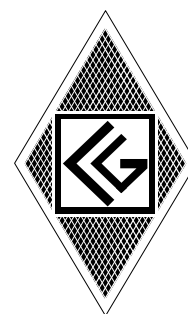# XR22 VCO

## VCO with AM Input and FSK (Frequency Shift Keying)

I. Features

- **AM (Amplitude Modulation) Input**

  - Ring modulation
  - CV controllable sine/triangle volume
  - Advanced waveform generation through feedback

- **FSK (Frequency Shift Keying)**

  - Pulse and ramp generation
  - Switching between two different frequency CVs
  - Advanced waveform generation

- **LFO Mode**

- **Available with banana or 3,5mm phone sockets**

- **Eurorack Module**

- **Width: 12 HP**

- **Dimensions:**
  128,5 mm x 60,6 mm
  Depth: 40mm

- **Supply Voltage: +-12V**
  Power consumption:
  ≈ 70mA
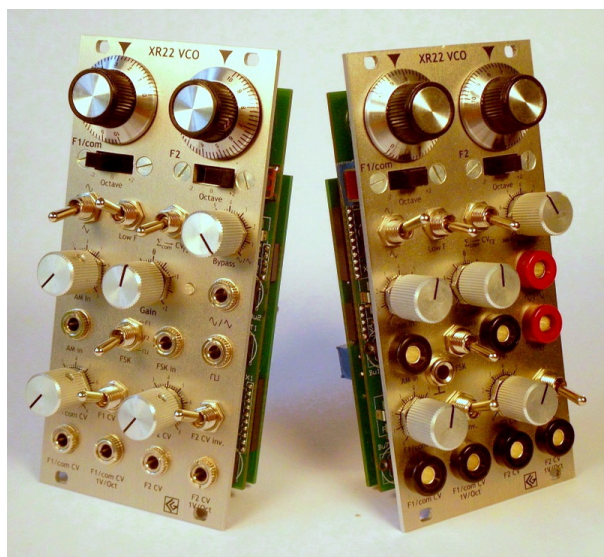
Left: 3,5mm phone jack version
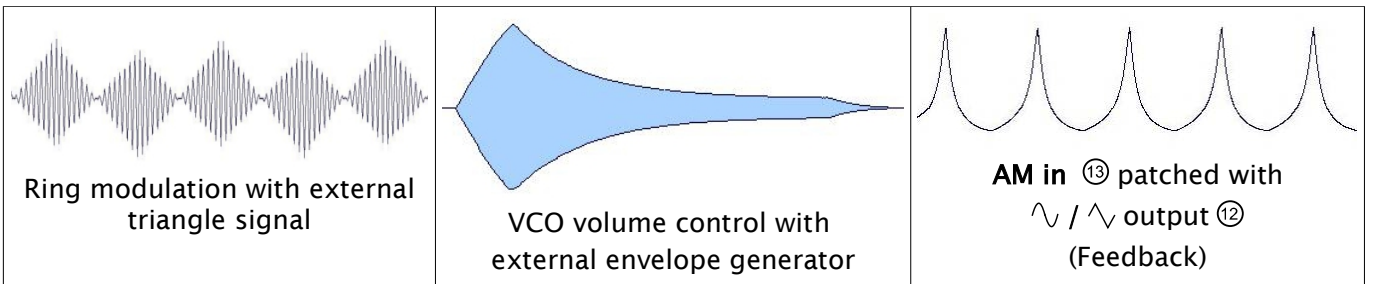Right: Banana jack version
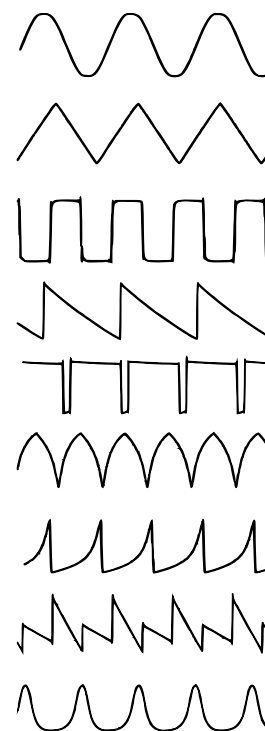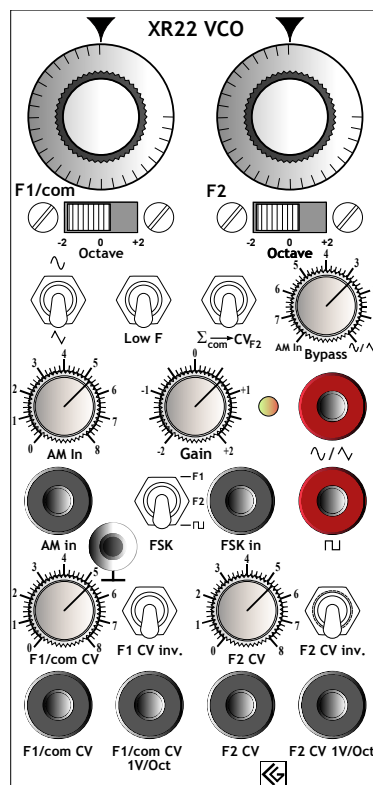
2. AM and FSK

2.1 AM (Amplitude Modulation)

The $\wedge\!\!\!\vee$ / $\wedge\!\!\!\vee$ output (⑫) amplitude varies linearly with the control voltage applied to "**AM in**" (⑬). The amount of the input signal can be adjusted with ⑨ .(See chapter 3: "Functions"). Negative CVs will cause phase inversion of the $\wedge\!\!\!\vee$ / $\wedge\!\!\!\vee$ waveform .

Examples:

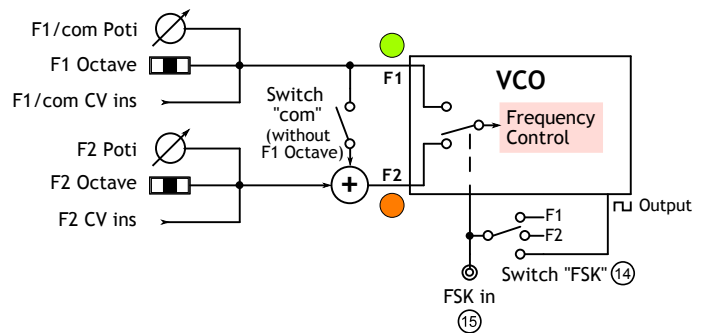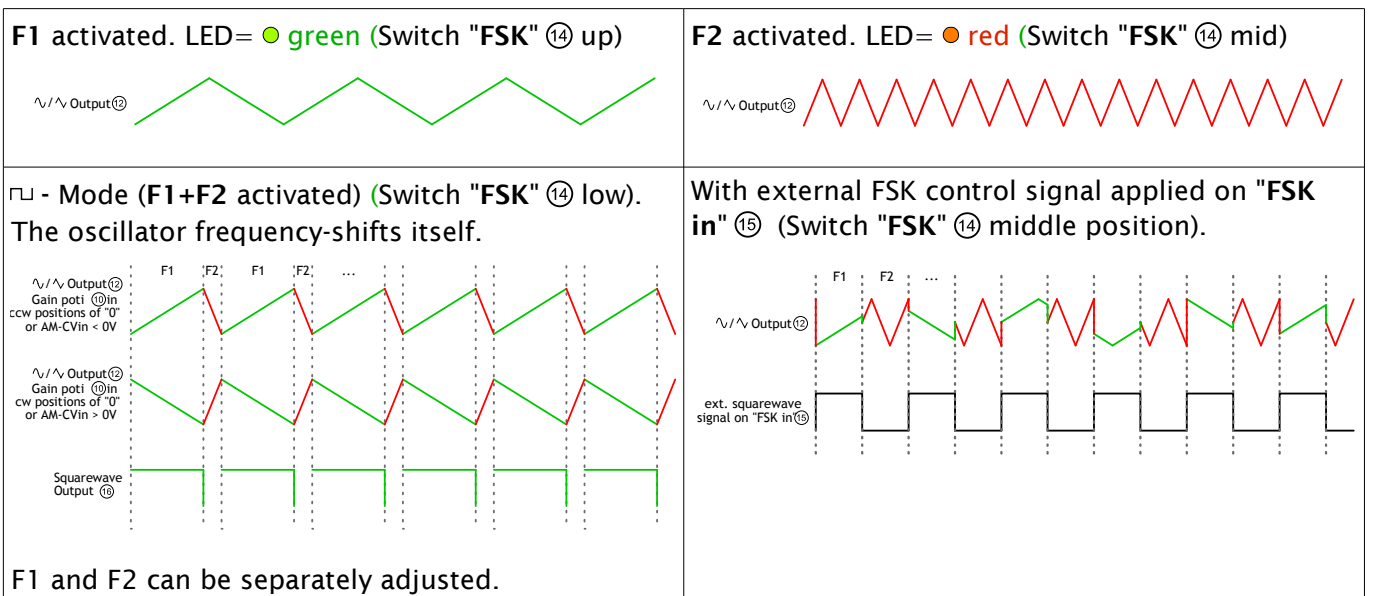|		
Ring modulation with external triangle signal	VCO volume control with external envelope generator	**AM in** ⑬ patched with $\wedge\!\!\!\vee$ / $\wedge\!\!\!\vee$ output ⑫ (Feedback)

2.2 FSK (Frequency Shift Keying)

The frequency of the XR22 VCO is controlled by two independent frequency control sections F1 and F2 with independent manual frequency controls and CV ins; either one or the other of these routes can be activated by an external logic signal applied on socket "**FSKin**" ⑮ , and/or by switch "**FSK**" ⑭ .

Switch "**FSK**"⑭ selects the FSK mode: F1, F2 or self-switching by the VCO's ⊓⊔ -output.

Switch "com" ⑦ is adding the F1-CVs to F2; this is to ensure 1V/oct. tracking if both routes are used e.g. in the self-frequency shifting ⊓⊔ - mode.

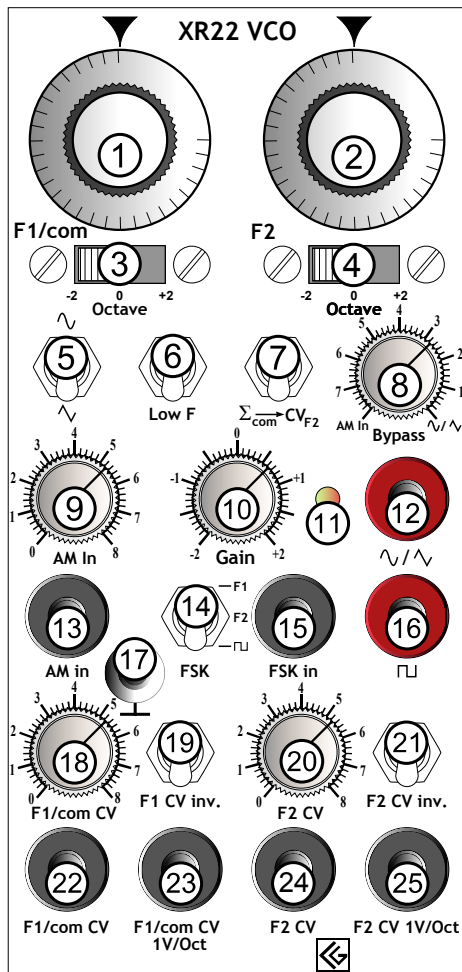F1/com Poti
F1 Octave
F1/com CV ins
F2 Poti
F2 Octave
F2 CV ins
Switch "com" (without F1 Octave)
F1
F2
VCO
Frequency Control
Output
F1
F2
Switch "FSK" ⑭
FSK in ⑮

Examples:

F1 activated. LED= ● green (Switch "**FSK**" ⑭ up)

$\wedge\!\!\!\vee$/$\wedge\!\!\!\vee$ Output⑫

F2 activated. LED= ● red (Switch "**FSK**" ⑭ mid)

$\wedge\!\!\!\vee$/$\wedge\!\!\!\vee$ Output⑫

⊓⊔ - Mode (**F1+F2** activated) (Switch "**FSK**" ⑭ low). The oscillator frequency-shifts itself.

$\wedge\!\!\!\vee$/$\wedge\!\!\!\vee$ Output⑫ Gain poti ⑩ in ccw positions of "0" or AM-CVin < 0V

$\wedge\!\!\!\vee$/$\wedge\!\!\!\vee$ Output⑫ Gain poti ⑩ in cw positions of "0" or AM-CVin > 0V

Squarewave Output ⑯

F1 F2 F1 F2 ...

F1 and F2 can be separately adjusted.

With external FSK control signal applied on "**FSK in**" ⑮ (Switch "**FSK**" ⑭ middle position).

$\wedge\!\!\!\vee$/$\wedge\!\!\!\vee$ Output⑫

ext. squarewave signal on "FSK in⑮

F1 F2 ...

3. Functions

XR22 VCO

① F1/com
② F2
③ -2 0 +2 Octave
④ -2 0 +2 Octave
⑤ ⑥ Low F ⑦ Σcom→CVF2 ⑧ AM In Bypass
⑨ AM In ⑩ Gain ⑪ ⑫
⑬ AM in ⑭ FSK ⑮ FSK in ⑯
⑰ ⑱ F1/com CV ⑲ F1 CV inv. ⑳ F2 CV ㉑ F2 CV inv.
㉒ F1/com CV ㉓ F1/com CV 1V/Oct ㉔ F2 CV ㉕ F2 CV 1V/Oct

Introduction

For better understanding it is recommended to read first about the control elements ⑭ *and* ⑪ *:*

⑭ **FSK mode switch** (frequency shift keying)
In upper position: Only F1 is active; LED= 🟢 green
In middle position: Only F2 is active, LED= 🔴 red
In lower position (" ⊓⊔ ") the ⊓⊔ (square) output of the VCO is connected to the FSK input and the oscillator automatically shifts itself between frequencies F1 and F2. In this mode, the oscillator produces ramp and pulse signals provided on output ⑫ (ramp) and ⑯ (pulse). The rising and falling time of the ramp waveform (and also the duration of high and low levels on ⊓⊔–output ⑯) can be separately adjusted with **F1** and **F2** (Cvin's 1 and Cvin's 2).
(Also see chapter 2.2 about FSK and ⑦)

⑪ **LED** FSK mode.
🟢 Green = F1, F1 CV ins (left half on the module panel).
🔴 Red = F2, F2 CV ins (right half on module panel).
When "Com Mode" is active (⑦ in lower pos.), knob "F1/Fcom" ① and "com Cvin's" ㉒ ㉓ work for both green and red leds.

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① **F1/com** Manual control of frequency 1 (F1). If "Com→F2" switch ⑦ is in lower position, this pot also affects frequency 2 (F2). See more under ⑦, ⑭.

② **F2** Manual control of frequency 2 (F2).

③ **F1 octave switch** for frequency 1. Left position: – 2 octaves; right position: +2 octaves. This switch is *not* affected by switch ⑦.

④ **F2 octave switch**

⑤ ∿/⋀ **Waveform selector** switches between ∿ (sinewave) or ⋀ (trianglewave) output on socket ⑫ .

⑥ **Low F switch:** In the lower position the VCO produces low frequency waves suitable for tremolo effects or signal modulation (like a LFO).

⑦ **Common → F2 switch** changes the routing between the frequencies F1 and F2. In the upper position, both frequencies F1 and F2 work independently and can be controlled separately by their respective frequency knobs and/or CV inputs.
In the lower position, knob "**F1/com**" ① and sockets "**F1/com CV**" ㉒ "**F1/com CV 1V/Oct**" ㉓ affect both F1 and F2. This coupling ensures that the ratio between F1 und F2 remains the same, and tracks 1V/oct. using both frequencies within the FSK option. The ratio can only be changed by the "**F2**" knob ② or the F2 CV inputs ㉔, ㉕. The octave selectors "**F1 Octave**" ③ and "**F2 Octave**" ④ also work indepently.
Note that in this mode the frequency range is expanded and that for F2 four independent CV inputs are now available.

⑧ **Bypass** Ratio between the "**AM in**" signal input ⑬ and the oscillator ∿ / ⋀ output. The mixed signal is provided at ⑫.

⑨ **AM in level** Controls the input level from ⑬ for amplitude modulation of ∿ / ⋀.

⑩ **Gain adjustment** Primarily to suppress the oscillator frequency in ring modulation. The denter in middle position "0" may be used as orientation.
This knob regulates an internal offset voltage between ca. +-2V which is added to the AM-input signal, adjusted by knob ⑨ . In counterclockwise positions of the potentiometer the ∿ / ⋀ – phase will be inverted (See also "Examples" in chapter 2.2 "FSK").
In some applications the "Gain" knob may be used to alter the waveshape (by adding more or less voltage to your input signal); e.g. if you feedback the ∿ / ⋀ output ⑫ to the AM-Input ⑬ and adjust ⑨ and ⑩ carefully, the oscillator generates very overtone-rich waveforms.

⑪ **LED** *see above ("Introduction")*

⑫ ∿ / ⋀ **(sine/triangle) output** or *ramp waveforms* output when switch "FSK mode" ⑭ is in lowest position ("⊓").
The controller "**Bypass**" ⑧ adjusts the AM-Input/∿ / ⋀ –oscillator output ratio. Fully clockwise: The ∿ / ⋀ –oscillator output is 100%. Fully counterclockwise: The ∿ / ⋀ –oscillator output is 0%, AM-input (⑬) is 100%. This is to mix the original to the "effect" signal (≙ "dry/wet") when the oscillator is used as a ringmodulator.
Sinewave output voltage: 3Vpp without AM; max. 6Vpp with AM.
Trianglewave output voltage: 6Vpp without AM; max. 8Vpp with AM.
In the banana version of the *XR22 VCO* the red sockets signalize *low impedance* outputs. These outputs may *not* be grounded or patched together! This may damage the module.

⑬ **AM input** Amplitude modulation input for the ∿ / ⋀ section of the VCO. The input amount can be adjusted with ⑨. Also, the input signal can be mixed to the waveform output ⑫ with **Bypass** controller ⑧.
(also see chapter 2.1 about amplitude modulation)

⑭ **FSK mode switch** *see above ("Introduction")*

⑮ **FSK in** is a logic input. When the "**FSK**" ⑭ switch is in the middle position ("F2") and a voltage greater than ≈+2V is applied to the FSK input (e.g. gate signal, squarewave), the internal switch will be switched from **F2** to **F1** (F2/ F2 CV (Led → 🔴 red) to F1/F1 CV (Led → 🟢 green) .
Note that if switch "Com" ⑦ is active the "F1/com" knob ① and the inputs "F1/comCV" ㉒ and "F1/comCV 1V/Oct" ㉓ affect both frequency "channels".

⑯ ⊓⊔ **Squarewave output** Level between ≈ 0V (GND) and +5V. In FSK mode " ⊓⊔ " (Switch "**FSK**" ⑭ lower position) pulse waveform output.

⑰ **Ground** This socket only exists in the *banana* version of the **XR22 VCO**. The ground connection is required if the module is connected to external equipment, e.g. a mixer. Within the modular system the module is grounded through the power supply.

⑱ **F1/com CV** Manual control adjusts the input level of **F1/com CV in** ㉒ .

⑲ **F1/com CV inversion switch** Inverts the incoming signal on socket **F1/com CV in** ㉒ .

⑳ **F2 CV** Manual control adjusts the input level of **F2 CV in** ㉔ .

㉑ **F2 CV inversion switch** Inverts the incoming signal on socket **F2 CV in** ㉔ .

㉒ **F1/com CV in** Frequency control voltage input for **F1/com.** Level can be adjusted by ⑱ and inverted by switch ⑲ . See also ⑦, ⑭.

㉓ **F1/com CV 1V/Oct in** 1V/Octave input for **F1/com.** See also ⑦, ⑭. (It may be necessary to readjust the tracking. See chapter 4 "Adjustment")

㉔ **F2 CV in** Frequency control voltage input for **F2.** Level can be adjusted by ⑳ and inverted by switch ㉑ .

㉕ **F2 1V/Oct in** 1V/Octave input for **F2** (It may be necessary to readjust the tracking. See chapter 4 "Adjustment").

4. Adjustment

The VCO is already carefully adjusted to 1V/Oct.
If you realize that the XR22 VCO isn't in tune with your other analog synthesizer equipment, it may be necessary to adjust it.

Procedure (Suggestion)

F1 1V/Octave

F2 1V/Octave
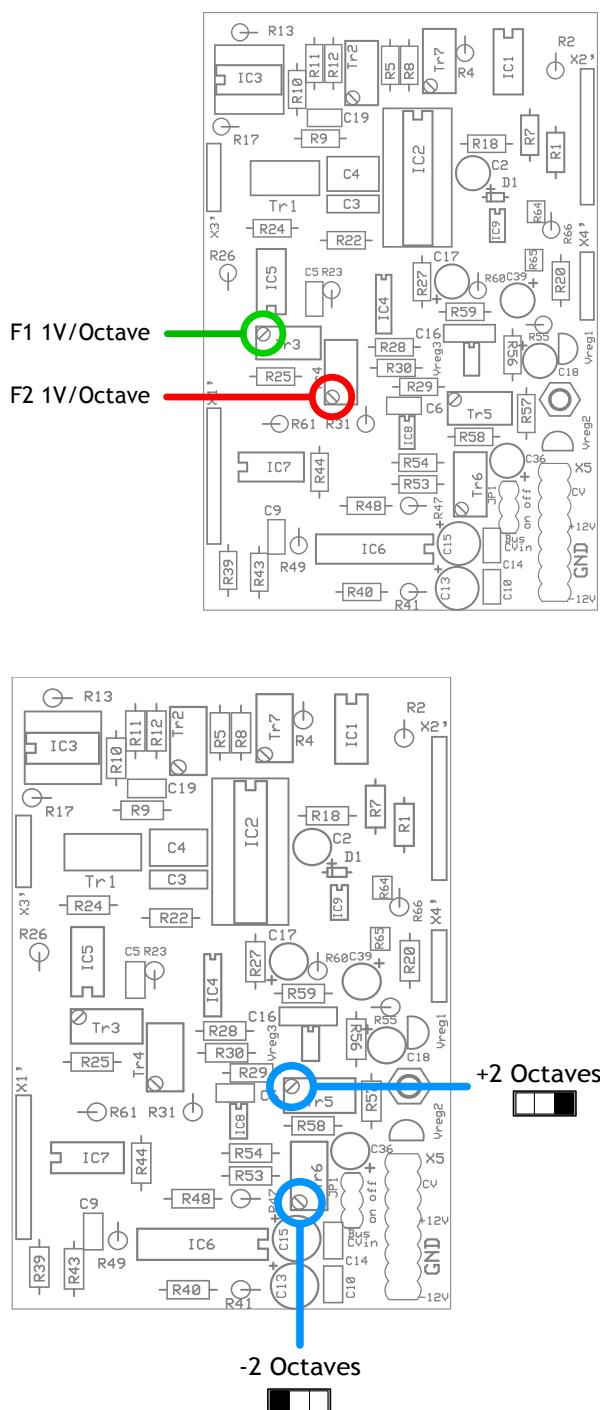
+2 Octaves

-2 Octaves

1. Switch on your equipment and the XR22 VCO and wait ½ hour until the oscillators have the right temperature.
2. Bring octave switches F1 ③ and F2 ④ in middle position. Adjust F1 & F2 knobs ① & ② to ≈ middle position (≈5-6 on scale)
3. Connect a CV from a keyboard (or similar) both to your favorite VCO's 1V/oct. input and to the XR22 VCO F1/com 1V/oct. input ㉓ .
   Put switch "com" ⑦ and switch "FSK" ⑭ in upper position ("F1").
4. Play a note on your keyboard in the middle range, e.g. "C", or "c". The note should be nearby to the tone you have adjusted on the XR22.
5. Adjust pot "F1" ① until the pitch of the XR22 is the same like that of the 2nd VCO.
6. Play a note ≈ 2-3 octaves higher. Adjust trimmer "F1 1V/oct" (see above) until the XR22 VCO is tracking to the 2nd VCO.
7. Go back to step "**4**" and repeat all other steps until both oscillators are in tune.
8. Repeat the same procedure with "**F2**" (with "FSK" ⑭ in middle position and F2 1V/Oct. Input ㉕).
9. After this it is necessary to readjust the octave tuning for switches F1 ③ and F2 ④ , too.
10. Disconnect the CV from your keyboard to the XR22 and bring FSK switch ⑭ in upper position ("F1").
11. Turn F1 pot ① in fully counterclockwise and octave switch ③ in middle position.
12. Tune your 2nd VCO until it pitches with the XR22 VCO.
13. Play a note 2 octaves higher on the 2nd VCO and bring the octave switch ③ in right position ("+2)
14. Adjust trimmer "+2 Octaves" until it matches.
15. Repeat step 11and the following until the trimmer no longer needs to be adjusted.
16. Turn F1 pot ① in fully clockwise and octave switch ③ in middle position.
17. Tune your 2nd VCO until it pitches with the XR22 VCO.
18. Play a note 2 octaves lower on the 2nd VCO and bring the octave switch ③ in left position ("-2).
19. Adjust trimmer "-2 Octaves" until it matches.
20. Repeat step 16 and the following until the trimmer no longer needs to be adjusted.

Older Version:

F1 1V/Octave

F2 1V/Octave

+2 Octaves

-2 Octaves
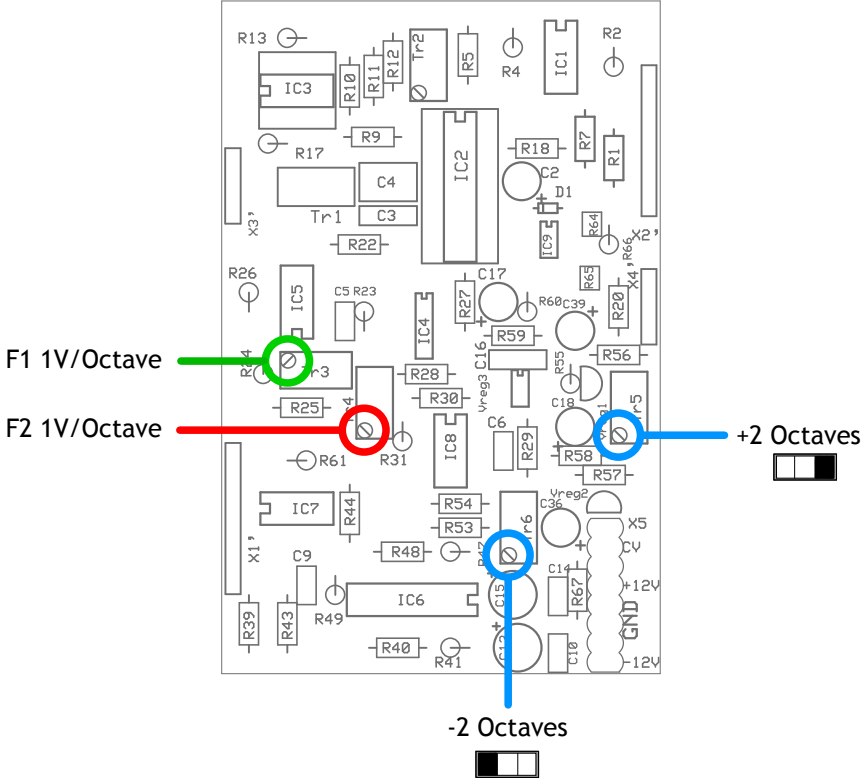
5. Bus CV

Jumper "JP1" in "on" position (on PCB): The Bus CV is controlling the XR22 VCO's frequencies.	Jumper "JP1" in "off" position (on PCB): The Bus CV is not connected.

   Note: In the older version of the XR22 VCO there is no Bus CV Jumper. The Bus CV is always connected to the VCO's frequency control.
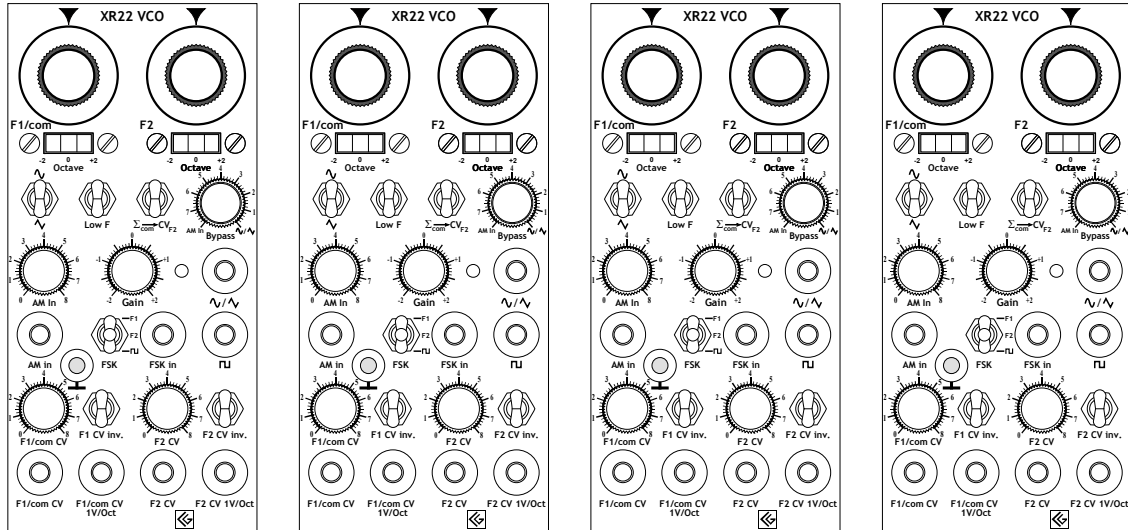
6. Patch Templates

Note your own patch ideas ✂
Template Height: 70mm; Width: 33,1mm

7. Contact & Support

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