Full Bucket Vocoder FBVC

Version 1.1

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http://www.fullbucket.de/music
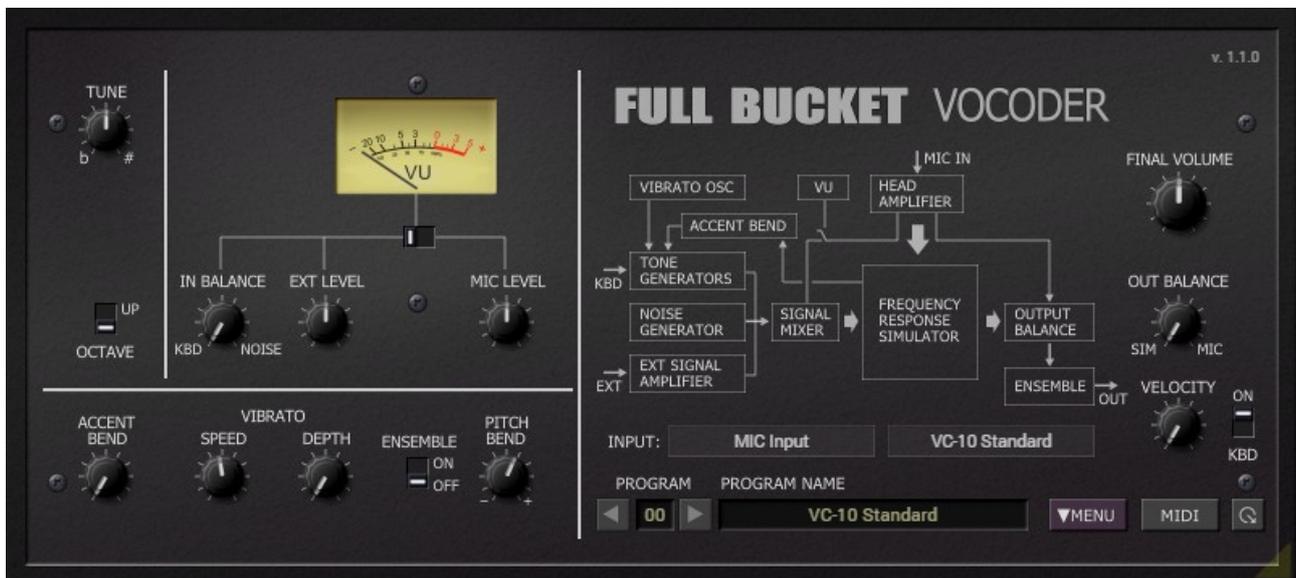
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Introduction

The *Full Bucket Vocoder FBVC* is a software plug-in for Microsoft Windows (VST2/VST3) and Apple macOS (VST2/VST3/AU) simulating the classic KORG® *VC-10 Vocoder* from 1978. It is written in native C++ code for high performance and low CPU consumption. The main features are:

- 20 band full stereo vocoder
- 64 voice polyphonic built-in Tone Generator section
- Accent Bending and Vibrato effects
- Optional WAV file playback
- Fully tweakable Analysis/Synthesis section
- Tweakable Ensemble effect
- Double precision audio processing
- All parameters can be controlled by MIDI controllers
- Plug-in supports Windows and macOS (32 bit and 64 bit)

FBVC is based on the new **iPlug2** framework maintained by **Oli Larkin and the iPlug2 team**. Big thanks, guys!!! Without your work it would not have been possible to create a resizable *FBVC* user interface.

To resize the plug-in you just grab the yellow triangle at the bottom right of the *FBVC* window and drag it. You can save the current window size using the menu entry "Save Window Size" in the *Options Menu*.

If you have trouble with the standard version of *FBVC*, please grab the (sound-wise identical) "N" version of the plug-in which is based on the original **iPlug** framework.

The Voice of the Past

Once upon a time I promised myself not to create a simulation of an existing piece of hardware that I do not own by myself. Well, as you can see, I broke my promise *again*: I never owned a *VC-10* nor is it very likely that I ever will. Hey, sounds like the introduction to my *Nabla* and *Stigma* synthesizers! ;-)

In 1978, KORG presented the *VC-10 Vocoder*. This neat little instrument was packaged in a MS-10 housing plus goose-neck microphone and keyboard that allowed for instant vocoding experience without attaching any other gear. The integrated *Tone Generator* was "fully polyphonic" (meaning that each key produced an individual Sawtooth wave), could be mixed with an additional White Noise source, and served as the *Carrier* signal, while the microphone input provided the *Modulator* signal. Of course it was possible to replace both Carrier and Modulator with external signal sources.

The VC-10 also offered some more cool effects like *Accent Bend* (where the level of the Modulator signal "bends" the pitch of the Tone Generator) and *Vibrato* for the Tone Generator, as well as *Ensemble* (known from the PS-3100/3200 and the *Delta*). But it also had some drawbacks like a missing voiced/unvoiced detector and even potential design flaws - for example the highest four filters of the vocoder section were only fed with the noise signal). But despite of these disadvantages the VC-10 was a fantastic instrument and well worth being recreated in software.

The Voice of Today

When creating the *FBVC* I took some liberty in that I added/changed the following features which cannot be found in the original VC-10:

- Full stereo operation
- 64 voice polyphonic Tone Generator supporting all MIDI note values (not only the 32 keys plus one octave)
- Velocity control for the Tone Generator
- Modulator signal can be replaced by mono/stereo WAV file playback

- Mode can be switched from "Standard" to the "Full Band" mode (where the signal of the Tone Generator is fed into all 20 bands)
- Tweak section:
  - Adjustable frequencies of all Analysis and Synthesis bands
  - Adjustable levels of all Synthesis bands
  - All Analysis and Synthesis bands can be switched to fixed levels
  - *Bias* and *Limit* for filter output VCAs
  - *Attack* and *Release* for Tone Generators
  - Adjustable LFO rates for Ensemble effect
- Not to forget: 64 presets and MIDI CC support!

The architecture of the *FBVC* is visualized by the following block diagram on the front panel.
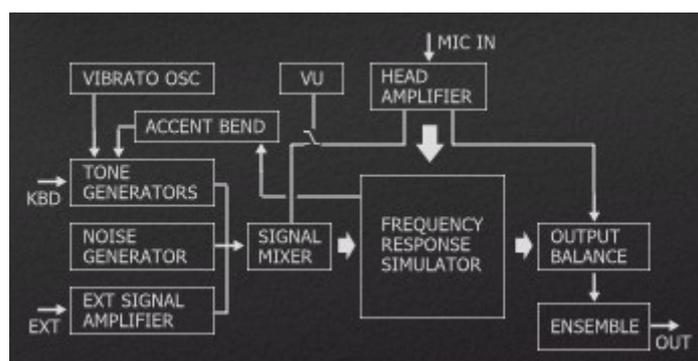
Architecture of the *FBVC*

So how does it work? The microphone input signal (well, any signal you feed into the first two inputs of the *FBVC…*) is used as the *Modulator* signal, i.e. it is analyzed by 20 bandpass filters and their responses are converted into 20 control signals. The Tone Generator signal mixed with the Noise and the external signal (any signal you feed into inputs 3 and 4 of the *FBVC*) serves as the *Carrier* signal: It is filtered by another bunch of 20 bandpass filters and their level is controlled in real-time by the control signals of the Modulator. These filtered carrier signals, summed-up and optionally send to the Ensemble effect, provide the output signal. Magic.

Acknowledgments

And at this point I would also like to say **Thank you!** to all the people who share their information about the VC-10 via the Internet, especially:

- **Oli Larkin** and the **iPlug2** team.

- **Eric G** at http://hem.bredband.net/elmuced/ericg.htm and

- **Ben Ward** for his excellent supporting material at http://www.korganalogue.net/.

And another THANK YOU! to the KVR Audio community and to the KORG engineers.

No, I am not affiliated with KORG in what relation ever except that I always find myself entangled with their instruments. ☺

Basic Operation

Although the panel of the VC-10 (and thus the panel of the *FBVC*) is laid out neatly, it is at the same time a bit cluttered. Let's get the pieces together!

The *Microphone* Section (MIC)

The *Microphone* section stands as a synonym for anything concerning the *Modulator* signal. It has only one control, namely the "MIC LEVEL" knob that controls the input volume.

Being a software plug-in, the *FBVC* of course does not have a real microphone. In fact the latter refers to the first two inputs, "MIC Left" and "MIC Right".

The *Tone Generator* Section

The *Tone Generator* produces the *internal* signals for the Carrier. It can be mixed with a White Noise signal via the "IN BALANCE" knob and shifted one octave up using the "OCTAVE" switch. Fine tuning is done by the "TUNE" knob, and three (!) independent LFOs provide a Vibrato effect with adjustable "SPEED" and "DEPTH".

"ACCENT BEND" bends the pitch of the Tone Generator with respect to the level of the analyzed Modulator signal. This is a pretty spooky effect – according to the original Owner's Manual of the VC-10 it "*adds a slight pitch wavering effect so that the sound produced is more like a real human voice*". Try it yourself.

"PITCH BEND" controls the amount of Pitch Bending of the Tone Generator (± 12 notes). Finally, the "VELOCITY" knob controls the amount of velocity applied to the volume of a played key. Note that the original VC-10 was not sensitive to velocity.

The External Section (EXT)

In parallel to the Tone Generator, you can use an external signal plugged into inputs 3 ("EXT Left") and 4 ("EXT Right") of the *FBVC* plug-in as a Carrier signal. The volume of this signal is controlled by the "EXT LEVEL" knob.

The VU Meter

Like the VC-10, the *FBVC* offers a VU meter to check the levels of the Carrier or Modulator signals. Note that the VU meter is an analog device – the readout values may differ a little bit from the exact level values.

Ensemble and Output Section

The Ensemble effect can be activated using the "ENSEMBLE" switch, and the "OUT BALANCE" knob controls the mix between Vocoder and Microphone (input) signal sent to the output. The total output volume is set by the "FINAL VOLUME" knob.

Input Mode

Typically, the Modulator signal is derived from the *Microphone* input (MIC) i.e. whatever is plugged into the inputs "MIC Left" and "MIC Right" of the *FBVC*. However, the *FBVC* allows to load a mono or stereo WAV file which can be used as the Modulator signal instead. To select the input and/or a WAV file just click on the box right to the "INPUT" label under the block diagram.
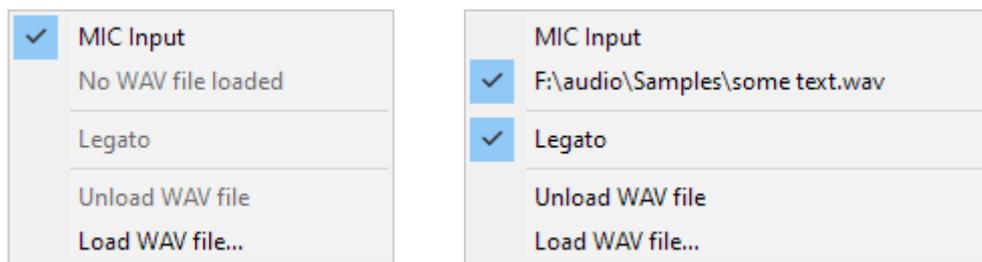
Example menu entries for the Input mode.

When you select a WAV file, its playback will be triggered by the keyboard. In "Legato" mode, playback starts once for the first key you press and will restart only if all keys have been released. If "Legato" mode is deselected, playback restarts with each key you press.

Note that you can set the default path for your WAV files using the *Options Menu*.

Vocoder Mode

As stated already in the introductory section, the VC-10 had a minor design flaw (well, I am not sure if it really was a flaw!): The highest four bands of the Synthesis section are only fed with the Noise signal but not with the Tone Generator of external signal. Thus, only the first sixteen bands could really be used for the Tone Generator.

The *FBVC* can fix this flaw by clicking the box right beneath the Input mode box. Here you can switch the Vocoder mode from "VC-10 Standard" to "VC-10 Full Bands".

Switching the "Keyboard" On/Off

The "KBD" switch right to the Vocoder Mode box (not to be found on the real VC-10) can be used to switch the internal "keyboard" of. This means that incoming MIDI notes do not generate a sound. WAV playback however will still be triggered. The handiness of this switch will be clear once you really need it! ;-)

Advanced Operation

Now we are getting to the advanced operation modes of the *FBVC* – the tweaks! Click on the little ↻ at the lower right of the front panel and get ready.

Tweaking the Vocoder Bands

The trim pots in first row "ANALYSIS" can be used to set the center frequency of the 20 analysis bandpass filters.

> Note: Each bandpass of the FBVC consists of a series of two 2-pole bandpass filters with identical Q. The center frequency of the second filter is 0.829 times lower than the center frequency of the first filter. The frequency displayed in the *FBVC* is always the frequency of the first filter.

The trim pots in the second row "FILTER" control the center frequencies of the Synthesis filters while the trim pots of the third row "LEVEL" set their respective levels.

The switches of the fourth row determine if the aplitude of a Synthesis filter will be modulated (via a VCA) by the respective output of the Analysis filter or if it will remain fixed. This feature allows to turn the FBVC into a fixed filter bank!

The "TOOLS" buttons opens a menu with some little helpers to set the various vocoder band parameters (including reset to default).

Bias, Limit, and Speed – Imperative Imperfection

Compared to the original VC-10 the *FBVC* sounds rather "clean" and "precise" because crucial parts of the VC-10 were analog circuitry having a rather limited working range. This was especially true for the 20 VCAs which controlled the filter band's amplitude.

The level at which the VCAs started to operate could be set via a trimmer potentio-meter at the back side of the VC-10. Normally this was done only once by the manufacturer but due to component aging etc. it would have been necessary to readjust this *Bias*. On the *FBVC* this trimmer is realized by the "BIAS" control on the tweak panel. Note that at a Bias level higher than 0 the *FBVC* produces a sound even if no Modulator signal is applied.

Another "problem" with the VCAs of the VC-10 was that at a certain level of the control input voltage the amplification of the respective VCA did not increase any more – the VCA control was "limited" to a maximum value. This behavior can be simulated with the "LIMIT" control: The higher the value of "LIMIT", the more extreme is the simulated limiting effect.

Finally you can adjust the responsiveness of the VCAs i.e. the "speed" at which they react to changes of the control voltages. The respective control is called "SPEED".

If you play with the "BIAS", "LIMIT" and "SPEED" controls you will soon find a setting that closely simulates the "imperfect" sound of the real VC-10. For sound comparison I recommend the nice track "Guten Abend, Leute" by Dorothea Raukes (*Deutsche Wertarbeit*).

Tone Generator Envelope

The Tone Generator of the VC-10 provided just an organ-like envelope of the signal amplitudes – even simple string machines could do more! That's why I added an "ATTACK" and "RELEASE" control to the *FBVC*. Note that the WAV playback is affected by this envelope too.

Ensemble

The original Ensemble effect earned a lot of criticism because its speed was fixed and to fast by default. Being controlled by two LFOs (a "slow" and a "fast" one) I decided to make their rates being set by dedicated controls (in fact four of them because the *FBVC* is stereo).

Control Operation

The Sound Manager

To select one of the 64 patches just click on the program number or the previous/next arrow buttons, and edit its name by clicking in the text field.
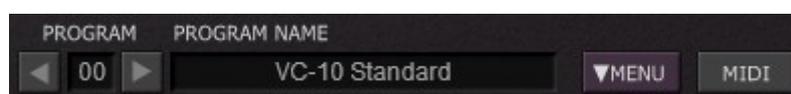
MIDI Learn And The Configuration File "fbvc.ini"

Every parameter of the *FBVC* can be controlled by one MIDI controller. If you want to change the assignment of MIDI controller (CC; *MIDI Control Change*) to *FBVC* parameter the *MIDI Learn* function comes in quite handy: Just click the *MIDI* button on the Sound Manager panel (button turns yellow) and wiggle both the MIDI controller and the parameter you want to assign (you can abort *LEARN* by clicking the button again). If you want to unlearn the assignment, right-click the *MIDI Learn* button (the label now reads "UNLEARN"). Now wiggle the MIDI controller or the parameter that you want to unlearn. To save the controller assignments use "Save Configuration" in the *Options* menu (see next section); they are stored in the `fbvc.ini` configuration file. The exact location of this file depends on your operating system and will be displayed when you click on "Reload" or "Save Configuration".

Options Menu

When clicking on the disk symbol of the *File* button, a context menu opens with the following options:

Copy Program	Copy current program to internal clipboard
Paste Program	Paste internal clipboard to current program
Load Program	Load a program file containing a patch to the *FBVC's* current program
Save Program	Save the *FBVC's* current program to a program file
Load Bank	Load a bank file containing 64 patches into the *FBVC*
Save Bank	Save the *FBVC's* 64 patches to a bank file
Init Program	Initialize the current program
Default Path for Program Files	Sets the default path for program and bank files
Default Path for WAV Files	Sets the default path for WAV files when using the WAV playback option (see section *Input Mode*)
MIDI Thru	Set globally if MIDI data sent to the *FBVC* should be sent through to its MIDI output (stored in configuration file)
Ignore Program Change	Set globally if MIDI Program Change data sent to the *FBVC* should be ignored (stored in configuration file)
Reload Configuration	Reload the *FBVC's* configuration file
Save Configuration	Save the *FBVC's* configuration file
Check Online for Update	When connected to the Internet, this function will check if a newer version of the *FBVC* is available at fullbucket.de
Visit fullbucket.de	Open fullbucket.de in your standard browser

Parameters

parameter	ID	description
Vocoder Mode	0	"VC-10 Standard" or "VC-10 Full Bands"
KBD Mode	1	Keyboard (Tone Generator) off/on
Input Mode	2	Selects signal input or WAV sample playback
Sample Legato	3	Legato WAV sample playback
Final Volume	4	Final output volume
Out Balance	5	Mix between input signal and Vocoder signal
Tune	6	Master tune of the Tone Generator
Velocity	7	Amount of velocity applied to the Tone Generator
Octave	8	Shifts the Tone Generator's pitch one octave up
In Balance	9	Mix between Tone Generator and external input
Ext Level	10	Level of external signal input
Mic Level	11	Level of signal (*Microphone*) input
Accent Bend	12	Depth of Accent Bend applied to Tone Generator
Pitch Bend	13	Depth of Pitch Bend applied to Tone Generator
Vibrator Speed	14	Speed of the Vibrato effect
Vibrato Depth	15	Depth of the Vibrato effect
Ensemble	16	Ensemble effect off/on
Meter Mode	17	Select Carrier or Modulator signal for VU meter
Attack	18	Attack of Tone Generator envelope
Release	19	Release of Tone Generator envelope
Ensemble (L) Rate 1	20	Rate of first LFO of left Ensemble unit
Ensemble (L) Rate 2	21	Rate of second LFO of left Ensemble unit
Ensemble (R) Rate 1	22	Rate of first LFO of right Ensemble unit
Ensemble (R) Rate 2	23	Rate of second LFO of right Ensemble unit
Analysis Frequency	24–43	Center frequencies of the analysis filters
Synthesis Frequency	44–63	Center frequencies of the synthesis filters
Synthesis Frequency	64–83	Levels of the synthesis filters
Synthesis Fixed	84–103	Sets synthesis filter VCAs to modulated or fixed
Bias	104	Bias of the filter VCAs control
Limit	105	Limit (peak) of the filter VCAs control
Speed	106	Speed (responsiveness) of the filter VCAs control

Frequently Asked Questions

How do I install the FBVC *(Windows VST2 32 bit version)?*

Just copy the files `fbvc.dll` from the ZIP archive you have downloaded to your system's or favorite DAW's VST2 plug-in folder. Your DAW should automatically register the *FBVC* VST2 plug-in the next time you start it.

How do I install the FBVC *(Windows VST2 64 bit version)?*

Just copy the file `fbvc64.dll` from the ZIP archive you have downloaded to your system's or favorite DAW's VST2 plug-in folder. Your DAW should automatically register the *FBVC* VST2 plug-in the next time you start it.

Note: You may have to remove any existing (32 bit) `fbvc.dll` from your VST2 plug-in folder or else your DAW may screw the versions up...

How do I install the FBVC *(Windows VST3 64 bit version)?*

Just copy the files `fbvc.vst3` from the ZIP archive you have downloaded to your system's or favorite DAW's VST3 plug-in folder. Your DAW should automatically register the *FBVC* VST3 plug-in the next time you start it.

How do I install the FBVC *(Mac VST2/VST3/AU 64 bit)?*

Locate the downloaded PKG package file `fbvc_1_1_0_mac.pkg` in Finder (!) and do a right- or control-click on it. In the context menu, click on "Open". You will be asked if you really want to install the package because it comes from an "unidentified developer" (me ☺). Click "OK" and follow the installation instructions.

What is the plug-in ID of the FBVC?

The ID is **f b v c** .

How do I know if a new version of the FBVC *is available?*

When connected to the Internet, open the File menu (see section *Options Menu*) by clicking the disk icon and select the entry "Check Online for Updates". If a new version of the *FBVC* is available on fullbucket.de the respective information will be shown in a message box.

The stock preset "XYZ (WAV play)" does not produce any sound!?

Copy the three WAV files that

- (Windows) come with the ZIP archive
- (Mac) are automatically installed under `/Users/Shared/FullBucketMusic/`

into your default WAV folder. You can set this folder using the *Options Menu*.