PGV manual

the stompbox version

The abbreviation PGV stands for Parametric Guitar Vocoder denoting the difference from a traditional vocoder that merely modulates the guitar signal based on the vocal spectrum. The PGV instead does an analysis of the guitar signal, and measures the pitch and amplitude of all the individual strings. Based on that data, the PGV does independent synthesis for all the six string signals, based solely on the vocal spectrum, and allowing controlled modification of the analyzed parameters. This opens up possibilities for such special effects as described in this manual. The PGV is available in three versions, the big studio version, a Eurorack version, and the stompbox version. The latter two are functionally similar, with different enclosures. This stompbox version has an added footswitch for typical stage performance, allowing either pure bypass or active use.

The connections

There are three ¼ inch jack I/O connections in the module: the **guitar in** and **out** are mono TS jacks, while the **pedal** is a three contact TRS jack. We have found that using the electric guitar's neck pickup (humbucker in our case) produces the best results.

Use only such an expression pedal that has the potentiometer slider output at the tip of the TRS plug (e.g. in the M-Audio pedal, switch in the “M-Audio” position).

For a dynamic vocal microphone there is a common XLR microphone connector.

The power connector is for a typical center negative 9V DC power adapter, the current requirement is 150mA. Please note that in other electronics, it is typical to use a center positive adapter, so turn to a store specialized in music electronics!

The controls

- The footswitch state is indicated by the red “bypass” led, i.e. when it is dark, the true bypass of the guitar signal is engaged, and when it is lit, the PGV is active.

- The 3-way **"pedal effect select"** switch is used to select which of the special effects is being controlled by the expression pedal. For the three control alternatives, there are also three potentiometers in the upper row of controls, **”vibrato”, ”VCF”**, and **”spectrum shift”**. When the switch is used to select one of the three alternatives, it disables the corresponding knob for the same function. In the case of **”VCF”**, and **”spectrum shift”**, e.g. if one selects the **”VCF”**, the effect is controlled by the pedal, and the **”VCF”** potentiometer has no effect, and correspondingly for the **”spectrum shift”** position. On the other hand, the **”vibrato”** knob is only functional when the 3-way switch is in the **”vibrato”** position. The functions of the various controls are described later in detail.

- The **”spectrum hold”** -toggle switch allows the freezing of a momentary spectrum (any vowel) from the vocal microphone, when flipped to the **”on”** position. The user also needs to adjust the **”noise gate / pilot gain”** knob up from the counter clockwise location to determine the threshold level, above which the spectrum freeze can be triggered. For the noise gate, the lower half of the knob range is used.

- The **transpose -1 octave** switch drops the measured guitar pitch down one octave, when in the **”on”** position.

- The large **volume** potentiometer controls the analog output preamplifier; the maximum level will be about 7V pp, AC connected, from the single-ended output jack to the guitar amplifier or mixer input.

The **”noise gate / pilot gain”** -knob has three functions:

1. For the vocal microphone signal, the background noise can be suppressed below the level set by the knob. It works from the counter clockwise to the middle position.

2. It determines the capture threshold level for the **”spectrum hold”** -function as described above.

3. From the center location to full clockwise position, the knob controls the **”pilot”** signal volume. The pilot signal is an additional synthetic output signal that is generated corresponding to the note pitch frequencies of the guitar strings. See later sections on how it can be utilized.

- The **”mic gain”** knob controls the volume of the vocal microphone signal, together with the guitar signal amplitudes, and the signal compressor logic, see the later section on how it works.

- The knobless **”threshold”** trimmer controls the input level of the guitar signal analysis section. The user has to adjust it to an optimal position for their particular guitar: if set too low, there is a risk of getting spurious low-level signals for the note pitch analysis logic, and if too high, there is a risk of missing some notes, especially from the higher pitched strings. The control is not very critical, the center position is a good start. Always use the guitar neck pickup for the most reliable detection.

The use of the I/O signal and compressor controls

Because the output signal of the PGV has to be a sensible combination of both the vocal microphone and the six guitar string signals that all have a wide dynamic range, signal compression is a critical part of the PGV software. The vocal microphone signal does not have any input gain adjustment. It is set for a typical dynamic microphone, and there is a fixed compression threshold above which there is no amplitude increase for louder vocal amplitude. The green LED **”mic compressor”** shows when this level is reached. The green light does not mean that the signal is clipped or distorted, and for normal operation, the user is recommended to sing loud enough so that the green LED is on. That makes for optimal vocoder dynamics.

The **”mic gain”** knob is used to control the mic compressor output gain to the second section of the compressor that also handles the six guitar string signals. That part also has a green LED marked **”guitar compressor”**. It shows when the total signal reaches the final output compression level. The total signal can be a maximum of six replicated vocal signals at the guitar string note frequencies. The player-singer needs to adjust the **”mic gain”** so that the output dynamic range is satisfactory. Again, green light does not mean that the signal is distorted, but if it is on all the time, the compression reduces the instrument's dynamic range because the volume may stay constant from when one or all strings are played. The compressors generally make sure that no output signal clipping occurs; however there are multiple complex signals, so just in case any of the LEDs turn red, the player should lower the **”mic gain”** knob. Also check that the pilot signal is not active at the same time as the vocal mic.

If the pilot signal is being used instead of the vocal signal, the compressors have additional significance. Three controls are now essential: the **”noise gate / pilot gain”** controls the pilot amplitude (from the center location to fully clockwise). The modulation strength of the pilot signal is controlled by the **”VCF”** knob, or the expression pedal if the 3-way position switch is in the **VCF** position. When the knob/expression pedal is in the minimum position, the pilot signal is pure sinewave, but if the **”VCF”** knob or expression pedal is activated, the pilot signal's modulation depends on the guitar strings' amplitude, i.e. it has higher harmonics with higher amplitude, and the knob or pedal controls sensitivity for the modulation. The **”mic gain”** knob controls the dynamics of the modulation. When the **”guitar compressor”** LED turns green, i.e. the compressor limits the amplitude, the modulation stays static, unlike below compression level. Therefore the **”mic gain”** knob should be adjusted lower for a maximum dynamic effect that follows the guitar picking strength.

The special effects

The behavior of each special effect selectable with the 3-way position switch is explained shortly:

- **“spectrum shift”**: If the 3-way switch is in the lowest position, the connected expression pedal controls the vocal spectrum shape. Otherwise the knob **”spectrum shift”** is used for the same control. This control compresses or expands the vocal spectrum (timbre) within the limits of the scale factors 0.7 – 1.5. The effect sounds like converting the speech to a ”giant speaker” – ”baby speaker” voice.

- **“VCF”**: This effect is a pseudo-voltage controlled filter that manipulates the vocal spectrum by attenuating bands selectable by the expression pedal when the 3-way switch is at the center position, or otherwise using the corresponding knob. Remember to return the potentiometer to full counter

clockwise if you do not want to retain the filtering effect in the other positions of the switch. For the pilot signal, it is instead the modulation sensitivity control, as explained in the previous section.

- **“vibrato”**: The highest position of the 3-way switch selects the vibrato effect. Now both the expression pedal and the **“vibrato”** knob are usable. The knob controls the frequency of the vibrato, and the pedal controls its strength, i.e. the pitch deviations from the base notes of the guitar strings. When the vibrato knob is at the minimum position, the expression pedal instead controls the upward pitch bend up to a maximum of a perfect fourth interval. In the other positions of the 3-way switch the **“vibrato”** knob has no effect.

The effects can be stacked, except the vibrato that is only active when the 3-way switch is in that positio

The limitations of the string pitch analysis software

The string pitch analysis has some limitations, because all the six string signals come stacked together in a standard guitar pickup signal. The main limitation is that the software does not recognise the harmonics of a lower base note as separate notes. The practical limitations are mainly relevant only with the octave interval, and the octave + fourth (=3rd harmonic) -interval, i.e. a note blocks all its higher octave notes, as well as notes above the octave + fourth pitch. In order to not unintentionally block higher harmonic notes, the player should dampen those lower strings that are not played, and/or adjust the ”threshold” knob more clockwise.

The frequency resolution vs. amplitude has limitations as well: the string detection software resolution goes down to one seminote, but a strong neighboring note may obscure a weaker note +- one seminote apart. Another limitation comes from the delay of the analysis. A few cycles are needed to find the frequency of each note. The frequency resolution and latency are tied together: higher resolution inevitably means longer latency and vice versa. Therefore we have tried to achieve a good tradeoff between an acceptable latency and good enough note discrimination resolution. The limitations are described in more detail in a separate document ”PGV explained” in the website www.audiospektri.com.