

The Vixen 415 Software Synthesizer

for the Commodore VIC20 personal computer with 16k memory expansion



Model versions: Vx415P (PAL), Vx415N (NTSC)

Eximietas Software

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1. Introduction

The Vx415 is a software synthesizer for the 16k expanded Commodore VIC20. It leverages the charms of the VIC, namely three square wave voices, one tonal noise generator and the 6502 CPU.

Although the Vx415 has many shortcomings and software limitations, it also sports many features:

- Supports the 4 independent voices of the Commodore VIC
- Master clock for setting the beats per minute for a four quarter note sequence
- Pitch lock for each voice
- 15 active quarter note sequences per voice
- Note detuning per active voice
- Envelope control using ADSR (Attack/Decay/Sustain/Release)
- Pitch LFO (Line Frequency Oscillator) with independent clock
- Volume LFO with independent clock
- 16 Patches per Bank
- Naming of patches
- Loading and saving of Banks to disk
- 16 Banks per floppy disk
- A two octave range accessed through the VIC keyboard
- Rotary switch selectors
- And supports both PAL and NTSC systems



2. Quick Start

To run the Vx415 synthesizer you need:

1. A Commodore VIC20 personal computer (or emulator)
2. A Commodore disk drive (or emulated drive). It currently only supports drive 8.
3. A Commodore joystick plugged into the joystick port
4. A television with audio output

Insert the Vx415 synthesizer program disk into the VICs floppy drive. Startup the VIC20 and then type:

```
load "*",8,1 and press return
```

When the software has loaded type: run and then press return

Press the joystick fire button to advance from the title screen to the synthesizer screen.

Now press and hold the letter Q on the Commodore's keyboard. The Commodore should make a sound because a default sound Patch is loaded for the Vixen on startup.

Figure 1 below shows how the Commodore keys map to the two musical octaves. Familiarize yourself with the layout by pressing more of the mapped keys.

One might also want to explore more sounds. To do that one can load a sound Bank of 16 sound patches. The next section will explain how to load and save sound Banks.

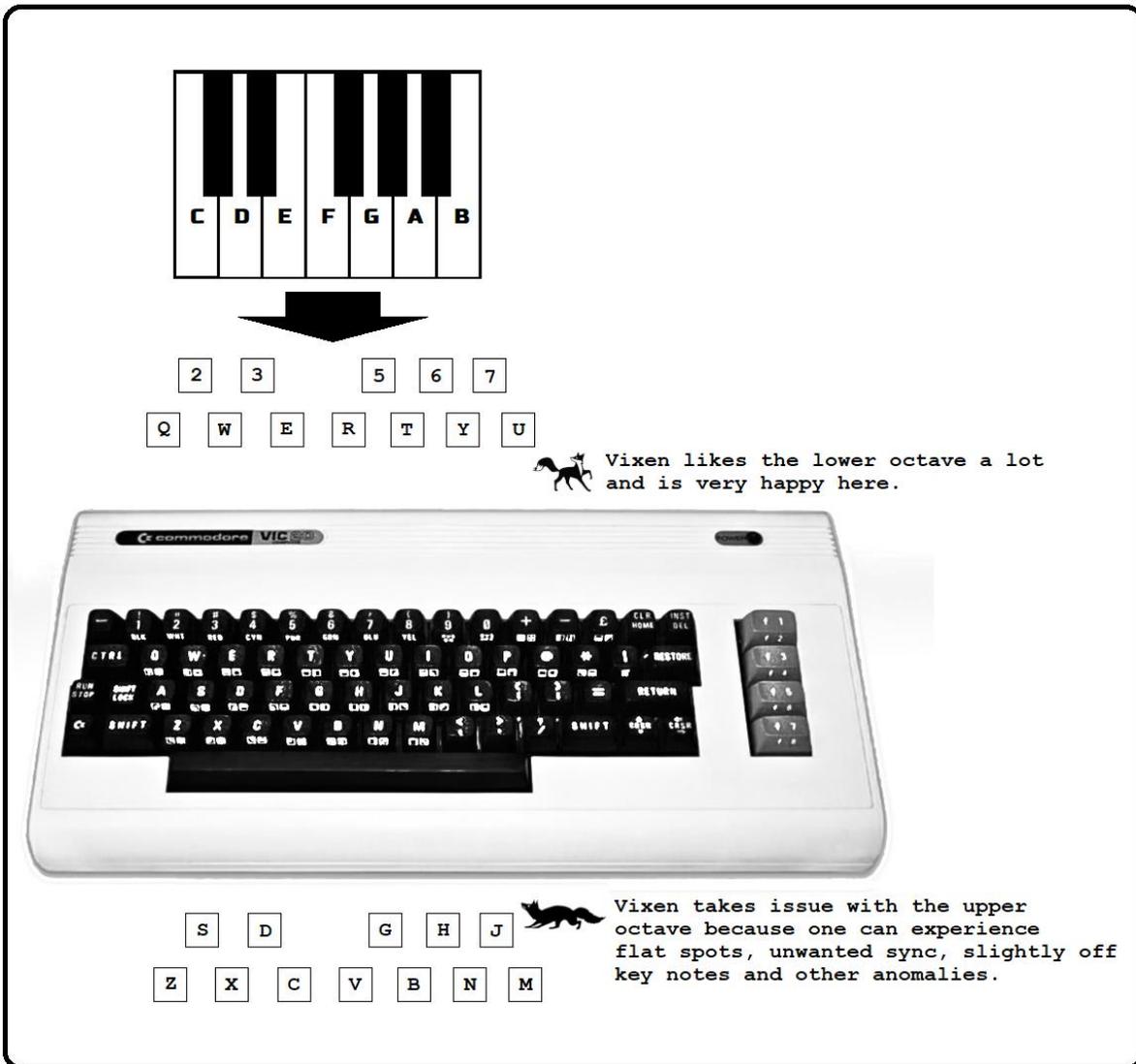


Figure 1 - Octave note keyboard layout

Loading and saving sound Banks

Use the joystick to navigate to the disk icon at the bottom right of the screen (See figure 2 on the next page), then press the fire button to access the Bank load/save menu. Selecting 'Load Sound Bank' will access the floppy disk and show the first 16 files on the software's floppy disk.

If the disk drive is offline or if the floppy disk has been removed, then the software will be unable to display the file list and therefore no sound Bank will be able to load.

Depending on the system type, PAL or NTSC, you will have to load a sound Bank relevant to the system.

PAL sound Banks have the prefix: VXP-
NTSC sound Banks have the prefix: VXN-

If one were to select a sound Bank not relevant to the particular Commodore model or one were to select a file that is not a sound Bank at all, the software will respond with a 'Not a correct VX bank' error message.

There are two banks per system type: VX*-DEFAULT and VX*-EMPTY.

The default Bank has 16 unique patches to demonstrate the capabilities of the Vx415. The empty Bank is exactly what it says and is meant as a starting point for your own patches.



Figure 2 - Load/Save Bank menu item

When saving a sound Bank one does not have to add the prefix. The software will save the Bank with the relevant prefix added (VXP- or VXN-) depending on which system one is using.

IMPORTANT: ONE CANNOT OVERWRITE AN EXISTING SOUND BANK

Therefore pick a new name (even if it differs by a single character). This is a feature and not a flaw.

After loading a sound Bank navigate to the Patch selector (m in figure 3) and then select one of the 16 Patches to play with.

IMPORTANT: WHEN SAVING A BANK DO NOT USE SPACES

The software will only save the Bank name up to the first space. Why is that? Programmer's preference. But why even have a space feature in the save Bank function if it cannot be used? I re-used the Patch alphanumeric display routine and I'm lazy. Now leave me alone.

3. Synthesizer layout

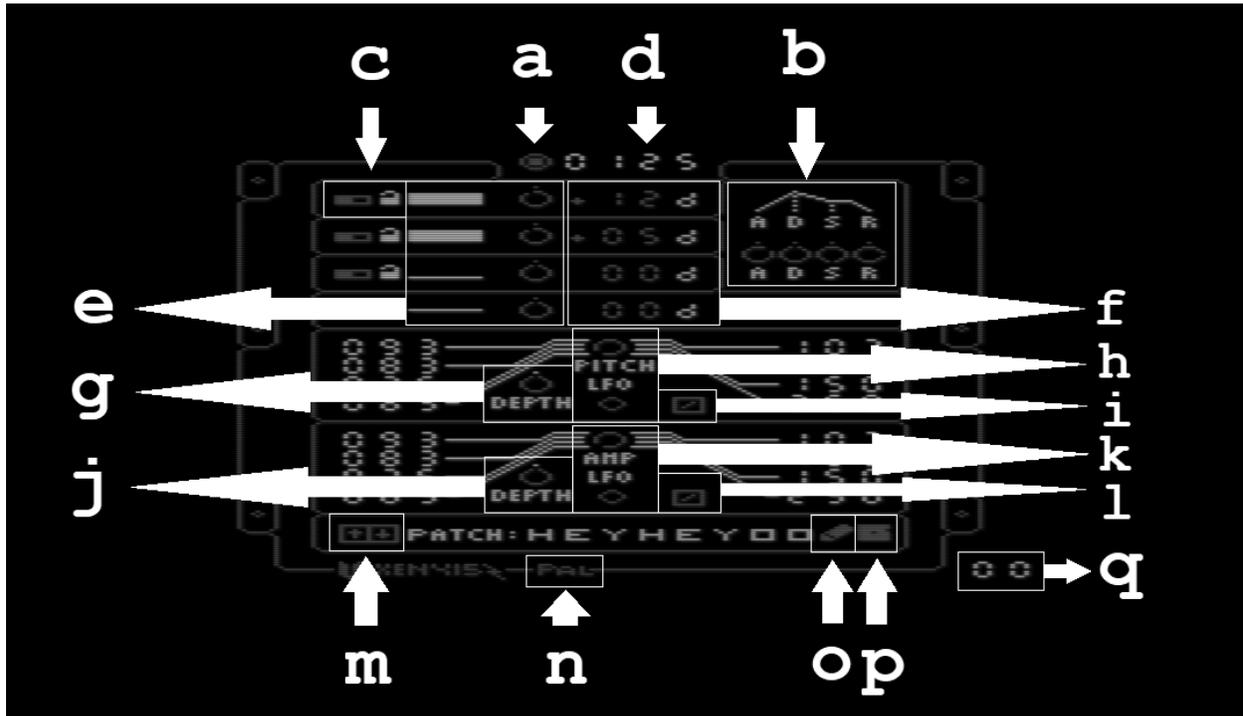


Figure 3 - Vx415 layout

Section 1 - Main

a = bpm (beats per minute) LED - The LED will light up on the 1st beat of every four beats. For example at 125 bpm the LED will pulse just over 31 times (31.25) in a minute.

b = Volume envelope

Attack	The time taken to reach the absolute peak volume (vol = 15)
Decay	The time taken to move from absolute peak volume to maximum volume (vol = 12)
Sustain	The time taken to remain at maximum volume
Release	The time taken to move from maximum volume to zero volume (vol = 0)

c = voice pitch lock = Each of the four voices can be individually pitch locked. This means that irrespective of

whatever keyboard key is pressed, the pitch of the pitch locked voice will remain locked at the base frequency determined by the detune value (f) for each voice.

d = bpm indicator and adjuster = This is the master clock indicator and adjuster.

e = quarter note pattern adjuster = Each voice can be adjusted to play one of the fifteen active patterns at a quarter note speed of the master clock (d). For example at 125bpm a total of 600 quarter notes (125x4) will be processed.

f = voice detune = detunes a voice by a given number of notes (positive or negative). This is so that a combination of the notes of the voices can form a chord or a four note arpeggio.

Section 2 - Frequency LFO

g = LFO depth

h = LFO bpm selector and LFO bpm LED indicator

i = LFO waveform selector and the four selectable waveforms are:



Section 3 - Volume LFO

j = LFO depth

k = LFO bpm selector and LFO bpm LED indicator

l = LFO waveform selector and the four selectable waveforms are:



Section 4 - Patches and Banks

m = Patch selector = There are sixteen Patches per Bank.

n = System indicator = This is either a PAL or NTSC version of the synthesizer depending on which system you own. This determines the base clock speed of the synthesizer: 50Hz for PAL and 60Hz for NTSC. This in turn affects the selectable bpm values for the master clock and the LFO clocks.

o = Save Patch = Once selected one can save a changed patch. One can name the patch and when 'save patch' is selected, it not only saves the new name but also all the associated settings.

p = Load/Save Bank

q = Patch indicator = Shows which one of the sixteen possible Patches is currently active. The Patches are numbered from 00h to 0Fh (h = hexadecimal)

A footnote on LFO's

The Pitch LFO and Volume LFO are not true LFO's but only partial LFO's. What does that mean?

It means that although the LFO's will set the Volume or Pitch according to the tempo indicated by the LFO bpm indicators and the LFO depth, after the first cycle the Pitch or Volume will be set back to its original value on the following interrupt cycle. On the next LFO cycle the volume or pitch will again be set to the next LFO waveform value and so on.

What this means is that the synthesizer will always retain a tonal quality and have some level of volume even if the LFO's are set to their respective maximum LFO depths. This was a conscious design choice because the thinking was that the Vx415 is primarily meant to be a musical instrument and not primarily a sound FX generator.



Appendix A - BPM tables

Calculations:

Interrupts per second x 60 seconds = ipm (interrupts per minute)

PAL: 50 x 60 = 3000 ipm

NTSC: 60 x 60 = 3600 ipm

ipm/counter = qnpm (quarter notes per minute)

qnpm/4 = bpm/npm (beats per minute/notes per minute)

PAL table

qnpm calculation	qnpm	Bpm*	exact bpm
3000 / 12	250	63	62.50
3000 / 10	300	75	75.00
3000 / 09	333	83	83.25
3000 / 08	375	93	93.75
3000 / 07	428	107	107.00
3000 / 06	500	125	125.00
3000 / 05	600	150	150.00
3000 / 03	1000	250	250.00

* These values are displayed on the synthesizer itself. The values are the floor values of the exact bpm values. The exception is the 63 bpm value which was rounded up from 62.5. (The reason for this is quite unclear)

NTSC table

qnpm calculation	qnpm	bpm	exact bpm*
3000 / 14	257	64	64.25
3000 / 12	300	75	75.00
3000 / 11	327	81	81.75
3000 / 10	360	90	90.00
3000 / 08	450	112	112.50
3000 / 07	514	128	128.50
3000 / 06	600	150	150.00
3000 / 04	900	225	225.00

* Exact bpm values may be useful for external sampling

Appendix B - Vx415 logic diagram

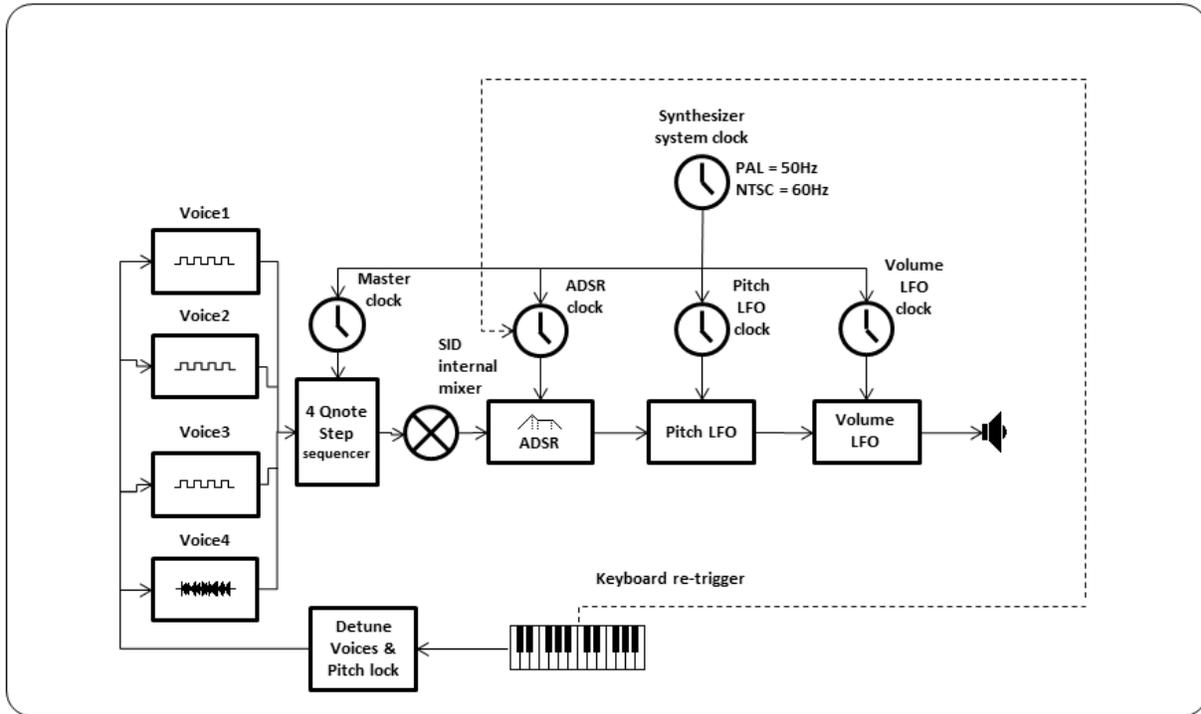


Figure 4 - The Vx415 logic diagram

Synthesizer version: 1.0

Systems supported: Commodore VIC20 PAL/NTSC + 16Kb RAM expansion

Input devices: Joystick/Computer keyboard

Storage: Commodore 1541 disk drive

Appendix C - Future additions

Proposed additions and changes for a Version 2 of Vixen415 (VX415v2)

- Review and modify the audio engine to be smoother and more robust
- Add a voice selector to the Pitch LFO so that it can be applied selectively
- Add a selector switch to change the keyboard re-trigger mode, for each patch
- Add a note range limit selector for each patch
- Add a selector switch to both Pitch LFO and Volume LFO to switch mode between partial LFO and full LFO
- A patch combinator - That would allow for a sequence of patches to be played as a single instrument
- Addition of MIDI support using Jason Justian's MIDI code (with his permission)
- Addition of a Pitch bend and the accompanying note bend range for each patch
- Addition of the pitch correction code of Alexi Eben (with his permission) to fix the VICs slight detuned sound on certain notes. And then make the engine selectable per patch¹.

Proposed global settings

- Allow for the changing the synthesizer's color scheme
- A selector switch to allow for patch bank overwrites on disk
- Support for more than 16 Banks per disk. This would become relevant if an effective patch combinator can be implemented.
- Support for other block devices (not just device 8)

Bug hunting and reporting

- Code refactoring - Removing routine duplications and all round code optimization
- If you find a bug in the software, please report it on the Denial VIC20 forum, my user handle is Huffelduff.



¹ All of these things would be nice to do, but as usual it's only possible as time and opportunity allows.

A special thank you: To the KORG musical instrument company for making some of the most beautifully crafted and amazing sounding electronic instruments in the world; and thank you to you, for being really bored and reading this far into the document, and also for using the Vx415.

