CV Tools User Manual

Introduction

Thank you for purchasing the Synovatron CV Tools Module. This manual explains what the CV Tools Module is and how it works.

The CV Tools Module is a 12HP (60mm) wide Eurorack analogue synthesizer module and is compatible with the Doepfer™ A-100 modular synthesizer bus standard.

The CV Tools Module is a versatile voltage processor intended for control voltage manipulation such as adding, subtracting attenuating, amplifying and offsetting. It can also be used with audio and gate signals to great effect.

Caution

Please ensure you use the CV Tools Module in accordance with these instructions especially taking great care to connect the ribbon cable to the module and the power bus correctly. Always double check!

Reversing or misconnecting the bus connector can result in equipment damage and will invalidate the warranty.

Only fit and remove modules with the **rack power off and disconnected from the mains electricity supply** for your own safety.

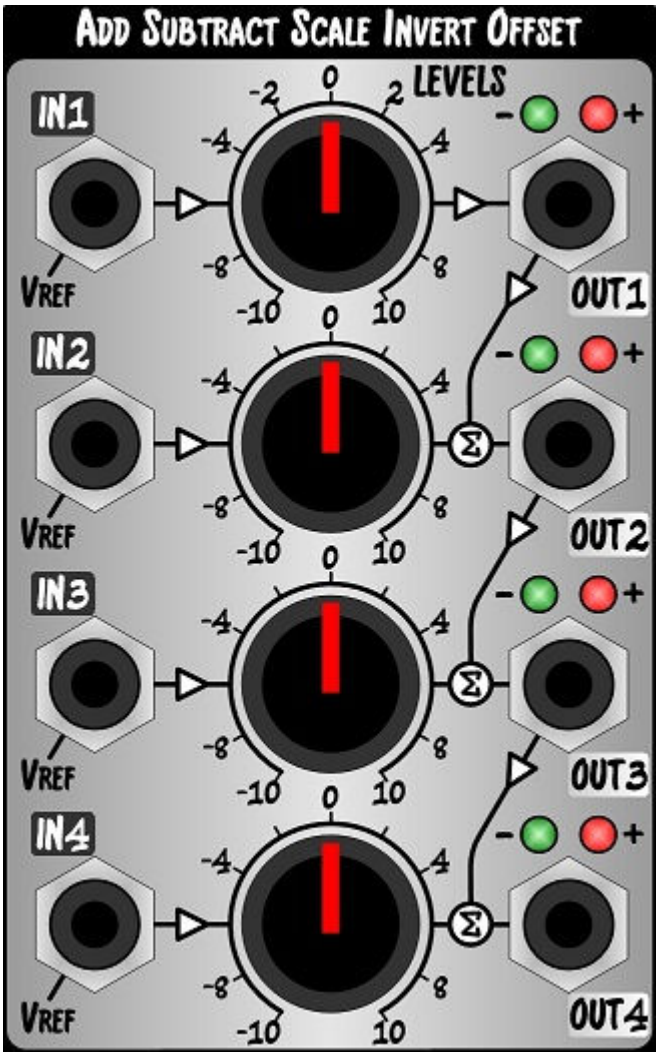
Refer to the connection section for ribbon cable connection instructions. Synovatron Electronic Music cannot be held responsible for any damage or harm caused through incorrect or unsafe use of this module. If in doubt, stop and think. If you are still unsure of what to do then please contact Synovatron for advice before proceeding.

CV Tools Description

The CV Tools Module has two main sections as follows:-

4-channel Polarizing Cascade Mixer Section

Essentially this is a 4-channel mixer but with two main differences:



The first and most significant difference is that it has a **cascade architecture** which, unlike a standard mixer that simply sums all four inputs into one output, has a summing stage at each of the outputs **OUT2**, **OUT3** and **OUT4** (denoted by the **Σ** symbol). So **OUT1** is added to **OUT2**, **OUT2** is added to **OUT3** and **OUT3** is added to **OUT4**.

Consequently **OUT1** is just from channel 1, **OUT2** is the sum of channels 1 and 2, **OUT3** is the sum of channels 1, 2 and 3, and **OUT4** is the sum of all four channels. However, when a patch lead is plugged into any, or all, of outputs **OUT1** to **OUT3** it disconnects that output from the next channel's output summing stage.

Example: A patch lead plugged into **OUT1** will ensure that whatever signal is output on **OUT1** will not be added to **OUT2**. So channel 1 becomes a single gain/inversion channel and in this example, with nothing plugged into **IN1**, the output on **OUT1** will simply be the normalled **VREF** modified by the position of the **LEVEL** control i.e. a variable DC voltage reference that could be set to anywhere between -10V and +10V (depending on channel 1 jumper settings – more on that later). This example shows that channel 1 can be used as a reference voltage generator whilst the remaining three channels can be used for other things – all the possibilities will be explained later.

The second main difference is that it is a polarizing mixer which allows an input signal's level to be adjusted or inverted. Each channel has a basic gain of 2 and therefore an input signal can amplified by up to a factor of 2 or inverted and amplified by up to a factor of 2 (i.e. -2). This is useful for adding and subtracting signals in varying degrees.

Channels 1-4 have jumper selectable normalled inputs. There are three jumper selectable options for channels 1-3, **option 1** *is +5.00V*, **option 2** *is a user set voltage reference of 0.5V-2.5V* or **option 3** *is no connection*. Each channel can be set separately.

Channel 4 has slightly different options for its normalled connection: **option 1** *is a user set voltage reference of 0.5V-2.5V*, **option 2** *is the A-100 bus CV signal* or **option 3** *is no connection*.

The gain for channel 4 is also jumper selectable between a gain of 2 and an accurately set unity gain (gain of 1). This allows the normalled A-100 bus CV signal to pass through with unity gain when the **LEVEL** control is set to **10**. This will allow an accurate CV of 1V/Octave to be added to the mix if required.

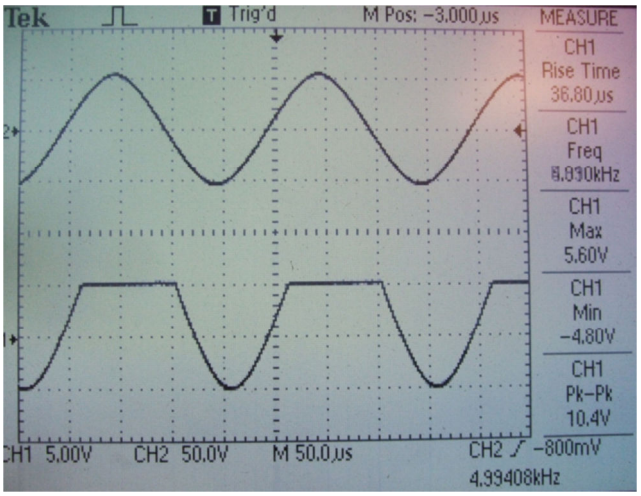
The object of jumper selectable normalled inputs is to give the user some flexibility for setting channel offsets: a coarse range (+5V gives ±10V swing), a fine range (0.5V-2.5V gives ±1V to ±5V swing) and in the case of channel 4 the option for a calibrated CV path.

A very useful feature of each channel, and because each channel can be used separately, is the level indication LEDS (marked **–** and **+**). These indicate the voltage level present on each output. The **green** **–** LED illuminates when there is a negative voltage present, the **red** **+** LED illuminates when there is a positive voltage present. If neither LED is illuminated the output is close to zero volts, conversely if both are illuminated there is an AC signal present that is fast enough not to see it flashing between red and green LEDs.

*The LEDs allow a channel to be used to 'scope' the level on any applied patch lead by simply setting the **LEVEL** control to anywhere clockwise of **0** (**10** would give the most sensitive response). Don't forget that **OUT2***

*to **OUT4** may include summed signals from other channels so put a patch lead in the preceding channel's output to make sure you only see one channel's activity.*

It is possible to overdrive any channel into clipping; either positive, negative or both positive and negative clipping is possible. This can be a great way of creating harmonics. In this image the sine has been offset to clip the top and then offset back to ±5V by a subsequent channel.



Slew Limiter Section

This is a very low frequency low-pass filter where the cut-off frequency is set by the **TIME** control. The purpose is to slow down control voltage changes so that the output slews from one level to another rather than stepping from one to another. Musically this would be used to add **portamento** to a VCO control voltage; one pitch blending into the next. This is also called **lag** or **glide** on other synthesizers. In the **MIN** position there is no noticeable slewing but in the **MAX** position it takes about one second to ramp up or down to the next voltage step.

As this function is mainly intended for slewing CVs for VCOs it is important that this does not change the scale (or volts/octave) of the CV signal therefore the input is buffered and has a very high input impedance (1MΩ) and the output is also buffered to give a very low output impedance in order to prevent any scale errors or signal distortion due to the loading effects of the large capacitance required to cause a slow slew rate.

*Note that **OUT4** is normalled to the Slew Limiter's input.*

Examples

The 4-channel polarizing mixer section is very versatile and can be configured in numerous ways just by patch lead connections. Here's a table of what can be done with just output patch leads.

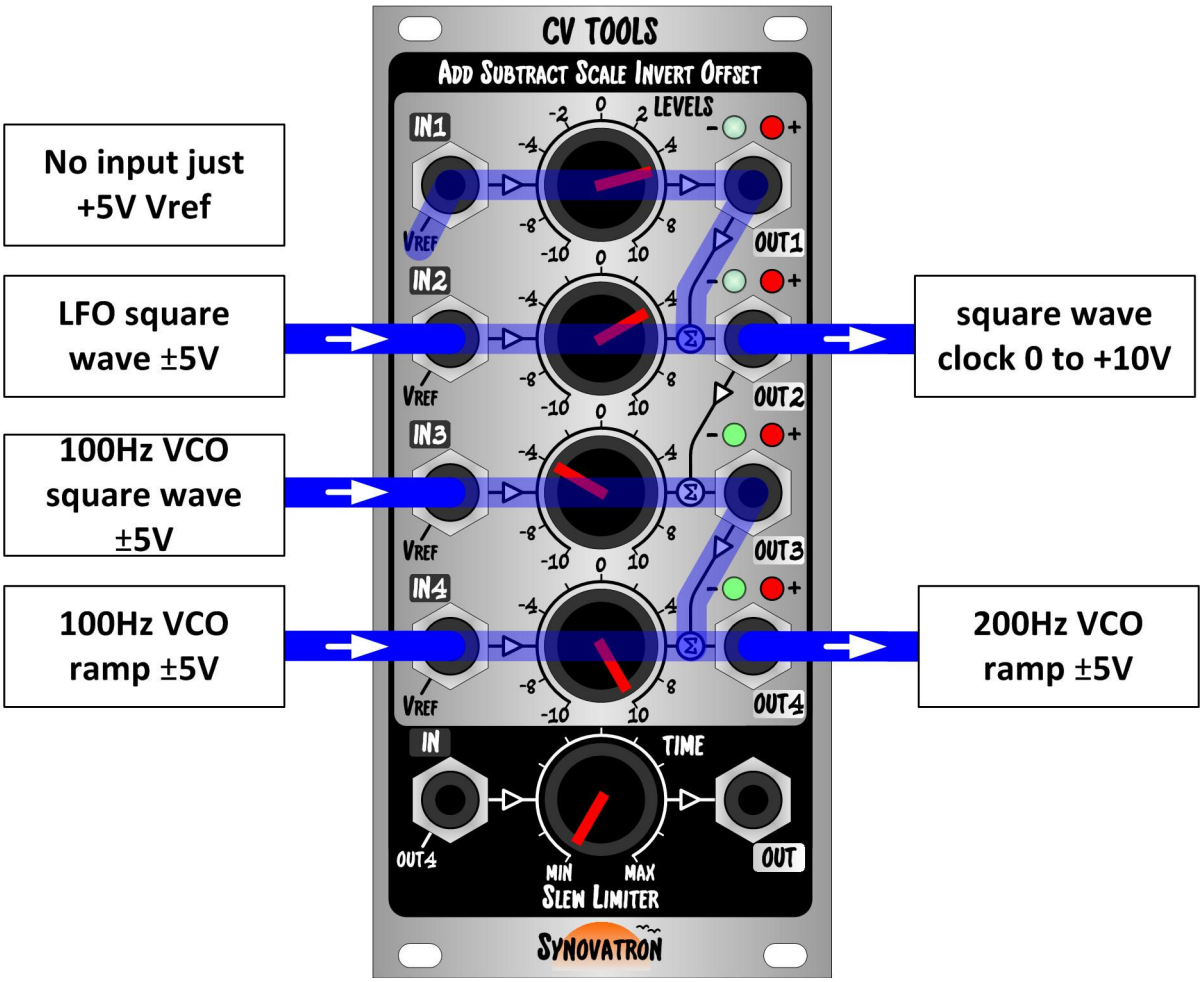
Patched Outputs	*Configuration*
OUT1	Channel 1 forms a single-channel level control. Channels 2 to 4 are unused.
OUT2	Channels 1 and 2 form a two-channel mixer. Channels 3 and 4 are unused.
OUT1 and **OUT2**	Channels 1 and 2 form two single-channel level controls. Channels 3 and 4 are unused.
OUT3	Channels 1 to 3 form a three-channel mixer. Channel 4 is unused.
OUT1 and **OUT3**	Channel 1 forms a single-channel level control. Channels 2 and 3 form a two-channel mixer. Channel 4 is unused.
OUT2 and **OUT3**	Channels 1 and 2 form a two-channel mixer. Channel 3 forms a single-channel level control. Channel 4 is unused.
OUT1, **OUT2** and **OUT3**	Channels 1, 2 and 3 form three single-channel level controls. Channel 4 is unused.
OUT4	Channels 1 to 4 form a four-channel mixer.
OUT1 and **OUT4**	Channel 1 forms a single-channel level control. Channels 2 to 4 form a three-channel mixer.
OUT2 and **OUT4**	Channels 1 and 2 form a two-channel mixer. Channels 3 and 4 form a two-channel mixer. See example.
OUT1, **OUT2** and **OUT4**	Channels 1 and 2 form two single-channel level controls. Channels 3 and 4 form a two-channel mixer.
OUT3 and **OUT4**	Channels 1 to 3 form a three-channel mixer. Channel 4 forms a single-channel level control.
OUT1, **OUT3** and **OUT4**	Channels 1 and 4 form two single-channel level controls. Channels 2 and 3 form a two-channel mixer.
OUT2, **OUT3** and **OUT4**	Channels 1 and 2 form a two-channel mixer. Channels 3 and 4 form two single-channel level controls.
OUT1, **OUT2**, **OUT3** and **OUT4**	Channels 1, 2, 3 and 4 form four single-channel level controls. See example.

In addition each level control or mixer channel can be used to either act upon a signal applied via a patch lead to an input or can provide a variable DC offset voltage if no patch lead is connected (refer to Input Board jumper settings)

Here are a few simple examples to demonstrate the principles:-

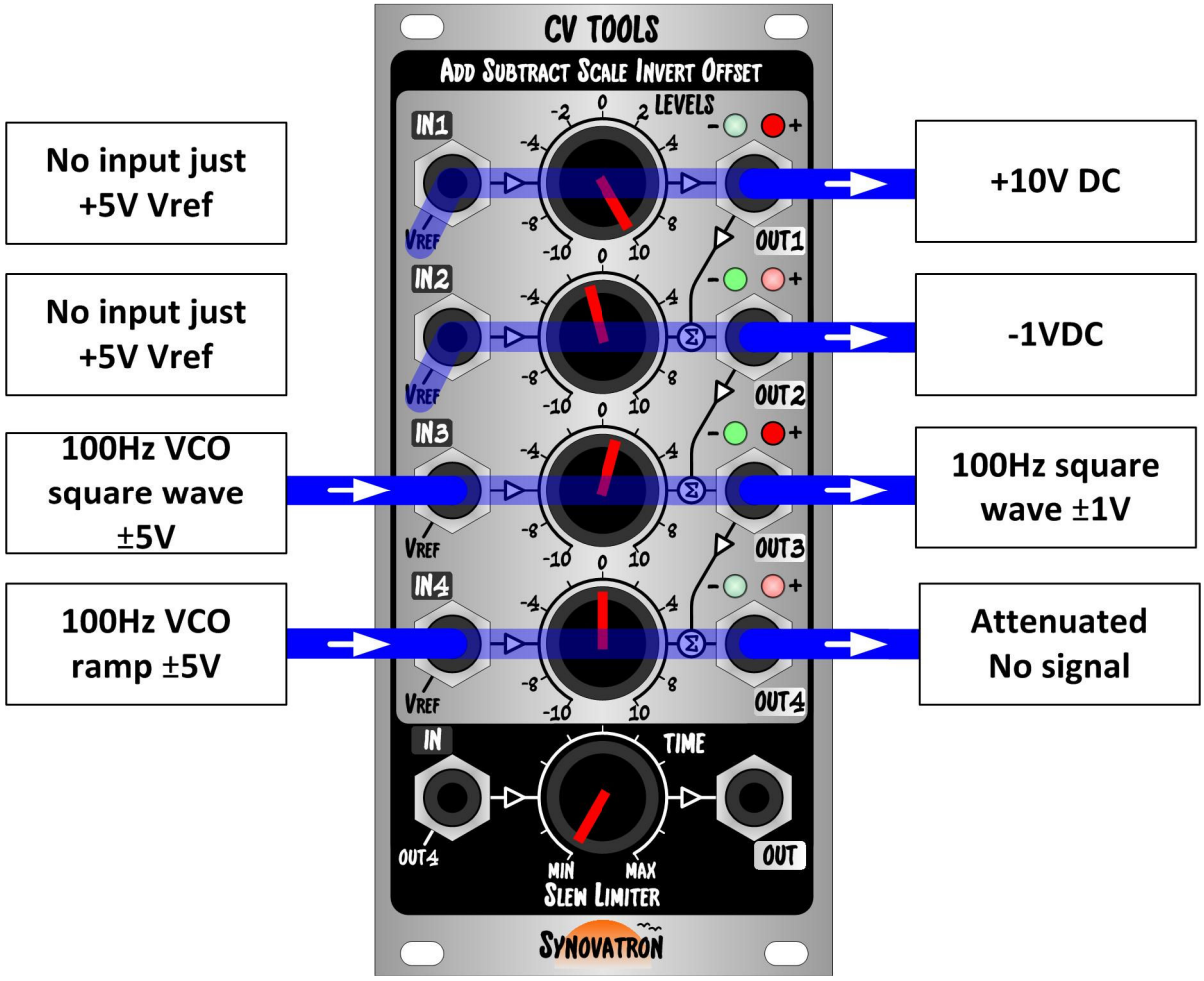
Two 2-channel mixers

This shows that by using two output patch leads that two 2-channel mixers can be configured – **OUT2** adds the offset applied to **IN1** to the bipolar LFO signal to give a 0 to +10V signal suitable for a clock or gate signal. A VCO's square wave and ramp waveforms are connected to **IN3** and **IN4** – the levels are adjusted to effectively provide a ramp of twice the frequency at **OUT4**.



Single channel level controls

This example uses each channel as separate level or offset controls. The top two channels are used as DC voltage generators and the lower two are used as signal attenuators – each channel is independent here.



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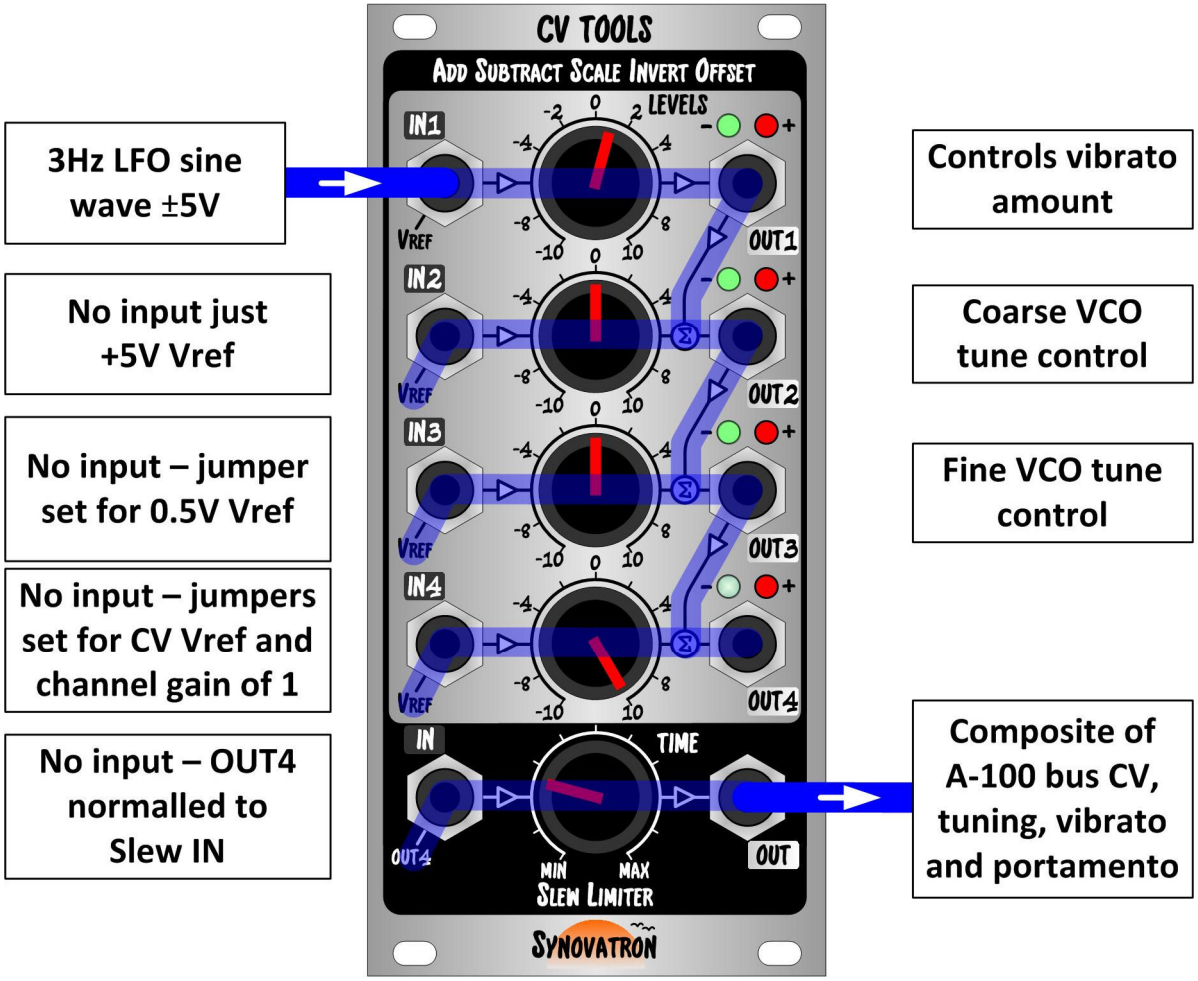
VCO CV mixer

This example uses channel 4 set to unity gain and the A-100 bus CV routed through it (see jumper settings). Channel 3 is configured for a +5V VREF to give a coarse tune control whilst channel 2 is configured for +0.5V VREF to give a fine tune control. Channel 1 has an LFO connected to provide vibrato. The output is routed via the Slew Limiter to give a portamento sound on the VCO.



Note that routing via the very low output impedance Slew Limiter ensures the VCO does not load the CV causing scale errors.

Other examples may also be posted from time-to-time on the blog at http://synovatron.blogspot.com

Please send any clever patches to synovatron@btinternet.com and they may get featured on the blog.

Jumper Settings

Input Board

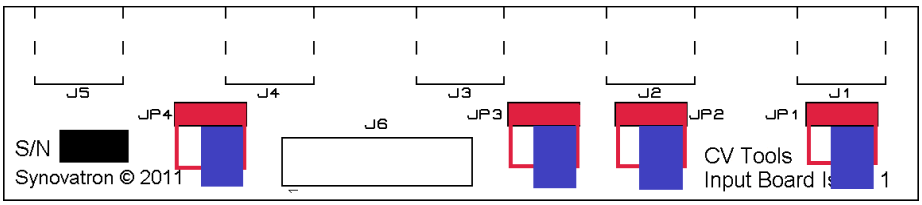
The Input Board has four jumpers **JP1** to **JP4**. These select the options for normalled inputs to **IN1** to **IN4**.

IN1 to **IN3** can each have their normalled inputs set to +5V, a user settable voltage of 0.5V to 2.5V* or none. *See adjustments section.

IN4 can have its normalled input set to +5V, A-100 bus CV or none.

As a guide the +5V setting provides an offset capability of ±10V (as channels have a gain of ±2); this is mainly used for offsetting large signals like ADSR envelopes or LFO waveforms and is especially good for forcing signals into clipping. The 0.5V to 2.5V setting is for much finer adjustment e.g. you may want a variable DC to provide an octave tuning range for a Doepfer A-110 VCO. The CV position on channel 4 routes the CV signal available on the A-100 bus to **IN4**. The 'none' settings are if you don't want an offset capability on all channels. To set to 'none' place the jumper on any one pin but leave the other jumper socket disconnected – or you could just remove it but it might get lost.

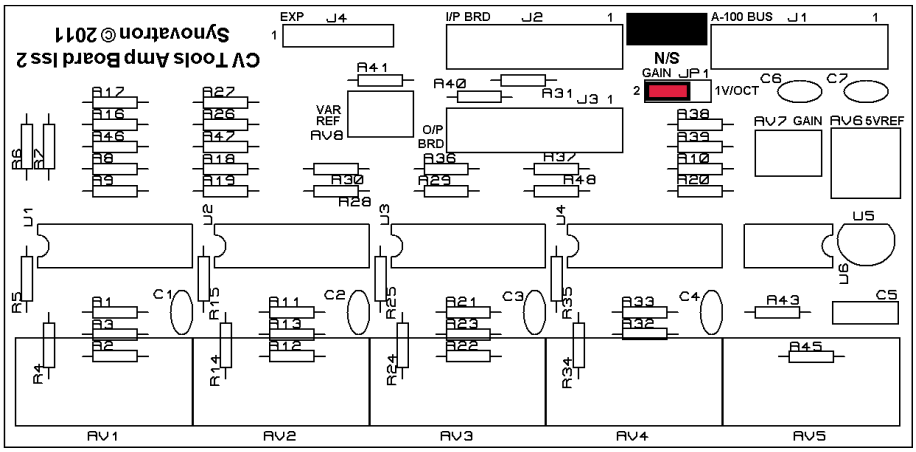
The factory pre-set jumper positions are all +5V as shown below.



Amplifier Board

The Amplifier Board has one jumper **JP1** marked **GAIN**. This selects the gain options for channel 4. The options are a gain of 2 or an accurately settable gain of 1 (called unity gain). Generally this will be set to unity gain if **IN4**'s normalled input jumper is set to the A-100 bus CV position.

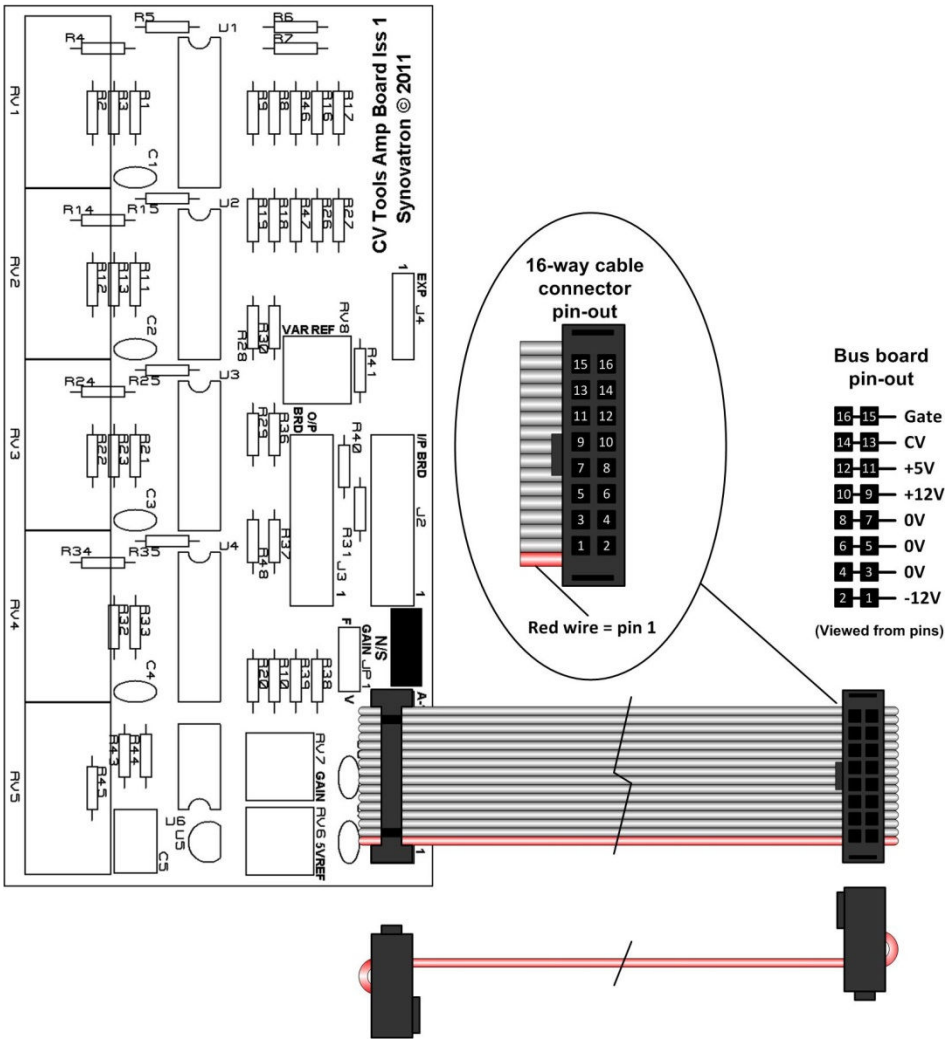
The factory pre-set position is a gain of 2 (the same as the fixed gain on channels 1 to 3). As shown below – the **2** denotes a fixed gain of 2 and **1V/OCT** denotes an adjustable gain of 1.



Connection Instructions

Ribbon Cable

The supplied ribbon cable connection to the module should always have the **red stripe** at the bottom to line up with the pin **1** marking on the CV Tools Amp Board's **J1 A-100BUS** connector. The same for the other end of the ribbon cable that connects to the modular synth racks power connector. The **red stripe** must always go at the bottom.

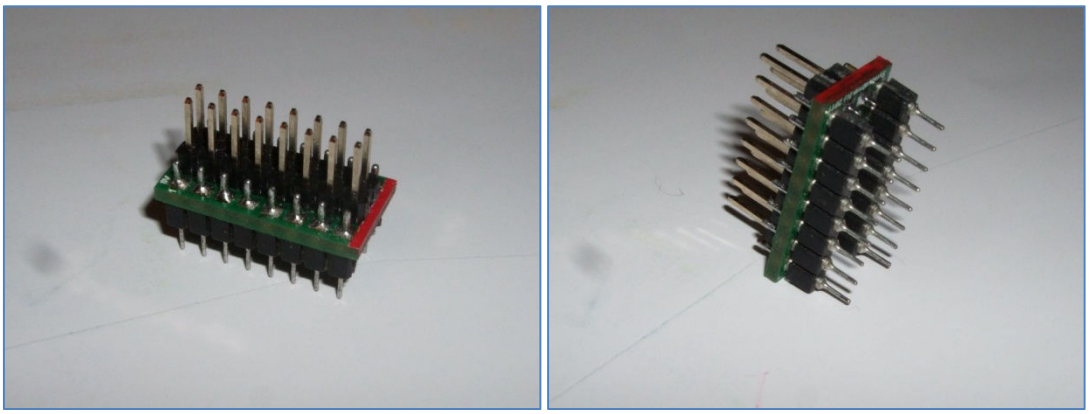


Getting this wrong may damage your CV Tools module and possibly your synth too so please always double check that you have got it right. If in doubt don't power up and get advice. Always change, fit or remove modules with the synth's power switched off and disconnected from the mains supply – for your own safety.

Adaptors

If you want to use the CV Tools Module but have an Analogue Systems rack, especially the older type with no Doepfer style sockets, then Synovatron has an adaptor specially designed for this – please contact Synovatron for details.

Note that Analogue Systems connectors do not support the bussed CV connection – this is left open-circuit on the adaptor.



Synovatron Doepfer Module to Analogue Systems Bus (DM2ASB) Adaptor

Front Panel Fixings

The CV Tools Module comes with M3 cap head socket screws, nylon washers and a 2.5mm hex key. The cap head socket screws look great and are very easy to fit using the supplied hex key, the nylon washers help protect the front panel. If you like the way they look and want to do the rest of your synth the same way then please contact Synovatron.

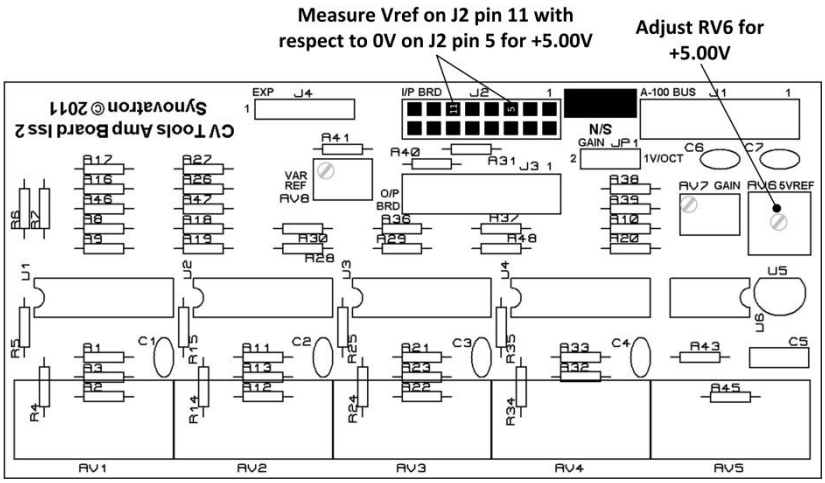
Adjustments

The voltage reference and gain adjustment pots are on the main amplifier board. These adjustments should only be performed by a suitably qualified person. The adjustments can be performed using a Digital Multi-Meter (DMM) and small screwdriver or trim tool as follows:-

+5V reference

The +5V reference is used for coarse offset adjustments and is factory set to 5.00V giving a ±10.0V offset capability. This adjustment affects the 0.5V to 2.5V setting so always do the adjustments in this order.

Disconnect the ribbon cable from **J2**. Measure the voltage on **J2 pin 11** with respect to 0V on **J2 pin 5**. Adjust **RV6** for a DMM reading of **5.00V**.



Alternative method

This simple alternative method uses front panel connections only and no ribbon cable disconnections are required. However jumpers need to be set appropriately; the channel being adjusted must have its input voltage reference jumper set to +5V position hence ensure **JP1** on the Input Board is set to +5V for this next step.

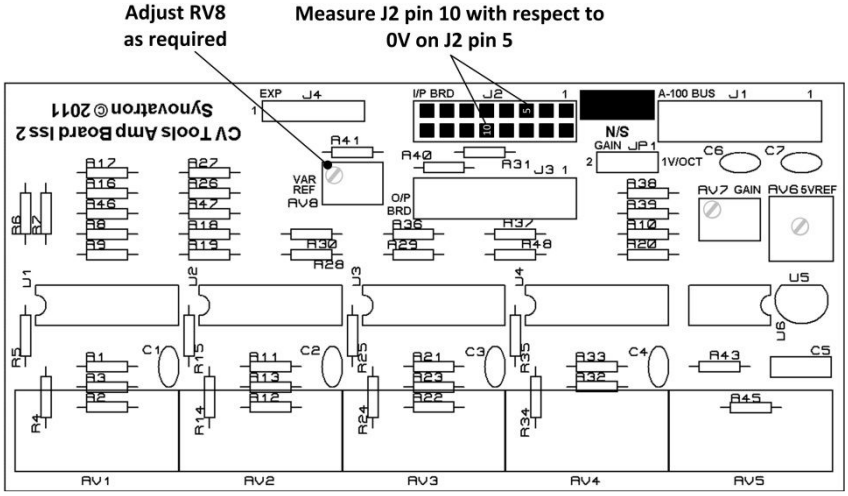
Set **LEVEL 1** control to **10**. Connect a patch lead to **OUT1**. Measure the voltage on the patch lead tip with respect its screen. Adjust **RV6** for a DMM reading of **10.00V**.

*Note that this sets Channel 1 accurately in the **10** position but there will be small gain differences on the other channels and at **-10** positions so check the other channels and positions in a similar way remembering to disable the preceding channel's output by inserting patch lead in the output above the channel of interest. This adjustment can be performed on any channel but they cannot be independently adjusted; there is only one adjustment. Either set one channel and position accurately or set for best compromise across all channels and positions.*

0.5V to 2.5V reference

The 0.5V to 2.5V reference is used for fine offset adjustments and is factory set to 1.00V giving a ±2V maximum offset capability. However this can be set as desired by the user within the range 0.5V to 2.5V to give maximum offsets of between ±1V and ±5V.

Measure the voltage on **J2 pin 10** with respect to 0V on **J2 pin 5**. Adjust **RV8** for a DMM reading as required. Reconnect the ribbon cable to **J2**.



Alternative method

This alternative method uses front panel connections only and no ribbon cable disconnections are required. Again jumpers need to be set appropriately; the channel being adjusted must have its input voltage reference jumper set to **0.5V to 2.5V** position. This adjustment assumes channel 1 but channel 2 or 3 (or none if this feature is not required) can be used as well.

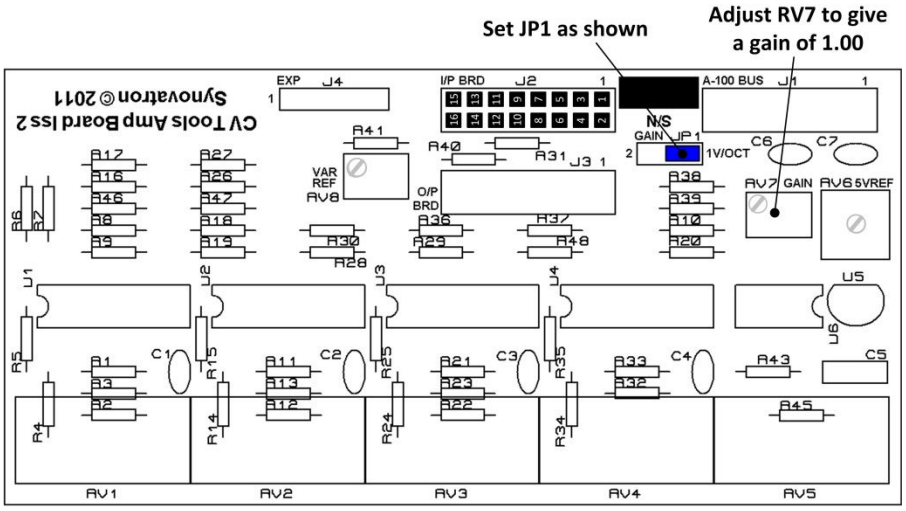
Set **LEVEL 1** control to **10**. Connect a patch lead to **OUT1**. Measure the voltage on the patch lead tip with respect its screen. Adjust **RV8** for a DMM reading as required (**1.00V to 5.00V**); your choice.

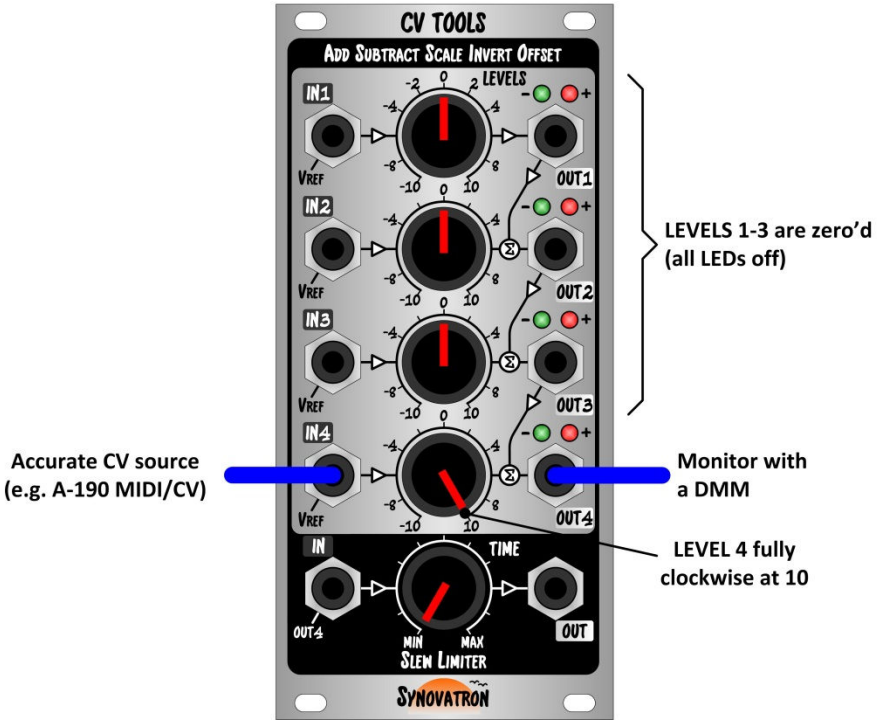
*Note again that this sets Channel 1 accurately in the **10** position but there will be small gain differences on the other channels and at **-10** positions so check the other channels and positions in a similar way remembering to disable the preceding channel's output by inserting patch lead in the output above the channel of interest. This adjustment can be performed on any channel but they cannot be independently adjusted; there is only one adjustment. Either set one channel and position accurately or set for best compromise across all channels and positions.*

Channel 4 gain

Channel 4 can be set to have a gain of 2 or 1V/Octave. The 1V/Octave gain can be adjusted as follows.

Set jumper **JP1** to the **1V/OCT** position as shown. Apply an accurate CV source e.g. MIDI/CV module such as the Doepfer A-190 to **IN4** using a patch lead. Set channel 4 **LEVEL** fully clockwise to **+10** position. Set **LEVEL**s 1-3 to **0** so that **OUT1**-**OUT3** LEDs are off. Monitor **OUT4** with a DMM connected via a patch lead. Set the CV source to change by exactly 1V e.g. if using a MIDI/CV adaptor with a MIDI keyboard press the lowest ***C*** note and then press ***C*** one octave up. By alternately going between octaves adjust **RV7** for a **change** of exactly **1.000V**; repeat as many times as necessary. Return **JP1** to the **2** position for a channel gain of 2 or leave as is for an accurate channel gain of 1.





CV Tools Specification

4-channel Polarizing Cascade Mixer

Channel 1

Input: 3.5mm jack **IN1**
Input impedance: 100kΩ (±1%)
Normalled input: **VREF** - jumper selectable to +5V, 0.5V-2.5V or none
Bandwidth: DC-15kHz (-3db)
Gain: **LEVEL** control variable 0 to ±2 (±3%)
Output: 3.5mm jack **OUT1** - Normalled to Channel 2 output mixer
Output impedance: 1kΩ (±1%)
Output indication: ±LEDs

Channel 2

Input: 3.5mm jack **IN2**
Input impedance: 100kΩ (±1%)
Normalled input: **VREF** - jumper selectable to +5V, 0.5V-2.5V or none
Bandwidth: DC-15kHz (-3db)
Gain: **LEVEL** control variable 0 to ±2 (±3%)
Output: 3.5mm jack **OUT2** - Normalled to Channel 3 output mixer
Output impedance: 1kΩ (±1%)
Output indication: ±LEDs

Channel 3

Input: 3.5mm jack **IN3**
Input impedance: 100kΩ (±1%)
Normalled input: **VREF** - jumper selectable to +5V, 0.5V-2.5V or none
Bandwidth: DC-15kHz (-3db)
Gain: **LEVEL** control variable 0 to ±2 (±3%)
Output: 3.5mm jack **OUT3** - Normalled to Channel 4 output mixer
Output impedance: 1kΩ (±1%)
Output indication: ±LEDs

Channel 4

Input: 3.5mm jack **IN4**
Input impedance: 100kΩ (±1%)
Normalled input: **VREF** - jumper selectable to +5V, A-100 Bus CV or none
Bandwidth: DC-15kHz (-3db)
Gain: **LEVEL** control variable 0 to ±2 (±3%) or 1 (set by RV7) with **LEVEL** control fully clockwise - jumper selectable
Output: 3.5mm jack **OUT4** and Slew Limiter input
Output impedance: 1kΩ (±1%)
Output indication: ±LEDs

Slew Limiter

Input: 3.5mm jack **IN**
Input impedance: 1MΩ (±1%)
Normalled input: Channel 4 output **OUT4**
Slew range: 0.5ms-1000ms
Gain: 1
Output: 3.5mm jack **OUT**
Output impedance: 0Ω

General

Dimensions

3U x 12HP (128.5mm x 60.6mm), depth 52mm

Power consumption

+12V @ 20mA max, -12V @ 18mA max, +5V is not used

Reference voltage (VREF)

Jumper selectable at each mixer input. Channels 1-3: 5.00V (set by RV6), 0.5V-2.5V (set by RV8), Channel 4: 5.00V (set by RV6), CV from A-100 bus

A-100 Bus utilisation

±12V, 0V, CV used; +5V and Gate are not used

Contents

CV Tools Module, 200mm 16-way ribbon cable, 4 sets of M3 cap head socket screws, nylon washers and a 2.5mm hex key

Environmental

All components used on the CV Tools Module are RoHS compliant. To comply with the WEEE Directive please do not discard into landfill – please recycle all **W**aste **E**lectrical and **E**lectronic **E**quipment responsibly – please contact Synovatron to return the CV Tools module for disposal if required.

Warranty

The CV Tools Module is guaranteed against defective parts and workmanship for 12 months from date of purchase. Note that any physical or electrical damage due to misuse or incorrect connection invalidates the warranty. A low cost repair service will be available for any repairs outside of warranty conditions.

Quality

The CV Tools Module is a high quality professional audio device that was lovingly and carefully designed, built, tested in the United Kingdom by Synovatron Electronic Music. Please be assured of my commitment to providing good reliable and usable equipment! Any suggestions for improvements will be gratefully received.

Thank you and happy music making.
Tony.

Contact details

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CE

SYNOVATRON™
ELECTRONIC MUSIC

EU DECLARATION OF CONFORMITY

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Product Description: CV Tools Module

I hereby declare that this product conforms to the essential requirements of the Electromagnetic Compatibility (EMC) Directive 2004/108/EC.

Harmonized EMC Standards applied:

- Emissions: EN 61000-6-3:2007/A1:2011
  Signal & control lines (Jack inputs & outputs)
  EN 55022:2010, Class B: Conducted RF 0.15-0.5MHz @ 40dBuA-30dBuA quasi-peak.
  EN 55022:2010, Class B: Conducted RF 0.15-0.5MHz @ 30dBuA-20dBuA average.
  EN 55022:2010, Class B: Conducted RF 0.5-30MHz @ 30dBuA quasi-peak.
  EN 55022:2010, Class B: Conducted RF 0.5-30MHz @ 20dBuA average.

- Immunity: EN 61000-6-1:2007
  Enclosure port (Module front panel)
  EN 61000-4-3:2006+A2:2010: RF EM field 80-1000MHz @ 3V/m, 80% AM (1kHz)
  EN 61000-4-2:2009: ESD Contact discharge ±4kV, Air discharge ±8kV

Date CE Mark first applied: 18.04.2011

Signed:

23.10.2011

Tony Steventon