

Fig. 1: A-101-9 Controls and In/Outputs

## 1. Introduction

We call the A-101-9 an *Universal Vactrol Module*. It contains two identical sub-units. Each unit has two vactrol outputs available that are controlled manually and by an external control voltage with polarizer. A *vactrol* is a combination of a light depending resistor (LDR) and a light emitting diode (LED) both put into a small light-proof case. For more general details about vactrols please look at the Vactrol basics page on our website [www.doepfer.com](http://www.doepfer.com). Increasing the LED brightness causes a decrease of the LDR resistance. The LED at the front panel displays the brightness of the LEDs of the vactrol pair in question. The resistances of the two vactrols of each sub-unit change simultaneously. This allows to control two parameters at the same time or to control a parameter that requires two variable resistors (e.g. frequency for certain filter circuits). The LDR terminals of each vactrol are connected to the jack sockets labelled VAC1 and VAC2.

Applications: A-101-9 introduces voltage control to any function that is controlled by a fixed or variable resistor (e.g. a two-terminal normal or trimming potentiometer). There are many applications within the A-100 (e.g. Attack, Decay, Release of envelope generators, time of slew limiters and trigger delays, random rate of noise module). But the module can be used even outside the A-100 in combination with any other circuit that uses a variable or fixed resistor to control a parameter (e.g. wah-wah or parameters of guitar stomp boxes). Even for "circuit bending" the vactrol outputs can be used.

## 2. Basic Principles

As mentioned in the introduction each sub-unit of the universal vactrol module has available two variable resistors. Each resistor is realized as a light depending resistor (LDR) that is combined with a light emitting diode (LED) both put into a small light-proof case. The two terminals of each LDR are connected to the two terminals of the corresponding VAC socket. In contrast to other sockets of the A-100 consequently the VAC sockets are not grounded and can be treated as "free" variable resistors without any connection to the A-100 power supply or A-100 GND. This allows the usage of the VAC outputs in any circuit (within A-100 or external) that uses a variable resistor to control a parameter of the device in question. Typical examples within the A-100 are:

- Attack, Decay, Release of all envelope generators (A-140, A-143-1, A-143-2)
- Slew time of slew limiter (A-170)
- Delay time and duration of trigger delay (A-162)
- Clipping functions of the extreme filter (A-106-1)
- Clock rate of digital noise (A-117)
- Random rate and level of analog noise (A-118)
- Frequency of Trautonium filter (A-104)

The A-101-9 module is intended only for users who are familiar with electronics as some soldering is required to install the vactrol connections on the module or device that has to be controlled by the A-101-9. For all A-100 modules that can be combined with the A-101-9 the required

information (i.e. the position of the two solder points for the parameter/potentiometer in question) is shown in the attachment. We also offer a service for A-100 users who are not familiar with soldering to modify the module in questions. The charges for the modification depend upon the customer's wishes and the working time required to carry out the modification. If there is sufficient space at the front panel of the module in question an additional socket can be added. For this a new hole has to be drilled into the existing front panel. If there is not sufficient space at the front panel a blind panel with additional socket(s) has to be mounted next to the module. The connections between the new additional socket(s) of the modified module and the vactrol output(s) of the A-101-9 are then made with standard patch cables.

For external devices (e.g. wah-wah pedal, effect unit, guitar stomp box) the user has to find out the solder points in question himself (a schematics of the device will be very helpful). We have to point out that the user is responsible for any damage that may appear at the module or device that is modified to be connected to the vactrol output of the A-101-9. All modifications are at your own risk! **Only low voltage devices** (max 40V) are allowed to be modified with the A-101-9. It is not allowed to use the A-101-9 in combination with high voltage devices (i.e. more than 40V). In this case there is **danger to life** !

Normally the vactrol is connected in parallel to the resistor/potentiometer that controls the parameter in question and the potentiometer is set to it's maximum value (e.g. 1 M $\Omega$ ). The dark resistance of the vactrol is several M $\Omega$  and consequently has no or little effect to the overall value. As the brightness inside the vactrol increases the LRD resistance becomes smaller and has the same effect as operating the potentiometer. The existing potentiometer can also be used to determine the upper value of the parameter in question if it is not set to it's maximum value. Typical example: a 1 M $\Omega$  potentiometer is used to control the decay of an envelope generator by discharging a capacitor to GND. The vactrol is connected in parallel to the decay potentiometer. The setting of the potentiometer defines the maximum decay time as the vactrol can only reduce the total resistance and consequently reduce the decay time.

Even a trimming potentiometer or a fixed resistor can be replaced or switched in parallel to one of the vactrol outputs of the A-101-9. If this makes sense depends upon the circuit in question and can be used for circuit bending applications.

In order to obtain a reasonable control scale the A-101-9 uses a logarithmic current source for the vactrol LEDs. With a linear relationship between the applied control voltage and the LED current the overall resolution would be very unsuitable. Fig. 2 shows the relation between LED current and LDR resistance of a vactrol (both scales of the graph are logarithmic).

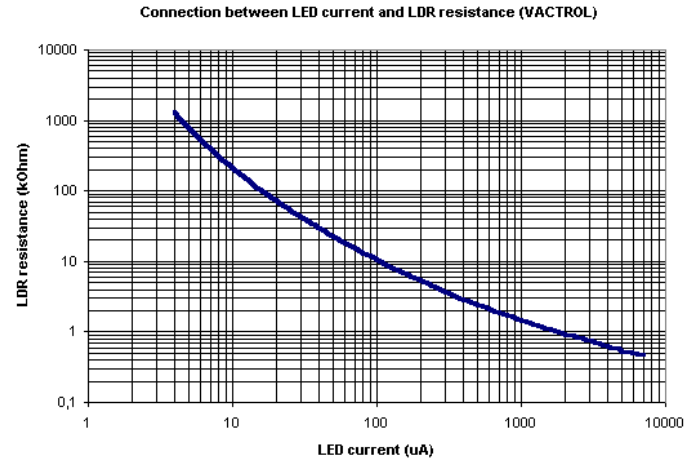


Fig. 2: Relation between LED current and LDR resistance of a vactrol

**Remark:**

*The A-101-9 cannot be used (or only with limitations) to replace a three-terminal-potentiometer (voltage divider) as the vactrol is a two terminal element only. Under certain conditions a three-terminal-potentiometer can be replaced by a fixed resistor and the vactrol connected in series. But this is possible only if the circuit is not sensitive to the overall resistance (vactrol+fixed resistor) as this changes while the vactrol changes it's value. One has to look at the schematics if this is true or try it out.*

### 3. Overview

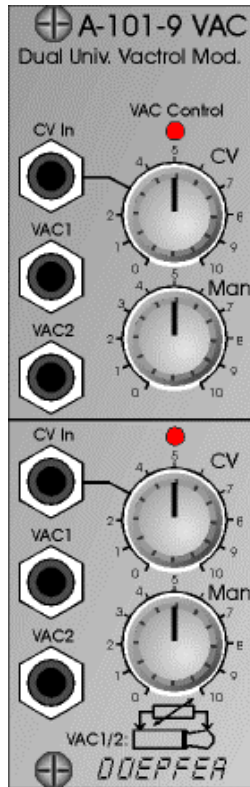


Fig. 3: front panel

#### Controls:

- ① CV: polarizer for CV input
- ② Man.: manual vactrol resistance control
- ③ VAC control: LED display

#### In- / Outputs:

- ① CV In: control voltage input
- ②a VAC1: vactrol 1 connector
- ②b VAC2: vactrol 2 connector

*Remark 1:* The front panel scale of the CV input control ① is wrong for the first series of modules. This control is a polarizer not a simple attenuator as shown on the front panel. The attenuator has been replaced by a polarizer after the front panels of the first series have already been printed.

*Remark 2:* In contrast to other A-100 sockets the VCA1/2 sockets ②a/b are not grounded, i.e. the two terminals of the vactrol are connected to the two terminals of the socket in question.

## 4. Controls and In- / Outputs

- ② Man.: manual vactrol resistance control
- ❶ CV In: control voltage input
- ③ CV: polarizer for CV input

This group of elements is responsible for the current vactrol resistance. Knob ① *Man* is used to adjust the vactrol resistance manually. Turning this knob clockwise reduces the vactrol resistance and lights up the display LED ③. A CV input ❶ is available to control the the vactrol resistance by an external control voltage (e.g. LFO, envelope follower, random, ADSR, keyboard CV, sequencer, theremin, ribbon controller, foot controller, Midi-to-CV, ...). The CV input is equipped with a **polarizer**. In principle a polarizer is an attenuator, but in contrast to a normal attenuator it enables both positive and negative attenuations (i.e. amplifications in the range -1...0...1). Negative attenuation means that the signal is inverted (please refer to the manuals of A-133 CV Polarizer or A-138c Polarizing Mixer for details). The middle position of the polarizer control corresponds to full attenuation (or amplification = 0). This is the same as the fully counterclockwise position of a "normal" attenuator. The fully clockwise position of the polarizer corresponds to amplification +1 (i.e. the signal passes unchanged), the fully counterclockwise position corresponds to amplification -1 (i.e. the signal is inverted).

- ❷a VAC1: vactrol 1 connector
- ❷b VAC2: vactrol 2 connector
- ③ VAC control: LED display

The sockets ❷a and ❷b make available the terminals of the two vactrols of each sub-unit. In contrast to most other A-100 sockets these sockets are not grounded, i.e. the two terminals of the vactrol are connected to the two terminals of the socket in question. The resistance of the two vactrols of each sub-unit changes simultaneously. The reason is that for some applications two simultaneously changing resistors are required (e.g. for some filter circuits).

The LED ③ displays the current vactrol resistance. A dark LED indicates a high resistance, a bright LED a small resistance. The minimum resistance range for each vactrol is about 1 k $\Omega$  (fully bright LED) to 500 k $\Omega$  (completely dark LED) but the actual resistance range varies a bit due to the vactrol tolerances (minimum value 500  $\Omega$  ... 1 k $\Omega$  at fully bright LED, maximum value 500 k $\Omega$  ... 2 M $\Omega$  at completely dark LED). For more general details about vactrols please look at the Vactrol basics page on our website [www.doepfer.com](http://www.doepfer.com).

## 5. Application Examples

The following examples show the silk-screen of the corresponding A-100 module to be able to find the correct solder points where the vactrol outputs have to be connected to. All silk-screens are top view. The solder terminals of the normal or trimming potentiometer(s) that can be modified by means of the A-101-9 are marked with dots. For some examples even fixed resistors are changed into variable resistors by means of the vactrol outputs of the A-101-9.

One solution is to wire the marked terminals to additional jack sockets.

***Attention: These additional sockets are allowed to be patched to A-101-9 vactrol outputs only. Connecting the sockets to other in/outputs may damage the module in question ! We recommend to mark these additional sockets correspondingly to avoid problems.***

If there is sufficient space at the front panel of the module in question an additional socket can be added. For this a new hole has to be drilled into the existing front panel.

If there is not sufficient space at the front panel a blind panel with additional socket(s) has to be mounted next to the module. For this we offer special 4HP blind plates with 8 holes (same as the A-180 front panel but without printing). In this case the connections between the new additional

socket(s) of the modified module and the vactrol output(s) of the A-101-9 are made with standard A-100 patch cables.

If the module A-101-9 has to be assigned firmly to another module without patching the vactrol output(s) of the A-101-9 can be wired directly to the marked terminals of the module that has to be modified. In this case the corresponding socket(s) **2a** and/or **b** should be marked to indicate that they are internally wired already and cannot be used for other applications.

5.1. Envelope Generator A-140 (A, D, R)

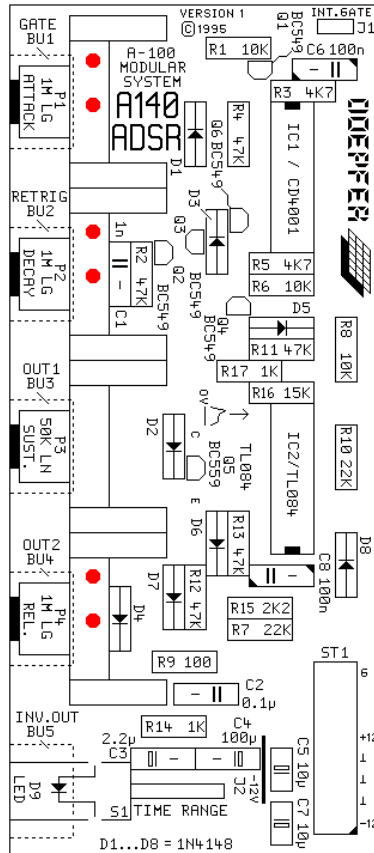
Affected potentiometers:

- Attack (A): P1
- Decay (D): P2
- Release (R): P4

**A**

**D**

**R**

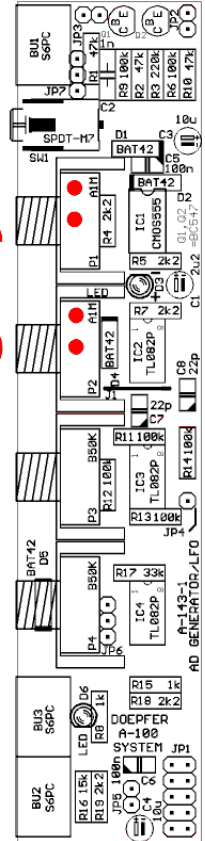


5.2. Envelope Generator/LFO A-143-1 (A, D)

Affected potentiometers:  
Attack (A): P1  
Decay (D): P2

**A**

**D**



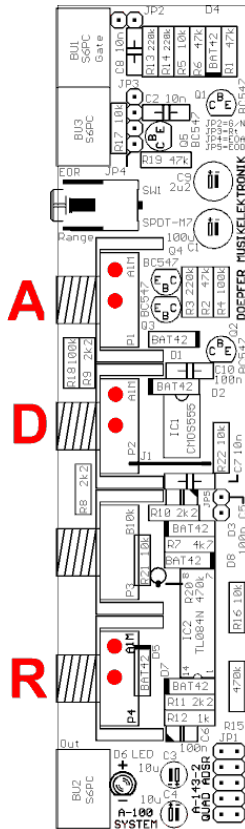
## 5.3. Envelope Generator A-143-2 (A, D, R)

Affected potentiometers:

Attack (A): P1

Decay (D): P2

Release (R): P4

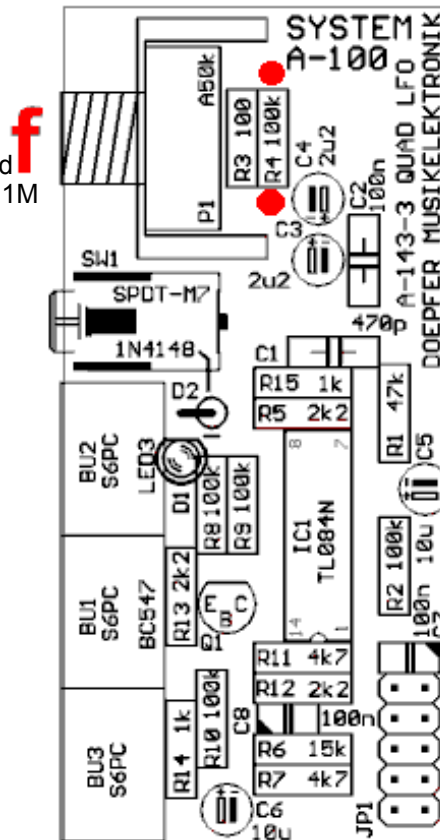


## 5.4. A-143-3 Quad LFO (frequency)

Affected resistors:

frequency: R4

(has to be increased **f** from 100k to about 1M and connected in parallel to VAC1 or VAC2)





5.5. Digital Noise A-117 (clock, f1, f2)

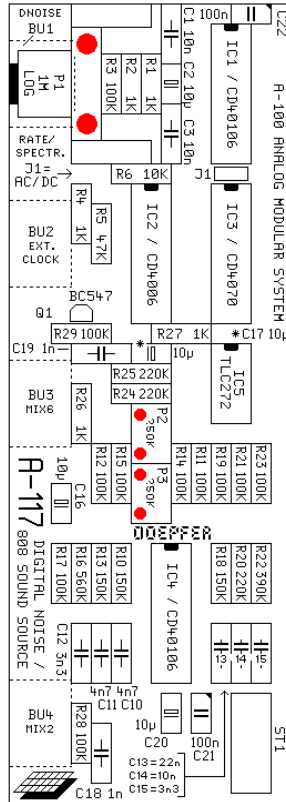
Affected potentiometers:

Digital noise section:  
Noise Clock (clk): P1

808 sound section:  
Frequency 1 (f1): P2  
Frequency 2 (f2): P3

clk

f1  
f2

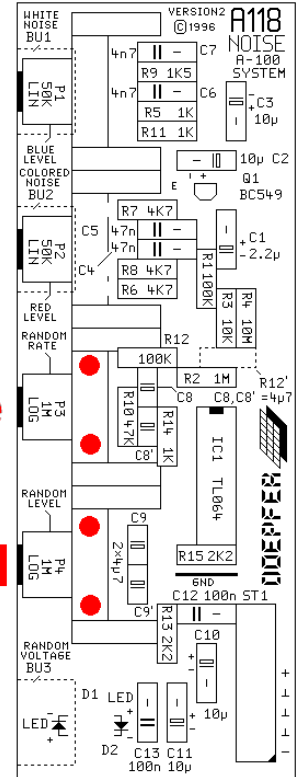


5.6. Analog Noise A-118 (random rate, random level)

Affected potentiometers:  
Random Rate (rate): P3  
Random Level (level): P4

rate

level



5.7. Gate Delay A-162 (delay, length)

Affected potentiometers:

Delay: P1 (2x)

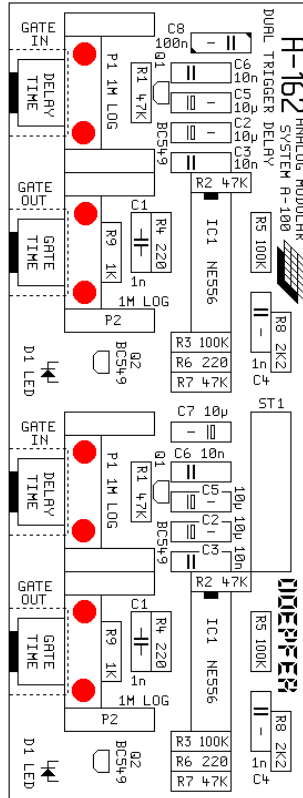
Length: P2 (2x)

delay

length

delay

length



5.8. Slew Limiter A-170 (slew time)

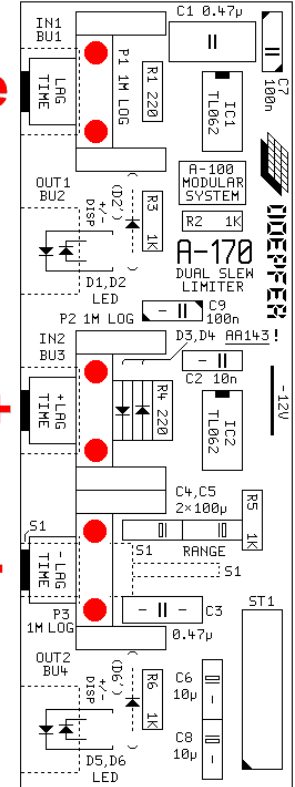
Affected potentiometers:

upper section: lag time  
lag time: P1

lower section:  
lag time + : P2  
lag time - : P3

lag time +

lag time -



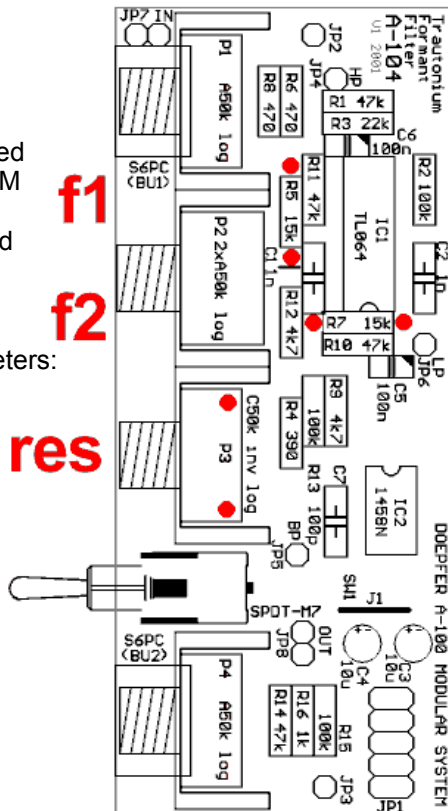
## 5.9. A-104 Trautonium filter (frequency, resonance)

Affected resistors:

frequency: R5 + R7  
(have to be increased from 15k to about 1M and connected in parallel to VAC1 and VAC2 of the same sub-unit)

Affected potentiometers:

resonance: P3



## 5.10. X-treme Filter A-106-1 (clipping)

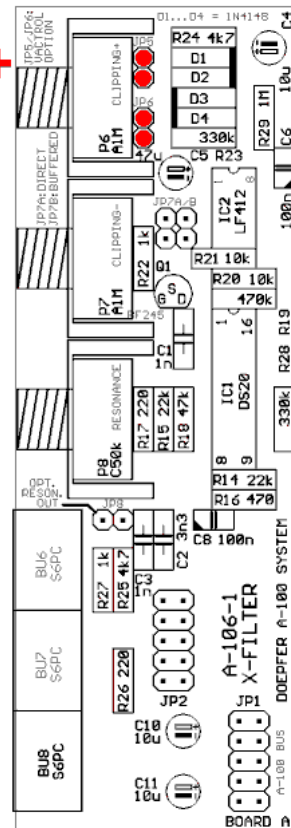
Affected pin headers:

**cl+**  
**cl-**

clipping + : JP5  
clipping - : JP6

For simultaneous control of cl+ and cl- VAC1 and VAC2 of the same sub-unit are used.

For separate control of cl+ and cl- VAC1 (or VAC2) of two separate sub-units are used.



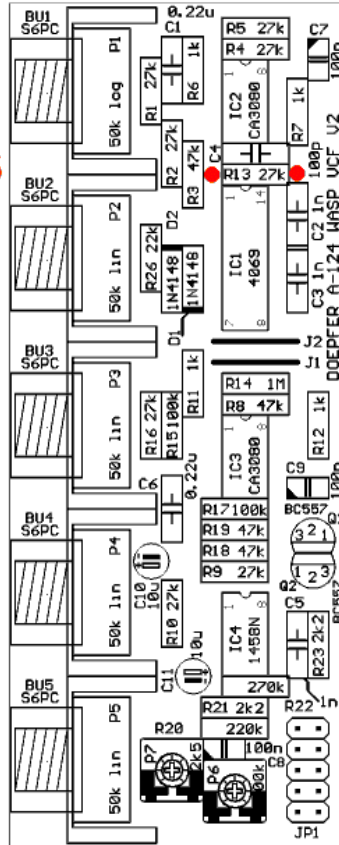
5.11. A-124 Wasp filter (resonance up to self oscillation)

Affected resistors:

resonance: R13

**Res**

with this modification normally resonance up to self oscillation is possible

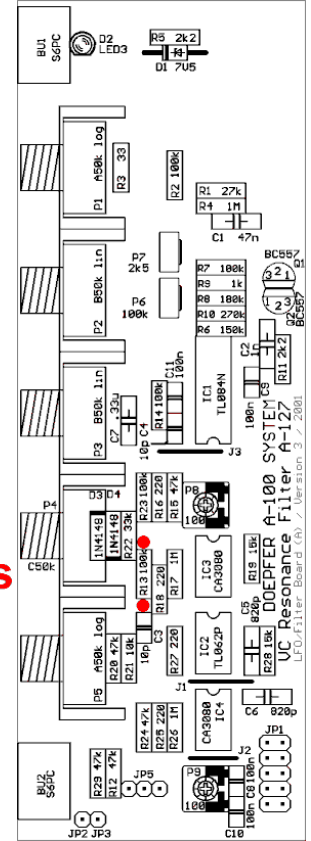


5.12. A-127 Triple VC resonance filter (resonance)

Affected resistors:

resonance: R13

**Res**

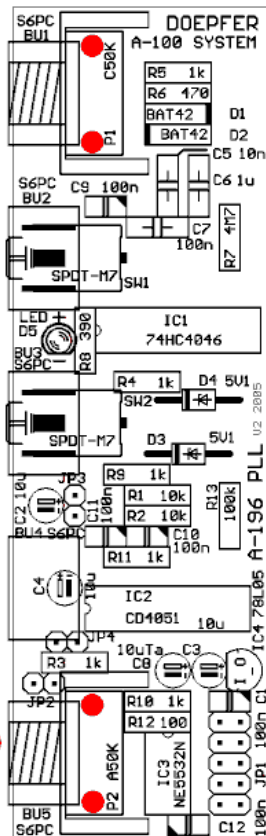


## 5.13. A-196 PLL (VCO offset, low pass frequency)

Affected potentiometers:

VCO offset : P1

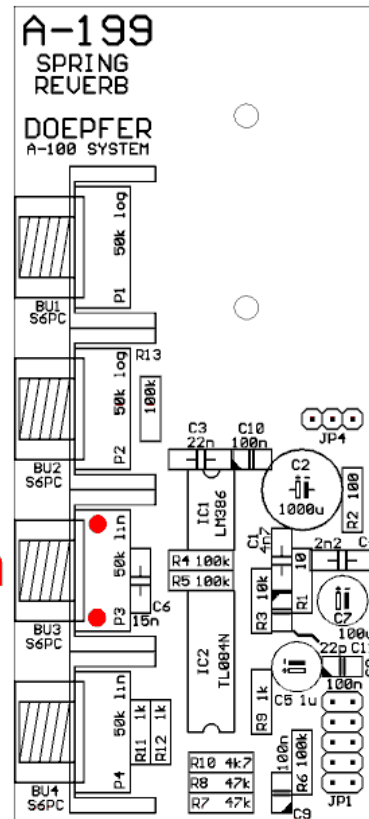
Low pass frequency : P2

**VCO****LP**

## 5.14. A-199 Spring reverb (emphasis)

Affected potentiometers:

Emphasis: P3

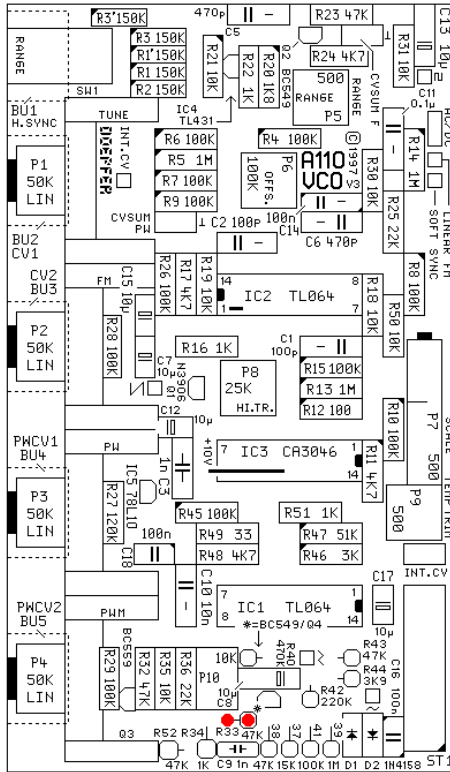
**Emph**

## 5.15. A-110 VCO (triangle/sine waveshaping)

Affected resistor:

waveshaping: R33

changes the  
waveshape of the  
triangle and sine  
outputs:  
triangle → saw  
sine → half sine



WS

More examples:**A-120 24dB Transistor ladder low pass**

resonance control : P5 // vactrol

**A-145 Standard LFO**

frequency control : R4 100k → 1M // vactrol

*(// = parallel connection)**to be continued ...*