CHIPPMANN
electronic musical instruments

CS-8 Series

Owners' manual DLFO

User manual by Carsten Schippmann
Graphic design CS-8 Series: Carsten Schippmann
Concept and development: Carsten Schippmann

English translation by Carsten Schippmann

Contact:

Schippmann electronic musical instruments
Dipl.-Ing. Carsten Schippmann
Wartburgstr. 8
D-10823 Berlin

Web: www.schippmann-music.com
Email: info@schippmann-music.com

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 present **DLFO** of the CS-8 series is a very flexible and precise fully analogue **dual quadrature Low Frequency Oscillator**. Each LFO provides the waveforms **sine**, **cosine**, **triangle**, **co-triangle** and **rectangle**. The parameter "**Slope**" allows continuously to adjust the time ratio of the rising and falling edge of the triangle output. I.e., this parameter will shift the triangle from a falling sawtooth to a rising sawtooth, fully voltage controllable. The rectangle changes its duty cycle and the cosine and co-triangle keeps a little surprise.

At any time the LFO output can be set to any voltage value within the output amplitude range, including its further direction (up or down). This can be used as a **synchronisation function**, either in a mode where the oscillator always continues or where the oscillator will be set and stops. Moreover there exists a **reverse sync** function where a trigger will reverse the current direction.

Furthermore each LFO provides a luxurious **shot function**, where a number of shots from 1 to 16 are adjustable. The first oscillation begins with a pre-selected starting value and direction (parameter "state") and the last one will ends at the same value unless the state value has been changed during the shot execution. The number of shots is also voltage controllable. A 7-segement display visualizes the shot number and the current state of an executed shot.

Design and implementation meet highest technical standards. The front panel is made from powdered and printed piece of aluminium sheet metal of 2 mm gauge. The entire design and production work was done in Germany.

Made 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. However, as a gesture of goodwill we give a lifetime warranty on our products. Nevertheless, this will be always a decision in an individual case. 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, switches and jacks 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 JACKS AND KNOBS / SWITCHES.***
- ***PROTECT YOUR SPEAKERS AND EARS (!) AGAINST EXCESSIVE AUDIO***

LEVELS.

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 Series DLFO 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 DLFO uses discrete all-analogue electronics. Thus certain parameters may be temperature-sensitive. We

recommend placing the DLFO 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 jacks.

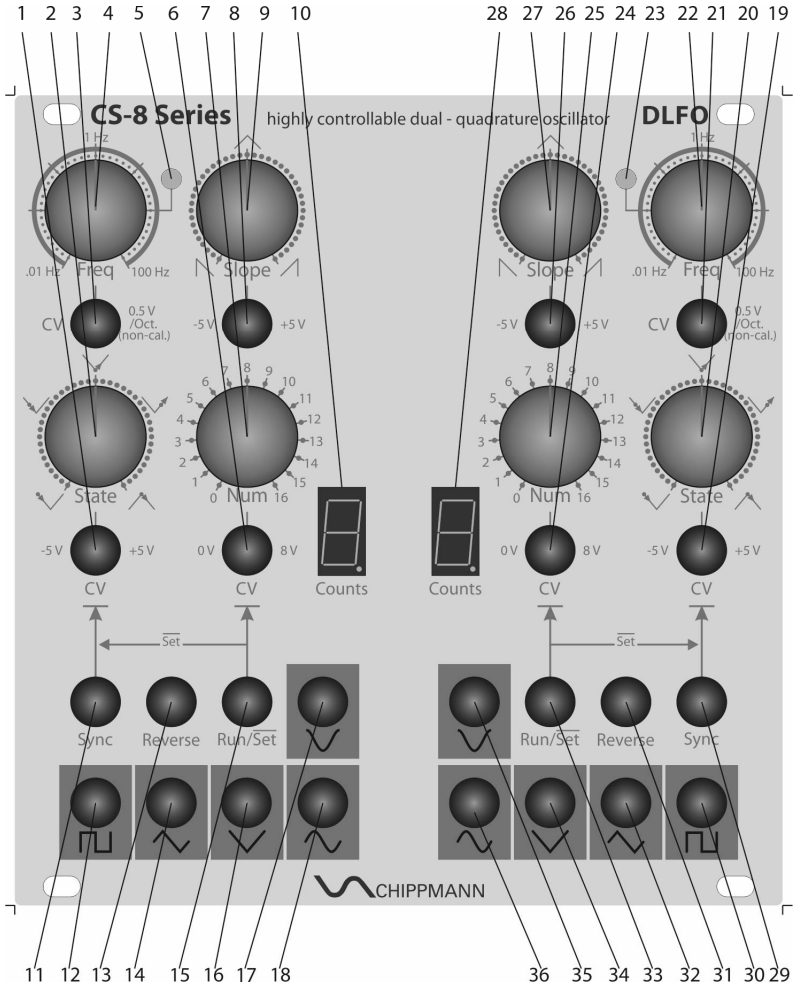
1 2 3 4 5 6 7 8 9 10
28 27 26 25 24 23 22 21 20 19
CS-8 Series
highly controllable dual - quadrature oscillator
DLFO
1 Hz
.01 Hz
Freq
100 Hz
Slope
CV
0.5 V /Oct. (non-cal.)
-5 V
+5 V
State
Num
0
16
0 V
8 V
Counts
Set
Sync
Reverse
Run/Set
CHIPPMANN
11 12 13 14 15 16 17 18
36 35 34 33 32 31 30 29

Fig. 1

1. **State-CV** jack (input) – determines by a control voltage (-5 V - +5 V) the Set value and the triangles' direction (up or down) of the LFO output
2. **State** controller – adjusts the Set value and the triangles' direction of the LFO output
3. **Freq-CV** jack (input) – controls the LFO's frequency with a scale of about 0,5 Volt/Octave; this input is not calibrated
4. **Freq** controller – set the oscillators' frequency (0.01 Hz - 100 Hz)
5. **LED** indicator – glows "red" from bright to off accordingly to the triangle
6. **Num-CV** jack (input) – set by a control voltage (0 V - 8 V) the number of shots (0 - 16); every 0.5 V increment per further shot
7. **Num** controller – adjusts the shot number (0 - 16)
8. **Slope-CV** jack (input) – determines by a control voltage (-5 V - +5 V) the rising-to-falling time ratio of the triangle
9. **Slope** controller – set the rising-to-falling time ratio of the triangle
10. **7-Segment Display** indicator – visualizes the set shot number and the current state of an executed shot (down counter)
11. **Sync** jack (input) – a +5 V trigger set the LFO immediately to the State value *(1)*, *(2)*
12. **Rectangle** jack (output)– provides the rectangle wave output (±5 V)
13. **Reverse** jack (input) – a +5 V trigger reverses the current output direction of the triangle wave
14. **Triangle** jack (output) – provides the triangle wave output (±4 V)
15. **Run/Set** jack (input) – **Set:** set by a 0 V signal the triangle output abiding to the State value *(1)*, *(2)*; **Run:** a +5 V signal unblocks the oscillator or starts a shot, resp.; this jack is tied by a switching contact to +5 V
16. **Co-triangle** jack (output) - provides the co-triangle wave output (±4 V)
17. **Cosine** jack (output) - provides the cosine wave output (±4 V)
18. **Sine** Buchse (Ausgang) - provides the sine wave output (±4 V)
19. **State-CV** jack (input) – determines by a control voltage (-5 V - +5 V) the Set value and the triangles' direction (up or down) of the LFO output
20. **State** controller – adjusts the Set value and the triangles' direction of the LFO output
21. **Freq-CV** jack (input) – controls the LFO's frequency with a scale of about 0,5 Volt/Octave; this input is not calibrated
22. **Freq** controller – set the oscillators' frequency (0.01 Hz - 100 Hz)
23. **LED** indicator – glows "red" from bright to off accordingly to the triangle
24. **Num-CV** jack (input) – set by a control voltage (0 V - 8 V) the number of shots (0 - 16); every 0.5 V increment per further shot

25. **Num** controller – adjusts the shot number (0 - 16)
26. **Slope-CV** jack (input) – determines by a control voltage (-5 V - +5 V) the rising-to-falling time ratio of the triangle
27. **Slope** controller – set the rising-to-falling time ratio of the triangle
28. **7-Segment Display** indicator – visualizes the set shot number and the current state of an executed shot (down counter)
29. **Sync** jack (input) – a +5 V trigger set the LFO immediately to the State value *(19)*, *(20)*
30. **Rectangle** jack (output)– provides the rectangle wave output (±5 V)
31. **Reverse** jack (input) – a +5 V trigger reverses the current output direction of the triangle wave
32. **Triangle** jack (output) – provides the triangle wave output (±4 V)
33. **Run/Set** jack (input) – **Set:** set by a 0 V signal the triangle output abiding to the State value *(19)*, *(20)*; **Run:** a +5 V signal unblocks the oscillator or starts a shot, resp.; this jack is tied by a switching contact to +5 V
34. **Co-triangle** jack (output) - provides the co-triangle wave output (±4 V)
35. **Cosine** jack (output) - provides the cosine wave output (±4 V)
36. **Sine** Buchse (Ausgang) - provides the sine wave output (±4 V)

7.2 Back

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

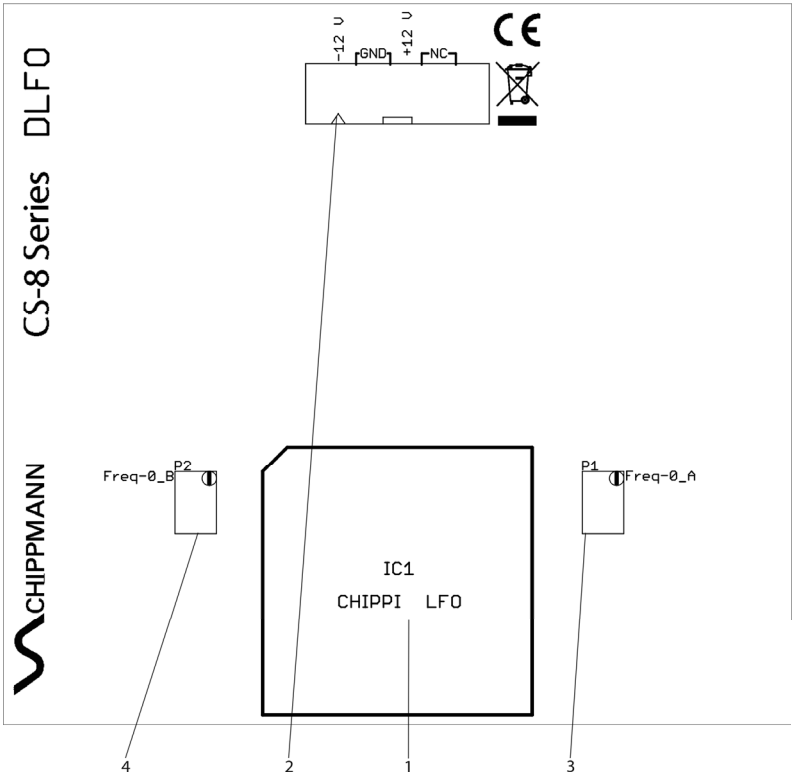

Fig. 2 Back

1. **IC1** – pinned LFO Modul
2. **16 Pin power supply box-header**
3. **P1** 12- gauge-trimmer – initial frequency LFO A (left side)
4. **P2** 12- gauge-trimmer – initial frequency LFO B (right side)

7.3 Initial operation

The power connector's **(2)** 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 jacks
Pin 9, 10 = +12 V
Pin 11-16= not in use

To hook up power to the module, connect one of the IDC-jacks 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**.

8. MODULE DESCRIPTION

8.1 Structure

The DLFO is a very controllable oscillator in duplicate design. The Fig. 3 shows the structure of one of these two LFO's. In the following piece by piece every parts will be described and as the case may be exemplified with graphics. Because of the identity of the two LFO's the following descriptions are referring to the elements 1-18 of the front panel (LFO A).

Hint: The overall 6 digital input jacks (2x Sync., 2x Reverse, 2x Run/Set) are so-called Schmitt-Trigger inputs, meaning they can be fed with any analog (also negative) voltages (max. ±12 V). The trigger point is about +3 V.

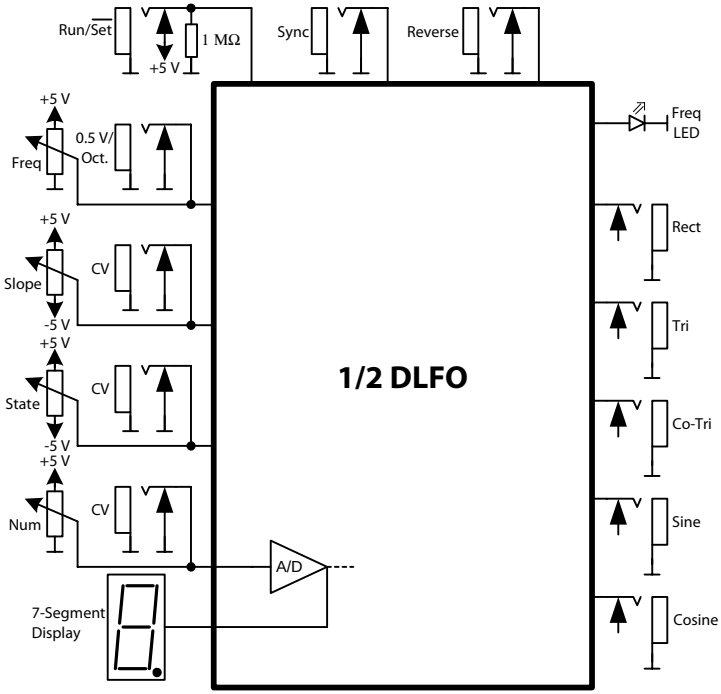

Fig. 3 Structure of the DLFO (one of two)

8.2 The LFO and its waveforms

The waveforms were provided by the jacks ***(12)-rectangle, (14)-triangle, (16)-Co-triangle, (17)-Cosine, (18)-Sine***. **Fig. 4** shows all waveforms in their correct phase relationship.

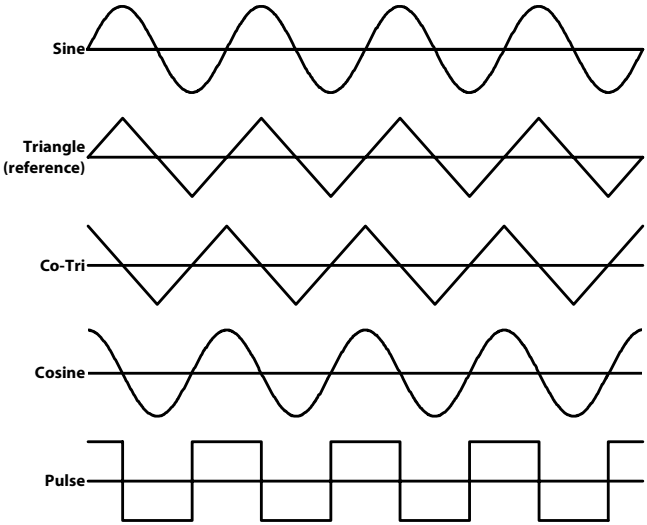

Fig. 4 The LFO waveforms

The red ***LED (5)*** follows the triangle output. The rectangle has an output amplitude of ±5 V, where all other waveforms have an output of ±4 V.

By the **controller (4)** the LFO frequency is adjustable between 0.01 Hz and 100 Hz. By the ***CV-jack (3)*** the frequency can be controlled with a scale of about 0.5 V/Octave - this input is not calibrated.

Hint: This is a **L**ow **F**requency **O**scillator specialized on very low frequencies. A good volt/octave tracking can be achieved for frequencies up to 1 kHz. Afterwards the sensitivity flattened more and more, i.e., higher voltage increments are necessary for the same interval. It could be showed that this behavior provides a lot better feeling to adjust modulations and bringing surprisingly different results.

8.3 The Slope function

The ***controller (9)*** or the ***CV-jack (8)***, resp. adjusts the time ratio of the rising to falling edge of the triangle wave while the frequency is kept constant - ideal

case. Because of different component tolerances, the frequency can shift slightly by some few percents. **Fig. 5a and 5b** shows how the waveforms changes with the Slope parameter. If the ***controller (9)*** is in mid position a voltage range of ±5 V at ***CV-jack (8)*** is needed for the full parameter control (-5 V falling - +5 V rising sawtooth). The Co-triangle and the Cosine waveforms will change their form probably surprisingly. This is, because these waves were first split into certain pieces and then reconstructed to achieve the wished phase shift of 90 degrees. The shortest rising/falling time of the triangle wave is less than 25 µs. With this the maximum frequency can be calculated to slightly more than 20 kHz, where the shape could be only a triangle wave, of course.

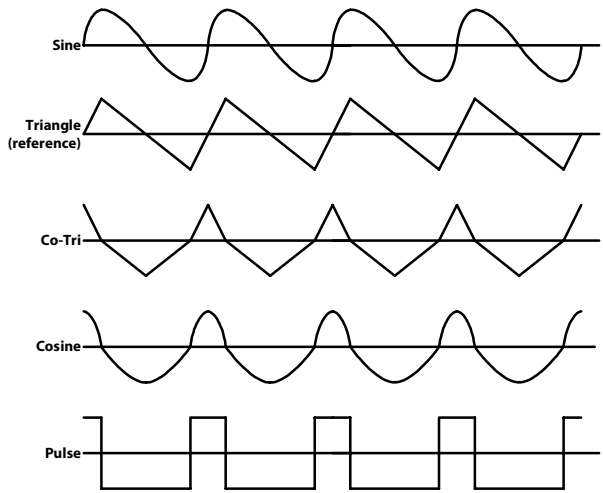

Fig 5a. The slope effect (controller 9 (27) on left side)

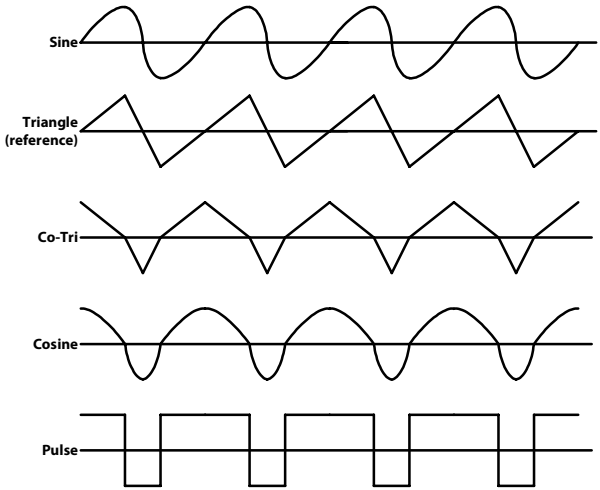

Fig 5b. The slope effect (controller 9 (27) on right side)

The algebraic sign of the rectangle is positive (+5 V) during the rising phase of the triangle or respectively at positive values of the Co-triangle and negative (-5 V) during the falling phase of the triangle or respectively at negative values of the Co-triangle.

8.4 The state parameter

The **state** value becomes relevant for the synchronization and for setting the LFO to a certain voltage value. The ***CV-jack (1)*** and the ***controller (2)*** determines the **state** value. Thereto the imagery at the dial of ***controller (2)*** is to understand as follows. The little dot on the triangle edge marks the voltage value (**state**) to which the triangle output will be set in case of a sync input trigger at ***jack (11)*** or with a set signal (0 V) at ***jack (15)***. The arrow implies the direction (rising/falling) of the triangle after the sync/set event. If the ***controller (2)*** is in mid position, a voltage range of **±5 V** at ***jack (1)*** is equal to the full range of controller **(2)**. The values of controller (2) and jack (1) sum up. On the left side of the dial ***(2)***, from full CCW to mid position, the full range of the triangle output voltage (from +4 V to -4 V) will be passed through, whereas the triangle direction is always downwards to more negative voltage values.

Further from the mid position ***(2)*** to full CW the state value arises again to more positive voltages (from -4 V to +4 V), whereas the direction is now upwards.

Hint: In a strong asymmetrically setting of the slope value (controller 9), close to full CCW or CW there will be a sound difference with synchronization when the LFO operates at audio frequencies.

8.5 Synchronization, Run/Set

A positive transition beyond a trigger level of about +3 V at the sync ***jack (11)*** leads to a synchronizing jump to the current **state value**, whereas the LFO continues oscillating. The **Run/Set *jack (15)*** is internally tied via a switching contact to +5 V, that the LFO can free oscillate in normal mode. A plugged cable even open ended or with applied 0 V causes a permanent set of the triangle to the state value until the applied voltage becomes +5 V (or unplug the cable) to release the oscillator. **Fig. 6a, 6b** visualize the effect of Sync and Run/Set in **free running** mode.

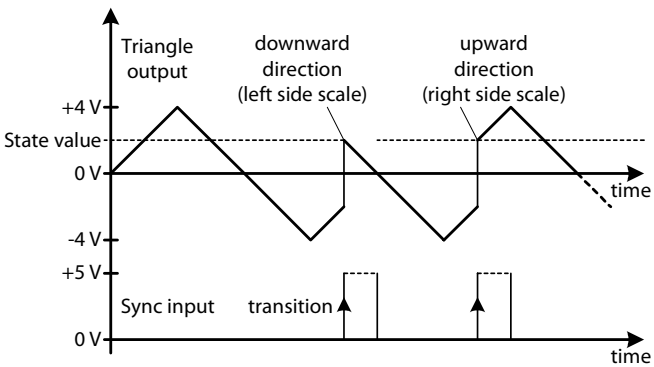

Fig. 6a State - Sync

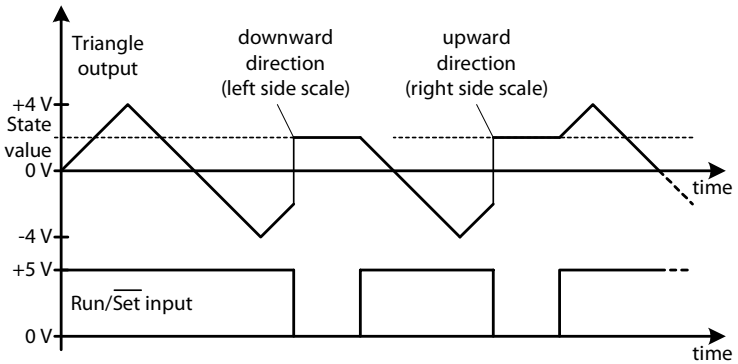

Fig. 6b State - Run/Set

Note: The overline above the word "Set" of "Run/Set" indicates a low active logic level (0 V).

8.6 The Shot function

The display ***(10)*** is normally off. The **shot** function becomes active as soon as the **Num *controller (7)*** is moved away from full CCW position ("0"). The oscillator stops immediately an goes to the pre-selected **state value**. By passing through the numbers 1 - 16 of the dial the display displays that numbers, whereas the decimal point lights up beginning with the number "10" and the display continues with 0 - 6, thus from 10 - 16. The selected number corresponds to the number of oscillations (**Counts**) after starting the shot (Run) via a 0 V -> +5 V **transition** at the **Run/Set *jack (15)***. Once started the shot, even when the transition returns to 0 V, the shot will be completed. However, another 0 V -> +5 V transition during a shot execution will restart the shot again, i.e. a reset to the selected count number and state value and continuing the oscillation without any break. During a shot the display ***(10)*** counts backwards to zero and displays after the completed last oscillation the selected number.

This number (Counts) can be changed during the shot execution without any effect on **this** shot. But after the completed shot the new number will be displayed and becomes active for the next shot. If the **Num *controller (7)*** is at

full CCW ("0") a control voltage at ***CV-jack (6)*** between +0.5 V and +8 V corresponds to the count values 1 - 16, thus 0.5 V/count. During a shot all other functions, e.g. the sync ***jack (11)*** or the reverse input ***jack (13)*** are working.

The starting voltage value (still look at triangle output) is always the pre-selected **state** value. Unchanged this value during a shot, the oscillator returns with the last oscillation to this value, coming from that direction from where it has started. This state value could also be changed during a shot without any effect on the current shot until to the last oscillation of this shot. Then the last oscillation will return to the new state value, where it also could come from the opposite direction from where it has started.

Hint: But what could happen by changing the state value during a shot is that the real number of counts could increment or decrement by one oscillation. It's arduous to explain in which case what will happen - so check it out! The **Fig. 7a, 7b, 7c** are showing three different cases of shots.

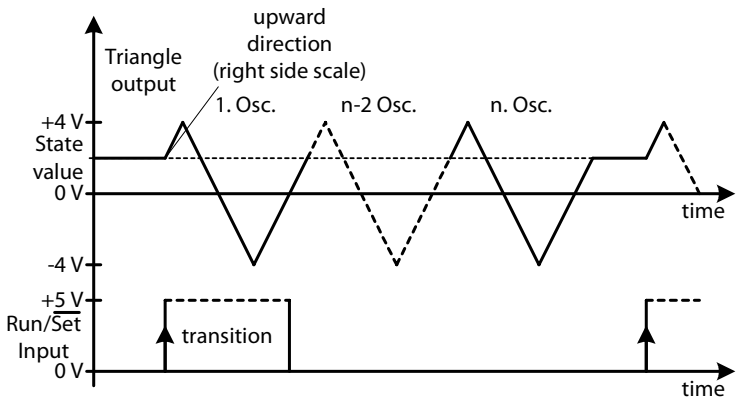

Fig. 7a The Shot function

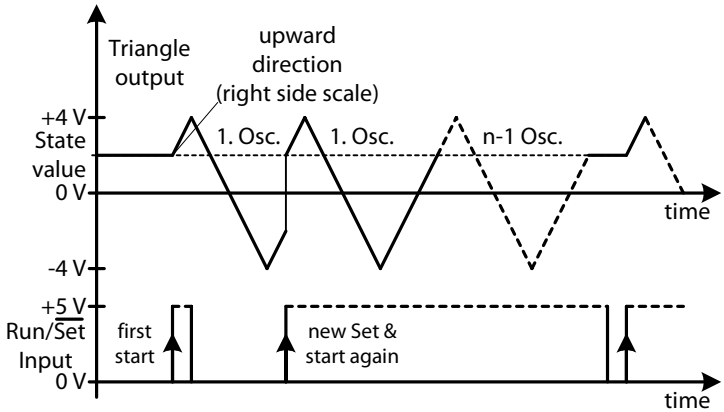

Fig. 7b The Shot function with reset and start again

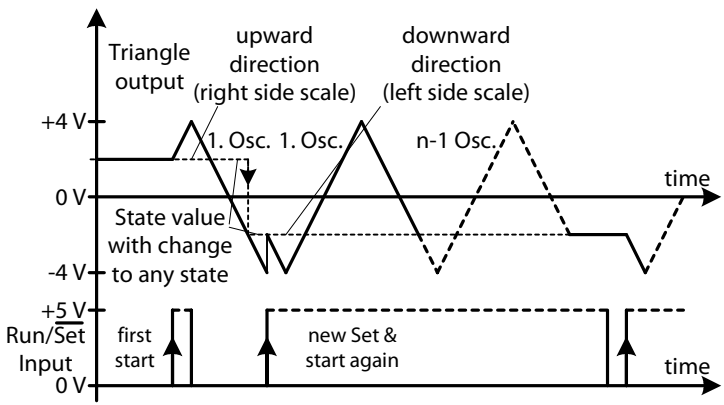

Fig. 7c The Shot function with reset, start again & change of the state value during the shot

8.7 The Reverse function

Finally, we have the reverse function. It's a kind of soft sync where by a 0 V -> +5 V **transition** at ***jack (13)*** the triangle direction will be reversed as shown in **Fig. 8**.

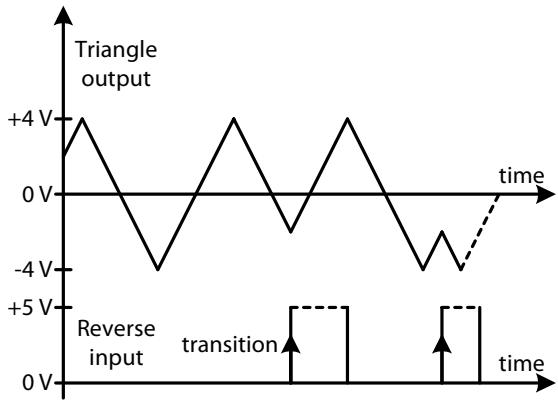

Fig. 8 Reverse function

8.8 Little maths

By corresponding weighting and following addition or subtraction, resp. of the sine and cosine outputs of one oscillator, any phase angle between 0° and 360° can be achieved, namely like this:

$$\sin(\omega t \pm \varphi) = cos\varphi \cdot \sin(\omega t) \pm sin\varphi \cdot \cos(\omega t)$$

Thereby ω (Omega) is the circular frequency of the LFO and t is the time. sin(ωt) stands for the sine output and cos(ωt) for the cosine output. Let φ (Phi) be the wished phase shift relative to the sine output. cosφ and sinφ are now the weightings (multipliers) of the corresponding outputs sine and cosine.

Example: One want to get a sinusoidal function shifted by 120° relative to the sine output, thus let φ = 120°. Then the equation above becomes:

$$\sin(\omega t + 120°) = cos120° \cdot \sin(\omega t) + sin120° \cdot \cos(\omega t)$$

$$= \sin(\omega t + 120°) = -0{,}5 \cdot \sin(\omega t) + 0{,}866 \cdot \cos(\omega t)$$

Inverting the sine output and halve its amplitude (-0.5) and adding the cosine output with an attenuation of a factor 0.866 leads to a sine function of 120° phase shift relative to the sine output.

To get a certain phase shift relative to the cosine output the equation looks like this:

$$\cos(\omega t \pm \varphi) = cos\varphi \cdot \cos(\omega t) \mp sin\varphi \cdot \sin(\omega t)$$

According to the example above with φ = 120° one get:

$$\cos(\omega t + 120°) = -0{,}5 \cdot \cos(\omega t) - 0{,}866 \cdot \sin(\omega t)$$

Attention: This ONLY works with sinusoidal functions not with triangular ones ;)

9. TECHNICAL DATA AND SIGNAL VALUES

9.1 Technical Data (in general)

Input- and output-jacks:	mono jack jacks 3.5 mm (1/8")
Input jacks have grounded switch (0 V)	
Power:	-12 V / +12 V (polarity protection)
Power consumption:	typ. +100 mA/ -70 mA
Proper ambient temperature:	0 °C – +55 °C / 32F – 131F
Net weight (module only):	approx. 220 g / 0,48 lbs
Dimensions (W x H x D):	24 PU (121.92 mm) x 3 HU (128.5 mm) x 47 mm
Installation depth (behind the panel)	<30 mm

9.2 Signals and ratings

Maximum input voltage at every input jacks:	±12 V
Frequency range:	<1 mHz - >20 kHz
shortest rising/falling edge time (triangle):	<25 µs