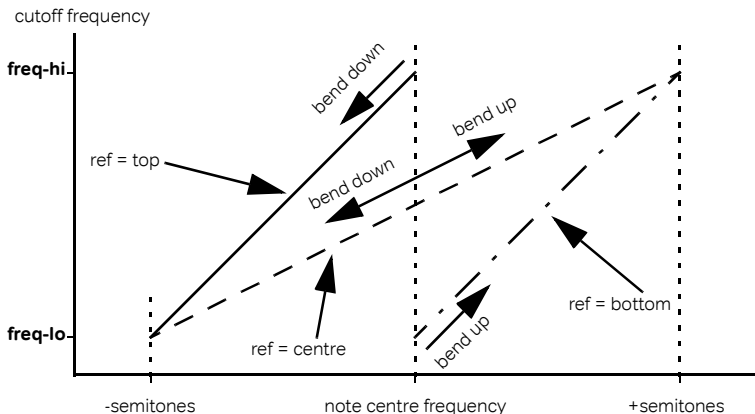
The pitch mode can be set to either pitch-track or pitch-bend using the **tyP** sub-parameter. These innovative effects use **sonuus'** unique, highly acclaimed, pitch detection and tracking technology.

Top Tip: Pitch tracking is monophonic (it can only track single notes) but you can still play chords in **pitch** mode: the **Wahoo** will track the dominant note. For best control of the effect in **pitch** mode, play single notes clearly.

Pitch-track (trA). In pitch-track mode, the cutoff frequency of the **Wahoo** filter is set to follow the pitch of the notes that you play. There are three parameters that control how this happens. The pitch tracking can be offset from the pitch of the notes you play by adjusting the **FrE** frequency sub-parameter— a positive number can move the filter frequency higher by up to 4 octaves; a negative number can move the filter frequency lower by up to 4 octaves. The other two parameters that control the pitch tracking are **freq-hi** and **freq-lo** in the filter set-up. The pitch tracking frequency is limited to always be between **freq-hi** and **freq-lo**. You can picture pitch tracking as a filter that moves with the pitch of your notes within frequency limits you define (just like when a synthesizer's filter is set to “keytrack” mode). It allows you to create interesting tonal effects, including synth-like sounds,

for example by configuring a low-pass filter to remove the harmonics of your instrument's signal to leave only the fundamental tone. The tracking will only follow your playing exactly when the curve sub-parameter of the filter **ShP** parameter is set to linear (**Lin**). If one of the other setting is selected (**Lo9–hi9**), you will change the point at which the filter follows your playing. Although this will be less predictable, you can create some nice effects like this.

Pitch-bend (bEn). In pitch-bend mode, when you bend a note, the cutoff frequency of the filter moves. You set how much of a bend should map onto the maximum cutoff control—this is set in semitones via the **S.tn** sub-parameter and can be between 1 and 36 semitones. Obviously, the larger values are not applicable to note-bending with your fingers; they apply to bending using a whammy/tremolo bar. The extremes of the pitch-bend are then mapped to the values of **freq-lo** and **freq-hi**: the limits you have set for the filter cutoff frequency. The reference point of the bend is set by the **rEF** sub-parameter. The reference point is the filter cutoff frequency before you apply a bend. For example, if the reference is bottom, then the filter cutoff is at **freq-lo** before you bend. Bending up by **S.tn** causes the filter cutoff to increase to **freq-hi**. The effect of different reference points is shown in the diagram below.



Top Tip: Pitch tracking is optimised for different instruments. You can choose the instrument setting in the custom settings (see “Custom settings” on page 27) to select between guitar, 4-string bass and 5-string bass.

Creating vowel sounds

To create convincing vowel sounds, you need to use both **Wahoo** filters working together to produce the characteristic frequency components of the desired vowels. The table below shows typical cutoff frequencies that can be set on each filter to obtain each vowel sound. Note that these values are approximate and are a good starting point. From here you can adjust the frequency and Q of each filter and experiment to see what sounds most vowel-like to you. Also try configuring one filter as band-pass and the other filter as low-pass to get variations of the sound.

How to use: to go from “ee” to “ah”, set **freq-lo** to the “ee” values, and **freq-hi** to the “ah” values.

Vowel	Frequency [Hz]	
	Filter 1	Filter 2
ee	300	2700
ah	800	1200
aw	600	800
oo	350	800
ae	800	2000

Vowel	Frequency [Hz]	
	Filter 1	Filter 2
i	400	2500
e	600	2300
u	500	1100
uh	750	1400
er	500	1600

MIDI operation

It is possible to control the **Wahoo** with MIDI input or to use the **Wahoo** as a MIDI controller. For example, the footpedal always sends 14-bit expression controller messages on MIDI channel 0 so you can use the **Wahoo** to control synthesizers. MIDI can also be used to synchronise LFOS to your sequencer to ensure their tempo matches that of your song, or to automate preset selection.

Connect the **Wahoo** to a USB port of your computer (OSX, Windows, Linux) via a USB cable connected to the USB port of the **Wahoo**. The necessary drivers are part of the operating system so your computer will automatically configure itself to work with the **Wahoo**. Once this is done, new MIDI-in and MIDI-out ports will appear, named “wahoo”. To send MIDI messages to the **Wahoo**, connect your software to the “wahoo” MIDI-out port. To receive MIDI messages from the **Wahoo**, connect your software to the “wahoo” MIDI-in port.

The following standard MIDI messages are supported. MIDI output (from **Wahoo** to computer)

MIDI message			Chan	Description
Controllers	MSB	LSB		
Expression	#11	#43	0	Always sent whenever the footpedal is moved.

MIDI input (from computer to Wahoo)

MIDI message			Chan ^a	Description
MIDI sync				
MIDI clock			N/A	Used when LFO is in MIDI sync (Syn) mode.
Song position				
Program Change				
Program Change			omni	Selects the preset to be used. Operates on the currently selected bank (factory or user). Use Bank Select controller message to switch between factory and user banks.
Controllers	MSB	LSB		
Bank Select	#0	#32	omni	Selects factory (0) or user (1) preset bank. (Factory: #0=0, #32=0. User: #0=0, #32=1.)
Expression	#11	#43	F(0,1)	Controls filter in pedal (Ctl) mode. The controller works just like a remote footpedal.
Cutoff	#74	—	F(0,1)	Controls filter in pedal (rEM) mode. Cutoff moves filter between freq-lo and freq-hi . Resonance sets the Q from 0 to 100. (Q-lo and Q-hi are not used in this mode.)
Resonance	#71	—	F(0,1)	
Note messages				
Note-on			F(0,1)	Controls filter in pedal (not) mode. The filter cutoff is set to the frequency of the note within the limits set by freq-lo and freq-hi .

a. Channel F(0,1): Channel 0 = Filter1, Channel 1 = Filter2.

Battery monitoring

When the battery level is getting low, **bAt** will periodically appear on the display to warn you.

To see the estimated percentage of battery life remaining, simultaneously press and hold the **FILTER** button and the **▲** button. When using batteries, it is a good idea to check the remaining battery capacity before a performance so that you can replace/recharge the batteries if required.

Note that when DC or USB power are available, the displayed battery level will not show the correct value, but will instead show a value related to the available supply voltage. This is because when an alternative power supply is available, the batteries are disconnected to prolong their life.

Custom settings

Further configurability of the **Wahoo** is possible through **custom**. This lets you change the setup of the **Wahoo** to suit your own instruments or personal preferences. For example, you can adjust the display LED brightness to a very low level to prolong battery life or to suit working in a darkened studio.

The custom settings are different from all of the other parameters: they affect the **Wahoo's** set-up, not the set-up of the current preset *i.e.*, they are global settings. The custom settings are not stored in a preset, they are stored in the **Wahoo** itself. They take effect from when they are changed. They are not changed by switching from one preset to another.

To make changes to the custom sub-parameters, enter **custom** mode by pressing and holding the **MODE** knob for 2s.

Custom sub-parameter	Default	Range	Description
LEd	40	1–100	LED brightness: 1 is minimum, 100 maximum. Reducing the LED brightness is useful for dark environments and for battery saving.
int	gtr	gtr bA4 bA5	Instrument (used for pitch-tracking and envelope-tracking) guitar (perfect for guitar, but also good for 4-string bass. Use this unless you need optimal pitch-tracking of the lowest notes.) 4-string bass (best to track the lowest notes of 4-string bass, but also works well with 5-string bass) 5-string bass (best to track the lowest notes of 5-string bass)
SEn	0	–60–60	Applies a global adjustment for envelope mode sensitivity (SEn) to compensate for instruments with different output levels. Gives a range of ± 24 dB.
P.En	on	oFF, on	Pedal enable. Allows you to enable the effect by moving the footpedal to the “toe-down” position rather than having to first press the footswitch.
g.At	0	0–200	Noise gate attack—how quickly the noise gate moves the filter cutoff frequency when the output falls to below the threshold set.
FS.t	4 (2s)	oFF, 1–8	Footswitch time. Time in 500ms steps that footswitch is held to enter and exit foot-operated preset selection mode.

User modifications of the Wahoo

For the avoidance of doubt, opening any part of the **Wahoo** other than the battery compartment will always cause your warranty to be invalid.

However, we realise that musicians sometimes make the minor modification of reducing the footpedal travel by sticking a piece of rubber under the front (heel position) of the footpedal. If you do this, you will need to follow the pedal calibration procedure below (page 29). Any damage caused to the **Wahoo** deemed by **sonuus** to be caused directly or indirectly by this (or any other) modification will not be covered by the warranty.

The rubber stop at the back of the footpedal (under the toe position) should never be modified to avoid damage to the pedal sensor.

Filter calibration

The **Wahoo** uses analogue filters and a pure analogue signal chain. These analogue electronics can be sensitive to temperature changes. To ensure presets continue to sound the same each time you use them, and so you can exchange presets with other **Wahoo** users and get the same sound, the **Wahoo** uses temperature-compensated calibration. Calibration has been done in the factory before you receive your **Wahoo**, but you may want or need to adjust this, for example if you are using the **Wahoo** in a particularly hot or cold environment.

Calibration has the best results if the **Wahoo** has been on for at least ten minutes so it can warm up to a stable temperature. If you calibrate the **Wahoo** in a warm room straight after you have brought it in from a cold car, the calibration may not remain accurate as the **Wahoo** warms up.

For calibration, the **Wahoo** outputs a tone by making the filters self-oscillate. To see this tone you need to connect the output of the **Wahoo** to a tuner that can tune 880Hz (A5). Enter calibration mode by simultaneously pressing and holding the **FILTER** button and the **FILTER** knob for 4s until **CAL** is displayed. Now adjust the **FILTER** knob until the output of the **Wahoo** is 880Hz (A5). Press the **FILTER** button and do the same for the other filter. To save the calibration and exit calibration mode, press the **save** button. Alternatively, save and exit calibration mode with another simultaneous press of both the **FILTER** button and the **FILTER** knob.

If you enter calibration mode accidentally and want to exit without saving, press and hold the **save** button to cancel.

Pedal calibration

Pedal calibration lets you configure the how much of the travel of the footpedal controls the effect. Normally you won't need to do this but if you make modifications such as limiting the travel of the **Wahoo** by sticking a rubber stop under the front of the footpedal, then this calibration will be useful.

Enter calibration mode by simultaneously pressing and holding the **FILTER** button and the **MODE** knob for 4 s until **CAL** is displayed. Rock the footpedal from one extreme to the other a few times. Save this calibration and exit calibration mode by pressing the **save** button or with another simultaneous press of the **FILTER** button and the **MODE** knob.

If you enter calibration mode accidentally and want to exit without saving, press and hold the **save** button to cancel.

Warranty

The **Wahoo** is supported by a limited warranty for a period of one year form the date of purchase. During this period, any faults due to defective materials or workmanship will be rectified (by repair or replacement) free of charge. A unit under warranty may be replaced with a reconditioned unit.

The warranty excludes damage caused by deliberate or accidental misuse or modification. It is the user's responsibility to ensure fitness for purpose in any particular application. The warranty is limited to the original purchaser, and excludes any consequential damage or loss.

Proof of purchase date is required for any claim under this warranty.

Warranty claims must be made through the retailer from whom the original purchase was made.

Firmware updating

To support new features and to make it future-proof, firmware (internal software) of the **Wahoo** can be upgraded.

To update the **Wahoo** firmware you will need to download the latest firmware file (.sfu) and Firmware Updater software (which includes an instruction manual). The updater software is available for both OSX and Windows. To access these files, you need to register and create a user account at the following web site:

register.sonus.com

To update firmware on the Wahoo

- ① While powering-on the **Wahoo**, press and hold: **FILTER + ▲**.
- ② The numeric display now shows **UPd** to indicate firmware update mode is active.
- ③ Connect the **Wahoo** to your computer via USB (if not already done during power-on).
- ④ Follow the steps in the Firmware Updater manual you have downloaded.

Note: if the **Wahoo** detects that your firmware is corrupt, it will boot straight into update mode to let you update the firmware.

Special key presses

Mode	Key Presses
Filter calibration: enter save and exit cancel and exit	Simultaneously press and hold FILTER button + FILTER knob for 4s until CAL is displayed. Press save . Press and hold save to cancel.
Pedal calibration: enter save and exit cancel and exit	Simultaneously press and hold FILTER button + MODE knob for 4s until CAL is displayed. Press save . Press and hold save to cancel.
Battery monitoring	Simultaneously press and hold FILTER + ▲ to display % battery charge.
Firmware update mode: enter exit	Simultaneously press and hold FILTER + ▲ when powering-on the Wahoo . Restart the Wahoo .
Cancel edit (enter Preset Select mode)	Press and hold save for 2s.
Foot-operated preset mode enter/exit	Press and hold footswitch until footswitch LED starts/stops flashing.
Display firmware version	Press and hold save on power-on (version number is shown until you release the save button).

Factory presets

The 100 **Wahoo** factory presets are arranged in 10 groups, summarised in the table below.

Factory Preset Number	Description
F00– F09	Pedal mode. Variations of 1 filter, but sometimes 2, <i>e.g.</i> , octaves.
F10– F19	Pedal vowel sounds: some clean, some throaty.
F20– F29	Touch wah/guitar.
F30– F39	Bass envelope.
F40– F49	LFO (not stepped).
F50– F59	LFO stepped— more rhythmic.
F60– F69	LFO beats—one filter providing a beat, the other sometimes in another mode.
F70– F79	Pitch-bend and pitch-track.

Factory Preset Number	Description
F80–F89	Bubbly, Envelope follower with two filters.
F90–F99	Mix-up. Combinations of different modes. Some exotic and strange.

Specification

Physical & Electrical	
Size	171 mm × 192 mm × 76 mm
Power	9VDC (any polarity), 4 × AA batteries, USB (500mA max)
Audio Input	6-35 mm (1/4") mono jack 900 kΩ impedance
Audio Output	6-35 mm (1/4") mono jack 3 kΩ impedance
Computer	Standard Type B USB socket
Effect	
Signal switching	Transparent-True-Bypass
Presets	100 factory 100 user
Number of filters	2
Cutoff range	10Hz–4000Hz
Resonance	0 (subtle) – 100 (self-oscillating)
Filter type	Band-pass (12 dB/octave), low-pass (24 dB/octave)
LFO types	Sine, square, triangle, saw-up, saw-down, trapezoid, random
Filter modes	Pedal, LFO, envelope, pitch-bend, pitch-track
Mixer	Filter drive, filter 1/2 mix, wet/dry mix, output level
Computer	
Drivers	Class-compliant HID/USB Audio (built into operating system)
Computer (Editor)	Windows XP, Vista, 7 and above Apple OSX 10.5 and above (Intel Mac only)
Computer (MIDI)	Windows XP, Vista, 7 and above Apple OSX 10.3.9 and above