CHIPPMANN
electronic musical instruments

CS-8 Series

Owners manual VCF02

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The manufacturer *Schippmann electronic musical instruments* is constantly striving for improvements and developments of their products. Therefore, we reserve the right to change technical specifications which improve our products at any time without notice. This includes the look of the unit which might differ from pictures in this manual.

PREFACE

First of all, congratulations on the purchase of this 3U Eurorack synthesizer module. This manual contains a condensed description of the functionality and addresses users with a certain level of elementary technical knowledge.

The CS-8 VCF02 is a very versatile, fully analogue, programmable and voltage-controlled filter (VCF). It is capable of processing all sorts of audio signals. It is designed for mounting into a 3U Eurorack with an internal +/- 12V power supply.

This module is capable of producing **121 different filter types** (27 low-pass, 18 high-pass, 13 band-pass, and 63 all-pass/notch/phase-type filters). **External control voltages** can be used to control all functions, thus the CS-8 VCF02 can be remote-controlled by sequencers, foot pedals/switches etc. The CS-8 VCF02 features some unique and **very powerful functions** that are entirely new to voltage-controlled filter modules such as **emph**asize, **2nd harm**onic distortion, and **drop**.

The CS-8 VCF02 features a unique "layer cake" design. This way, its installation depth is reduced to a minimum, compared to other Eurorack modules.

Design and implementation meet highest technical standards concerning usability, sound quality, and signal-to-noise ratio. The front panel is made from an anodised and printed piece of aluminium sheet metal of 2 mm gauge. The entire design and production work was done in Germany.

1. WARRANTY

1.1 Limited Warranty

Schippmann electronic musical instruments warrants the mechanical and electronic components of this product for a period of two (2) years from the original date of purchase, according to the warranty regulations described below. If the product exhibits any faults within the specified warranty period that are not excluded from this warranty, *Schippmann electronic musical instruments* shall, at its discretion, either replace or repair the product. This warranty exists in addition to the general terms of business of the manufacturer *Schippmann electronic musical instruments*.

1.2 Terms of Warranty

Schippmann electronic musical instruments reserves the right to execute warranty services only if the product comes with a copy of the dealer's original invoice. Final discretion of warranty coverage lies solely with *Schippmann electronic musical instruments*. Any *Schippmann electronic musical instruments* product deemed eligible for repair or replacement under the terms of this warranty will be repaired or replaced within 30 days after receiving the product at *Schippmann electronic musical instruments*. Damages or defects caused by improper handling or opening of the unit by unauthorized personnel (user included) are not covered by this warranty. Products which do not meet the terms of this warranty will be repaired exclusively at the buyer´s expense and returned C.O.D. with an invoice for labour, materials, return shipping, and insurance. Products repaired under warranty will be returned with shipping prepaid by *Schippmann electronic musical instruments*. **Outside Germany, products will be returned at the buyer´s expense**.

1.3 Warranty transferability

This warranty is extended to the original purchaser and cannot be transferred. No other person (retail dealer, etc) shall be entitled to give any warranty promise on behalf of *Schippmann electronic musical instruments*.

1.4 Claim for damages

Schippmann electronic musical instruments does not accept claims for damages of any kind, especially consequential loss or damage, direct or indirect of any kind however caused. Liability is limited to the value of this product. The

general terms of business drawn up by *Schippmann electronic musical instruments* apply at all times.

Please note: The controls and switches, especially the ***Freq*** **(cutoff-frequency)** or ***Reso*** **(resonance)** controls are programming facilities, **no real-time controllers!** Tweak them carefully since we cannot be held liable for "abused" potentiometers and switches.

2. CE AND FCC COMPLIANCE STATEMENTS

This device has been tested and deemed to comply with the **DIN EN 60065** standards.

This device has been tested and deemed to comply with the requirements, listed in FCC Regulations, part 15. The device complies with **EN 55103-1** and **EN 55103-2** standards.

Because of the entirely analogue construction, this device does not generate radio frequencies and will not interfere with radio frequencies generated by other electronic devices.

3. DISPOSAL

This device has been manufactured to RoHS-standards, in compliance with the requirements of the European parliament and council and is thus free of lead, mercury, and cadmium.

!! Notice: This product is still special waste and is not to be disposed of through regular household waste !!

For disposal, please contact your local dealer or *Schippmann electronic musical instruments*

4. SAFETY INSTRUCTIONS

BEFORE USING THIS PRODUCT FOR THE FIRST TIME, PLEASE READ THE ENTIRE USER MANUAL THOROUGHLY.

- PLEASE AVOID SHARP BENDING OF ANY CORDS AND CABLES.
- CORDS SHOULD NOT BE INSTALLED WITHIN THE REACH OF CHILDREN OR PETS.
- DO NOT TREAD THE ENCLOSURE OF THE PRODUCT, DO NOT PLACE HEAVY OBJECTS ON IT.
- BEFORE REMOVING THE PRODUCT FROM THE RACK, PLEASE DISCONNECT THE POWER PLUG AND ALL OTHER CABLE CONNECTIONS.
- PLEASE DISCONNECT THE POWER PLUG FROM THE OUTLET IN CASE OF A THUNDERSTORM.
- NEVER OPEN THE ENCLOSURE OF THE PRODUCT! NEVER TRY TO MODIFY THE INTERNAL CIRCUITRY! ONLY QUALIFIED SERVICE PERSONNEL IS ALLOWED TO OPEN THE ENCLOSURE.
- DO NOT PLACE OPEN FIRE ON TOP OF THE PRODUCT (CANDLES, ASH TRAYS, HOT THAI CURRIES ETC).
- NEVER EXPOSE THE PRODUCT TO WATER, BEER, OR MOISTURE.
- ADULTS ARE TO MAKE SURE THAT CHILDREN FOLLOW ALL SAFETY INSTRUCTIONS. SAME THING GOES FOR PETS.
- AVOID MECHANICAL STRESS OR IMPACT. DO NOT DROP THE PRODUCT; EVEN IF THERE IS A CONTROL LABELLED "DROP"!.
- DO NOT USE THE PRODUCT WITH TOO MANY OTHER ELECTRONIC DEVICES RUNNING FROM ONE SINGLE OUTLET, ESPECIALLY IN CONNECTION WITH EXTENSION CORDS. DO NOT ATTEMPT TO SAVE MONEY ON CHEAP SOLUTIONS. BUY PROPER HIGH-DUTY POWER DISTRIBUTORS AND CORDS!
- NEVER USE EXTENSION CORDS WITH LESS MAXIMUM LOAD THAN THE TOTAL POWER CONSUMPTION OF ALL DEVICES CONNECTED TO A SINGLE POWER OUTLET COMBINED. OVERLOADING EXTENSION CORDS CAN CAUSE FIRE.
- ***AVOID MECHANICAL STRESS ON SOCKETS AND KNOBS / SWITCHES.***
- ***PROTECT YOUR SPEAKERS AND EARS (!) AGAINST EXCESSIVE AUDIO LEVELS. THE CS-8 VCF02 UNIT IS CAPABLE OF GENERATING EXTREMELY LOW AS WELL AS EXTREMELY HIGH FREQUENCIES. BOTH MIGHT CAUSE SERIOUS DAMAGE TO AUDIO EQUIPMENT AND EAR-DRUMS!***

5. MAINTAINANCE/ CLEANING

- BEFORE CLEANING THE PRODUCT, PLEASE DISCONNECT THE POWER

PLUG FROM THE OUTLET OR DISCONNECT THE MODULE FROM ITS POWER CONNECTOR BY PULLING THE FLAT RIBBON CABLE.

- USE A DRY OR SLIGHTLY MOIST CLOTH OR COMPRESSED AIR FOR CLEANING. NEVER USE ANY CLEANER OR THINNER (E.G. PAINT THINNER OR ACETON). PRINTS AND PAINTWORK WILL IMEDIATELY BE DESTROYED!! ALSO AVOID ALCOHOL (ISOPROPYLIC), GAS, SPIRITS (SCOTCH SINGLE MALTS, FOR A START) OR ABRASIVE HOUSEHOLD CLEANERS!

6. GETTING STARTET

6.1 Unpacking

The box should contain the following items:
- 1 x CS-8 VCF02 3HU rack-mount module
- 1 x Ribbon cable (20 cm length with two 16 pole IDC-connectors)
- 4 x M3 screws
- 4 x polypropylene washers
- This owners' manual

If the content of the box turns out to be incomplete, please get in touch with your dealer or *Schippmann electronic musical instruments* immediately. In case of damage caused in transit, please get back to the responsible carrier and *Schippmann electronic musical instruments* immediately. We will support you in this case.

6.2 Installation

Place the unit on a clean, dry and sturdy surface, or use a suitable keyboard stand or 19" rack. For 19" rack mounting, a suitable rack (3U Eurorack with +/- 12V power supply rails) is required. The CS-8 VCF02 uses discrete all-analogue electronics. Thus certain parameters, such as **Reso**nance and **Emph**asize, may be temperature-sensitive. We recommend placing the CS-08 VCF02 away from heat sources such as radiators, lamps or other units that produce heat (e.g. power amps or internal power supplies).

7. CONTROLS

7.1 Front panel

Fig. 1 shows the front panel with consecutively numbered controls and sockets.

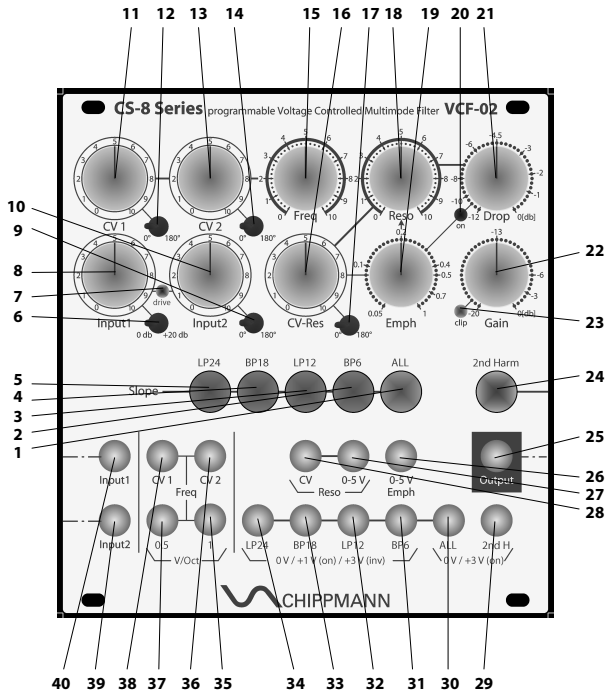

Fig. 1

1. **ALL** button – activates the all-pass function (blue LED lights up)
2. **BP6** button – activates the 6 dB band-pass non-inverted or inverted function (LED lights up green = non-inverted, red = inverted)
3. **LP12** button – activates the 12 dB low-pass non-inverted or inverted function (LED lights up green = non-inverted, red = inverted)
4. **BP18** button – activates the 18 dB band-pass non-inverted or inverted function (LED lights up green = non-inverted, red = inverted)
5. **LP24** button – activates the 24 dB low-pass non-inverted or inverted

function (LED lights up green = non-inverted, red = inverted)

6. **Gain** switch – 0 dB/+20 dB boost of audio **Input1**
7. **drive** LED – lights up red at approx. 2 vpp (peak-to-peak) audio level (sum of input 1 and input 2) and increases its brightness at higher input levels. High levels overdrive the filter circuitry and produce non linear performance with interesting sonic results.
8. **Input1** control – attenuates the incoming audio signal at Input1 socket between -∞ dB and 0 dB
9. **Phase reverse** switch – 0°/180° inverts (180°) (0 is no inversion) the incoming audio signal at Input2 socket
10. **Input2** control – attenuates the incoming audio signal at Input1 socket between -∞ dB and 0 dB
11. **CV1** control – adjusts scaling of the FM control voltage applied to CV1 socket (CV = control voltage) between 0 Oct./V and 3.6 Oct./V
12. **Phase reverse** switch – 0°/180° inverts (180°) (0 is no inversion) the incoming CV-signal applied to CV1 socket
13. **CV2** control – adjusts scaling of the FM control voltage applied to CV2 socket (CV = control voltage) between 0 Oct./V and 3.6 Oct./V
14. **Phase reverse** switch – 0°/180° inverts (180°) (0 is no inversion) the incoming CV-signal applied to CV2 socket
15. **Freq** control – adjusts the cut-off / centre frequency of the filter between 2 Hz und 35 kHz
16. **CV-Res** control – adjusts scaling of the resonance control voltage applied to Reso CV socket between 0 resonance/Volt and self-oscillation/5 Volt
17. **Phase reverse** switch – 0°/180° inverts (180°) (0 is no inversion) the incoming CV-signal applied to Reso CV socket
18. **Reso** control – adjusts the resonance of the filter (Q-factor) between 0 (1) and self-oscillation (∞)
19. **Emph** control – adjusts the emphasis of resonance and thus controls the level of the self-oscillation between 0.05 (weak emphasis/low self-oscillation level) and 1 (strong emphasis/high self-oscillation level)
20. **on** LED – indicates the activity of the Drop control; lights up when **low-pass** functions are active
21. **Drop** control – controls the loss of signal level (Drop) below the cut-off frequency (resp. passed through frequency range) when resonance increases. Range between -12 dB and 0 dB; only active at low-pass settings (LED lights up yellow)
22. **Gain** control – adjusts the output gain of the filter between -20 dB and 0 dB
23. **clip** LED – lights up when filter output is clipping (results in hard

distortion)

24. **2nd Harm** button – adds soft harmonic distortion (2nd harmonic) to the output signal, increasing at higher resonance levels; lights up red when active
25. **Output** socket – provides the filtered output signal
26. **Emph 0-5 V** CV socket (input) – modulation input to control the Emphasize parameter; accepts -5 V - +5 VDC; applied CV is added to the current parameter/knob setting
27. **Reso** 0-5 V CV socket (input) – modulation input to control the resonance parameter; applied CV of +5VDC and control 18 (Reso) = 0 measures up with resonance at maximum; resp. an attached CV of -5VDC results in a resonance of "0" when control 18 (Reso) is set to 10
28. **Reso** CV socket (input) – DC-CV-input routes the applied modulation signal to the CV-Res control
29. **2nd H** socket (input) – an applied CV switches the function 2nd Harm to "on" (≥+3 V) or "off" (≤+2 V); the LED of the button shows current setting; when plugged in, the corresponding button is not active
30. **ALL** socket (input) – an applied CV switches the filter function ALL to "on" (≥+3 V) or "off" (≤+2 V); the LED of the button shows current setting; when plugged in, the corresponding button is not active
31. **BP6** socket (input) – an attached CV switches the filter function BP6 to "non-inverted" (≥+1 V), "inverted" (≥+3 V) or "off" (<+1); the LED of the button shows current setting; when plugged in, the corresponding button is not active
32. **LP12** socket (input) – an attached CV switches the filter function LP12 to "non-inverted" (≥+1 V), "inverted" (≥+3 V) or "off" (<+1); the LED of the button shows current setting; when plugged in, the corresponding button is not active
33. **BP18** socket (input) – an attached CV switches the filter function BP18 to "non-inverted" (≥+1 V), "inverted" (≥+3 V) or "off" (<+1); the LED of the button shows current setting; when plugged in, the corresponding button is not active
34. **LP24** socket (input) – an attached CV switches the filter function LP24 to "non-inverted" (≥+1 V), "inverted" (≥+3 V) or "off" (<+1); the LED of the button shows current setting; when plugged in, the corresponding button is not active

    Sockets **29 – 34** accept AC voltages covering the entire audio range!

35. **1 V/Oct** socket (input) – calibrated CV-input for cut off / centre frequency control; scaling is 1V/octave

36. **CV2** socket (input) – DC-CV-input routes the applied modulation signal to the CV2 control
37. **0.5 V/Oct** socket (input) – non-calibrated CV-input for cut off / centre frequency control; scaling is 0.5V/octave
38. **CV1** socket (input) – DC-CV-input routes the applied modulation signal to the CV1 control
39. **Input2** socket (input) – (AC) audio input routes the applied audio signal to the Input2 control
40. **Input1** socket (input) – (AC) audio input routes the applied audio signal to the Input1 control

7.2 Back

Fig. 2 shows the back of the module with consecutively numbered elements.

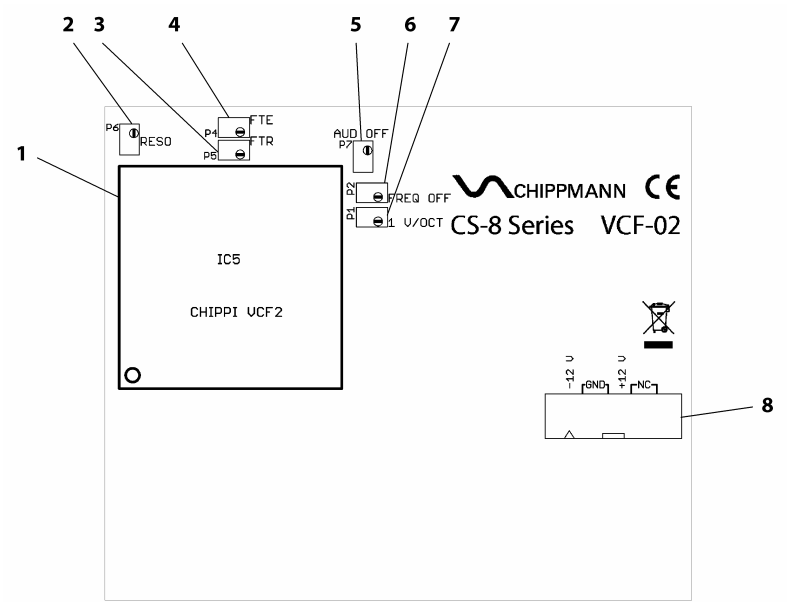

Fig. 2

1. **Filter module** – contains the core of the filter circuitry
2. **Reso** trimmer **P6** – calibration of zero resonance point
3. **Emphasize feed-through** trimmer **P5** – calibration of the emphasize modulation-signal feed-through to the audio output (→ no feed-through)
4. **Resonance feed-through** trimmer **P4** – calibration of the resonance modulation-signal feed-through to the audio output (→ no feed-through)
5. **Output offset** trimmer **P7** – calibration of audio output DC-offset (→ 0 V)
6. **Cut-off/ centre frequency offset** trimmer **P2** – calibration of cut-off /centre frequency (→ 35 kHz@Freq Pot.(15) fully clockwise)
7. **1 V/Oct scaling trimmer P1** – calibration of CV-scaling at socket 35 (→ 1V/oct)
8. **16 Pin power cable connector**

7.3 Initial operation

The power connector's (8) pin-out in top view (refer to fig. 2) is assigned as follows:
Bottom to top, left to right. Thus pin 1 is located at bottom left, pin 2 above pin 1 etc. Pin 15 is at bottom right, pin 16 at top right.

Pin 1, 2 = -12 V (labelled with a triangle)
Pin 3-8 = GND (ground, 0 V), located outward on all sockets
Pin 9, 10 = +12 V
Pin 11-16 = not in use

To hook up power to the module, connect one of the IDC-sockets of the included flat ribbon cable to the connector (refer to fig. 2). Observe guide key for the polarity of the connector in order to avoid pin reversal. The red tag of the cable is to match the triangle-label.

7.4 Calibration

All trimmers are 12 gauge trimmers, i. e., 12 turns are needed to cover the entire range. Trimmers P2, P6 and P7 increase their parameters when turned clockwise. Trimmer P1 increases the sensitivity when turned clockwise, meaning the control voltage variation that is required to cover a one-octave range is reduced. Trimmers P4 and P5 should better be left untouched.

Needless to say that the module VCF02 is delivered perfectly calibrated!
(but we thought we´d point that out anyway)

8. MODULE DESCRIPTION

8.1. Layout and functions

Fig. 3 shows the layout of the VCF02 module:

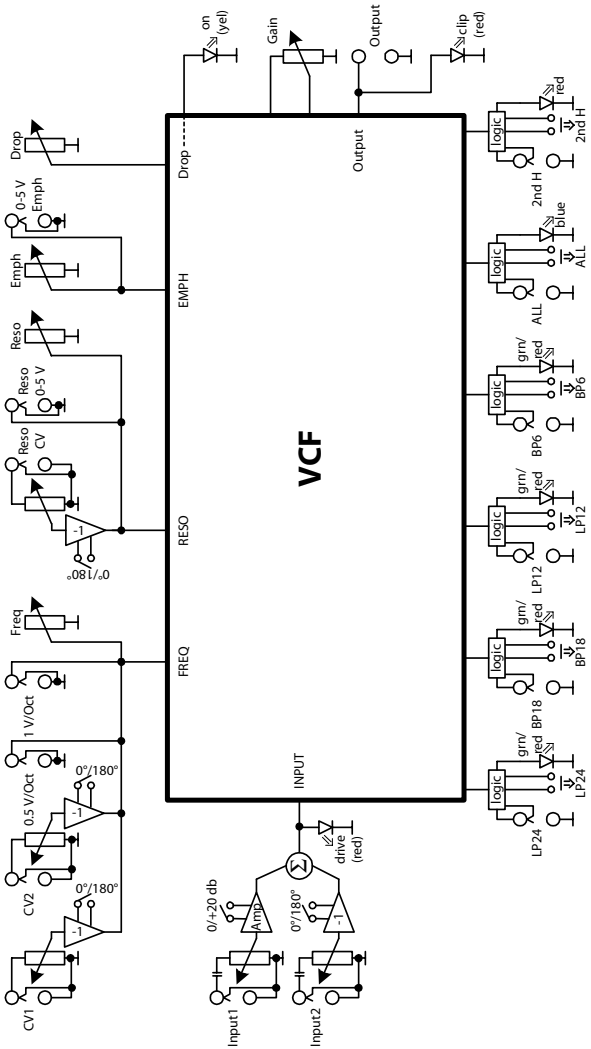
VCF
Drop
EMPH
RESO
FREQ
INPUT
Output
on (yel)
Gain
Output
clip (red)
drive (red)
Drop
0-5 V Emph
Emph
Reso
Reso 0-5 V
Reso CV
0°/180°
Freq
1 V/Oct
0.5 V/Oct
0°/180°
CV2
0°/180°
CV1
0/+20 db
Amp
0°/180°
Input1
Input2
logic
2nd H
red
ALL
blue
BP6
grn/red
LP12
grn/red
BP18
grn/red
LP24
grn/red

Fig. 3

INPUT: The audio inputs are labelled Input1 and Input2. They are true AC-inputs. Both controls Input1 and Input2 are decoupled by means of a capacitor and directly connected to their input sockets. They simply attenuate the signal between the factor 0 and 1. Input1 switch provides a signal boost of 0 dB resp. +20 dB. Input2 switch provides a phase shift of 0° (no shift) or 180° (phase inversion).

Output: Output is a DC-output. After some operation time, a certain voltage offset might build up. It can be reset to zero (0V) by trimmer P7, located at the back of the module.

drive-LED: The drive-LED lights up at signal levels of 2 vpp (volts peak-to-peak) and higher, applied to the VCF INPUT. At higher levels, the LED lights brighter. There is no clipping produced but a non-linear distortion softly coming in.

FREQ: Several factors influence the VCF-parameter FREQ, known as cut-off frequency (f_c) or resonance frequency. The cut-off frequency defines the frequency at which the high and low-pass filters start to attenuate the signal and band-pass filters have their maximum peak (centre frequency). Around the cut-off/resonance frequency, the signal is also emphasized, which leads to more sound coloration up to self-oscillation of the filter.
The Freq knob covers a parameter range of 2 Hz to 35 kHz. External control provides a maximum range of 40 kHz and virtually no limits at the low range (e.g. 0.1 Hz).

Fig. 4 shows the four basic types of filter characteristics and their cut-off frequency (resonance frequency) curves.

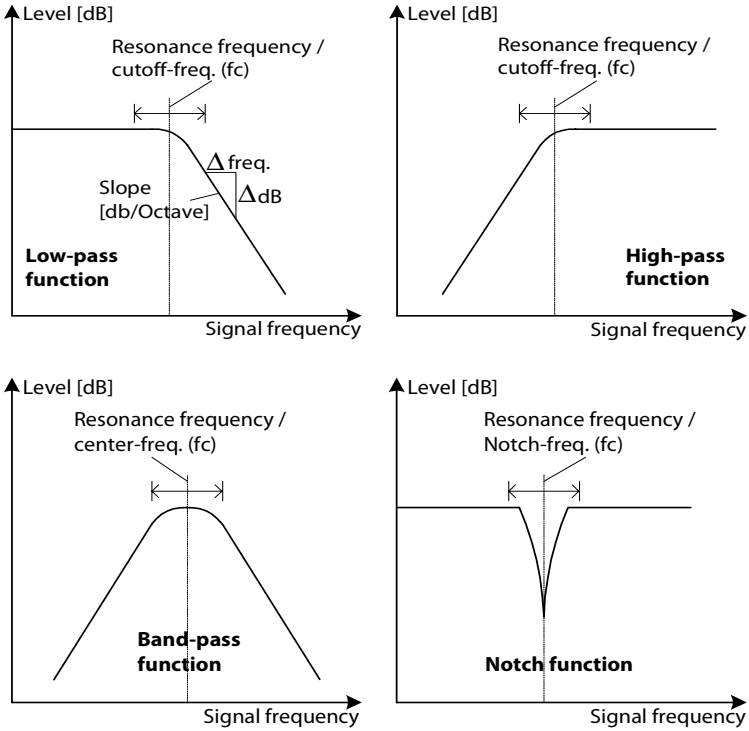

Fig. 4

Control voltage inputs are *CV1, CV2, 0.5V/Oct* and *1V/Oct*.
Both control s CV1 and CV2 are directly connected to their input sockets. They simply attenuate the signal between the factor 0 and 1. The corresponding switches provide a phase shift of 0° (no shift) or 180° (phase inversion) of the applied modulation signal.

RESO: The factors that influence the filter parameter RESO also have an effect on its self-resonance. At higher resonance settings, frequencies around the cut-off/centre frequency are emphasized more than others, which produces a resonant peak.

The Reso control controls this boost from "0" (no resonance) to "10" (self-oscillation). The starting point of the self-oscillation depends a bit on the **Emph** parameter setting (see below). It will start approx. at settings of Reso = 6 (if Emph = 1) and 8 (if Emph = 0.3).

Fig. 5 shows the effect of the **Reso**nance and **Drop** parameters of a low-pass filter.

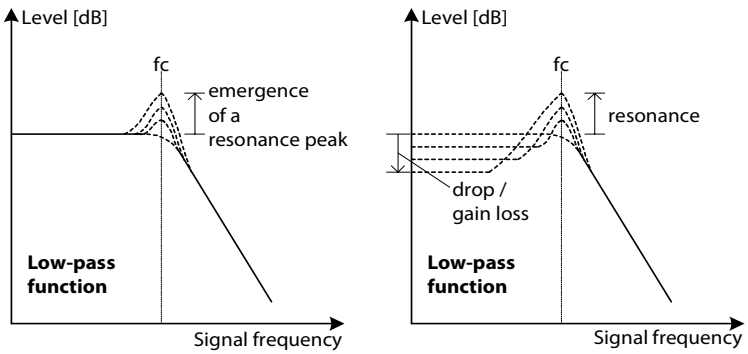

Fig. 5

The corresponding control voltage inputs are CV-Res and Reso 0-5 V. The CV-Res control is directly connected to the input socket. It simply attenuates the signal between the factor 0 and 1. The corresponding switch provides a phase shift of 0° (no shift) or 180° (phase inversion) of the modulation signal applied to Reso CV.

EMPH: This function is really unique! It allows for control of the level of emphasis, independent from the strength of the resonance setting! Thanks to this, the tone produced by the self-oscillating filter will not necessarily have a high level, which makes it much easier to handle within a musical or timbral context. Use low Emph values (Emph = 0.05 – 0.1) and the filter will oscillate only slightly, use high values (Emph = 0.5 – 1) and the filter's self-oscillation will produce very high output levels – just as you may know from any other synthesizer filter. Fig. 6 will help to explain this feature in a bit more detailed way.

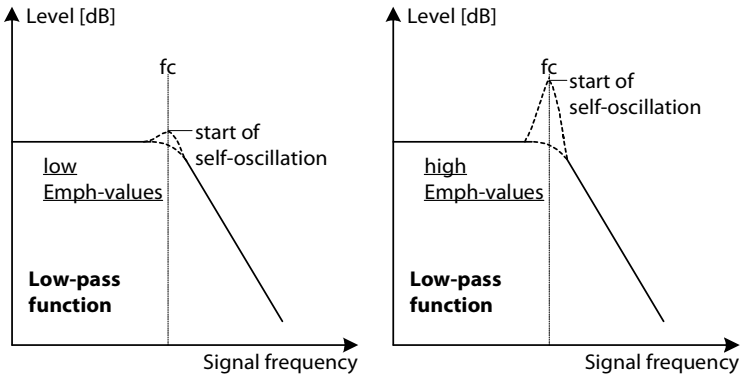

Fig. 6

Please note: Some other manufacturers use the term "emphasis" to describe the parameter that we call "resonance". On your CS8, emphasis has a completely different meaning. Please make sure not to mix up these terms.

The control voltage input labelled **0-5 V Emph** can be used to control the entire parameter range.

Drop: This function is also pretty unique. You will love it since it very effectively compensates a phenomenon that is not only common on most synthesizer filters, but also unwanted at that: With low-pass filters, the level of the signal passed through usually drops significantly when increasing resonance – resulting in a weak-sounding bottom end. On the CS8, you can work against this effect by using the Drop control. It adjusts the boost of the signal passed through between -12 dB and 0 dB (also see fig. 5 top).

The Drop-function is only available in low-pass modes!

Note 1: The more you turn up the Drop control, the more the filter input will be overloaded. Sometimes, these resulting saturation effects may be desired, sometimes not. A good compromise between effective level compensation and low saturation effects are Drop-settings between -3 dB and -6 dB. Experiment and go from there.

Note 2: The Drop compensation only works with low-pass settings.

Unfortunately, there is no way of getting round this fact, regardless of any design tricks. If you happen to come across one, please feel free to share yourself with us. Eternal praise will be yours.

on-LED: The activated Drop function is indicated by the lit yellow LED. At the same time, it shows an active low-pass setting.

Gain: The Gain control adjusts the output boost of the filter or, in other words, the level ratio between output and VCF-INPUT (sum of input 1 and input 2). The range is between -20 dB and 0 dB. Use the Gain control to reduce the output level in order to avoid undesired clipping (watch clip-LED).

The filter output signal can be tapped from the *output* socket.

2nd Harm-button**:** As you may have noticed already, your CS8 sports some pretty unique features – the 2nd Harm button is one of them. It generates a soft distortion in the filter output which emphases the 2nd harmonic (overtone), resulting in a subtle, "warm"-sounding coloration. When activated, the button lights up red.
The corresponding **control input 2nd H (29)** allows for a remote control of this function. Plugging in a cable will render the button inactive, but the LED will still show the status of the function. The input accepts a DC-voltage of -12 V - +12 V as well as audio signals of any frequency. The function is activated at a voltage of +3 V (or higher) and is disabled at +2 V (or lower) (hysteresis).

Slope: This function selects the different filter types (low, high, band-pass etc.). They can be selected by using the five buttons labelled LP24, BP18, LP12, BP6 and ALL. Their respective function is described in the following section.

ALL-button: This special filter function passes all frequencies to the filter output. It lights up blue when active. The corresponding **control input (ALL)** allows for remote control of this function. Plugging in a cable renders the button inactive, but the LED still shows the status of the function. The input accepts a DC-voltage of -12 V - +12 V as well as audio signals of any frequency. The function is activated at a voltage of +3 V (or higher) and is disabled at +2 V (or lower) (hysteresis).

BP6-button: This filter function activates a band-pass type. It attenuates frequencies above and below the centre frequency (or resonance frequency) at a slope of 6 dB/octave.

LP12-button: This filter function activates a low-pass type. It attenuates frequencies above the cut-off frequency (or resonance frequency) at a slope of 12 dB/octave.

BP18-button: This filter function activates a band-pass type. It attenuates frequencies above the centre frequency (or resonance frequency) at a slope of 18 dB/octave and below at 6 dB/octave.

LP24-button: This filter function activates a classic low-pass type. It attenuates frequencies above the cut-off frequency (or resonance frequency) at a slope of 24 dB/octave.

The four buttons labelled **LP24, BP18, LP12, BP6**, as well as the previously mentioned **ALL**-function, work like this: Their respective function (e.g. BP18) is added or subtracted to/from the filter output, depending on the setting which is indicated by its LED-colour. Hit each button repeatedly and it will change *off-green-red-off-green-red-…etc*. Green means that the selected filter function works with a positive algebraic sign (addition), red means a negative algebraic sign (subtraction) and – you guessed it – off means that the function is not active.
By combining these settings (more on this below), you can create up to 121 different filter types, which truly gives a new dimension to the term "multi-mode filter"!

The five corresponding control voltage inputs allow for remote control of these functions. As soon as a cable is plugged in, the corresponding button will no longer be active, but its LED will still be working, showing the current setting. These inputs work at positive DC-voltage from 0V to +12V. Negative voltages may cause unpredictable behaviour but will not cause any detrimental effects or electronic damage.

0 V to +1V	(ideal: 0 V)	→ setting: off
>+1 V to +3V	(ideal: 2 to 2.5 V)	→ setting: green (+)
>+3V	(ideal: 4 to 5 V)	→ setting: red (-)

The five filter functions LP24, BP18, LP12, BP6 and ALL are combined according to their algebraic sign and define the resulting behaviour of the filter.

Example: If button ALL lights "blue", BP18 "green", LP24 "red" and all others are off, the output signal will behave like this:

Output = ALL + BP18 – LP24 (resulting in a high-pass filter)

8.2. Filter types

In the following section you will find some basic rules that will help you create various sorts of filter types.

Band-pass filters:

A band-pass filter lets a band around the centre/resonance frequency pass. Frequencies above and below are attenuated (see fig. 4). The following combinations will result in a band-pass setting:

1. ALL always inactive

2. BP6 and ***BP18*** any – since they are band-pass filters in itself, all combinations of them will also result in more band-pass filters.

3. LP12 and ***LP24*** – both have to be activated but with opposite algebraic signs, either

a.) +LP12(green)–LP24(red) (band-pass in-phase)
or
b.) -LP12(red)+LP24(green) (band-pass out-of-phase by 180° for all frequencies)

Initially this results in 26 band-pass combinations in total [3 (BP6) x 3 (BP18) x 3 (LP12/24 combinations) – 1(all off)], each of them in-phase and phase-inverted. Since the characteristics stay the same, we have 13 different band-pass functions.

High-pass filters:

A high-pass lets the frequencies above the cut-off/resonance frequency pass. Frequencies below are attenuated (see fig. 4). The following combinations will result in a high-pass setting:

1. ALL always active

2. either

a.) –LP12(red) (LP24 disabled)
or
b.) –LP24(red) (LP12 disabled)

3. BP6 and ***BP18*** any

Subtraction of one low-pass (LP12 or LP24) produces a high-pass. This means 18 different high-pass combinations in total [3 (BP6) x 3 (BP18) x 2 (LP12/24 combinations)].

Low-pass filters:

A low-pass lets the frequencies below the cut-off/resonance frequency pass. Frequencies above are attenuated (see fig. 4). The following combinations will result in a low-pass setting:

1. ALL always inactive

2. BP6 and ***BP18*** any

3. At least ***one LP-function*** active

a.) LP12 and LP24 should not have different algebraic signs, therefore no settings like (+LP12(green)-LP24(red) or -LP12(red)+LP24(green)), since this would result in a band-pass (see above).

LP12 **and** LP24 with the same algebraic sign generate a signal boost of +6 dB (addition of two low-passes). Simple maths.

Initially, this results in 54 low-pass combinations in total [3 (BP6) x 3 (BP18) x 6 (LP12/24 combinations), each of them in-phase and phase-inverted. Since the characteristics stay the same, we have 27 different low-pass functions altogether.

All-pass/notch/phase shifter:

These filter types pass all frequencies but alter the phase of the signal. Some of them, e.g. notch types, generate phase cancellations at certain frequencies (see fig. 4).

1. ALL always active

2. BP6 and ***BP18*** any

3. More than one LP-function has to be "negative" (red LED, "–"). If not, the setting will generate a high-pass function.

a.) +LP12(green)–LP24(red) OR ***-LP12(red)+LP24(green)*** generate a signal boost with factor 1 (0 dB) from input to output.

b.) +LP12(green) OR ***+LP24(green)*** generate a signal boost of factor 2 (+6 dB) on signals below the cut-off/resonance frequency.

c.) +LP12(green)+LP24(green) generates a signal boost of factor 3 (+9.5 dB) on signals below the cut-off/resonance frequency.

d.) -LP12(red)-LP24(red) generates a phase shift of 180° (inversion) on signals below the cut-off/resonance frequency.

This results in 63 different combinations in total [3 (BP6) x 3 (BP18) x 7 (LP12/24 combinations)].

Summery of filter type rules:

ALL active (blue) → high-passes: just **one** LP(12 or 24) active **red (-)**
BP6/BP18 **any**

→ all-passes: any other

ALL inactive (off) → band-passes: BP6/BP18 **any**
LP12 and LP24 **both off**
or both at once active with subtended algebraic signs
(LP12/24 = **green/red** or = **red/green**)

→ low-passes: at least one **LP active**
(though not as the band-pass setting)
BP6/BP18 **any**

The following chart (c. 1) shows a selection of filter types and their button combinations, organised by type and slope. Except *ALL*, the button labelling matches the scheme on the front panel (left to right).

No.	Button Combination	Filter Type
	Low-passes	
T1	+LP12 +BP6	**6 db LP**, classic RC-element, powerful character
T2	-BP18 +LP12 +BP6	**6 db LP**, unobstrusive character
T3	+BP18 +LP12 +BP6	**6 db LP**, pronounced character
T4	+BP18 +LP12 -BP6	**6 db LP**, soft character
T5	+BP18 +LP12	**12 db LP**, classic double-RC-element, powerful character
T6	+LP12	**12 db LP**, unobstrusive character
T7	-BP18 +LP12	**12 db LP**, with **Notch** at Reso-Freq.
T8	+LP24 +BP18	**18 db LP**, classic triple-RC-element, powerful character
T9	+LP24	**24 db LP**, classic quad-RC-element, powerful character

Band-passes		
B1	-BP18 +BP6	**6/6 db BP**, classic double-RC-element, smooth character
B2	+BP18 +BP6	**6/6 db BP**, full bodied character
B3	-LP24 +LP12	**6/12 db BP**, classic triple-RC-element, very smooth character
B4	+BP18	**6/18 db BP**, classic quad-RC-element, very smooth character
B5	-LP24 -BP18 +LP12	**12/12 db**, classic quad-RC-element, very smooth character
High-passes		
H1	ALL -LP12	**6 db HP**, classic RC-element
H2	ALL -LP24	**6 db HP**, full bodied character
H3	ALL +BP18 -LP12 -BP6	**12 db HP**, classic double-RC-element (very steep)
H4	ALL -LP24 -BP6	**12 db HP**, soft, silky character
H5	ALL -BP18 -LP12	**12 db HP**, soft, full bodied character
Notches		
A1	ALL +BP18	**Soft 6 db Notch**
A2	ALL	some **more Notch**
A3	ALL -BP18	**25 db Notch**, pronounced notches and silky character
A4	ALL +BP18 -BP6	**21 db Notch**, very notch-y, very silky character
A5	ALL -LP24 +LP12 -BP6	**fat Notch**
A6	ALL -LP24 +BP18 +LP12 -BP6	**Super Notch**, best approach to a 4-pole Notch

Phase shifter (Phaser, mixed with unprocessed signal)		
A7	ALL -BP6	**10 db Notch** with phaser characteristics
A8	ALL -BP18 -BP6	**Notch**, **stronger** phaser
A9	ALL +LP24 -BP18 -LP12 -BP6	**2-stage phaser**, best approach
All-Low-passes with Notch feel		
A10	ALL +LP12	**softly opened up lowpass**
A11	ALL -BP18 +LP12	**opened up lowpass**
A12	ALL +LP12 -BP6	**opened up lowpass**, more notch-y character
A13	ALL +LP24	**opened up lowpass**, even more notch-y
A14	ALL +LP24 -BP18	**opened up lowpass**, quite notch-y
A15	ALL +LP24 +LP12	**strongly opened up lowpass**, quite notch-y
All-Low-passes with Phaser/Notch feel		
A16	ALL -BP18 +LP12 -BP6	**opened up lowpass** with phaser feel
A17	ALL +LP24 -BP18 -BP6	**opened up lowpass** with strong phaser feel
A18	ALL +LP24 -BP18 +LP12 -BP6	**strongly opened up lowpass**, (Phaser)
Phase-inverter		
A19	ALL -LP24 -LP12 -BP6	**Phase-inverter**, inverts all frequencies below the centre/reso-frequency
A20	ALL -LP24 -BP18 -LP12 -BP6	**Phase-inverter**, inverts all frequencies below the centre/reso-frequency, with soft Notch feel
All-pass		
A21	ALL +BP6	**All-pass**, passes all frequencies unprocessed

C.1

9. TECHNICAL DATA AND SIGNAL VALUES

9.1 Technical Data (in general)

Input- and output-sockets:	mono jack sockets 3.5 mm (1/8")
Input sockets have grounded switch (0 V)	
Power:	-12 V / +12 V (polarity protection)
Power consumption:	max. 150 mA (for both supplies ±12 V)
Proper ambient temperature:	0 °C – +55 °C / 32F – 131F
Net weight (module only):	approx. 400 g / 0,88 lbs
Dimensions (W x H x D):	24 PU (121.92 mm) x 3 HU (129 mm) x 47 mm
Installation depth (behind the panel)	<30 mm

9.2 Signals and ratings

Max. input voltage at sockets (26-38): ±12 V

!! Negative voltages at sockets (31-34) may result in unwanted effects but will not cause any damages to the circuits !!

Max. input voltage at sockets (39, 40): ±12 VAC

Output noise at single taps (worst case, filter fully open, no resonance):

L24: <90 µVrms ≅ -81 dbV
LP12: <70 µVrms ≅ -83 dbV
BP18: <60 µVrms ≅ -84 dbV
BP6: <70 µVrms ≅ -83 dbV
ALL: <150 µVrms ≅ -76 dbV