MODE MACHINES©

SYNTHLAB SL-1

POCKET-SIZE SYNTHESIZER LABORATORY

MANUAL

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Contents

General safety information

Please adhere closely to the following instructions when using the appliance, only then can a trouble free operation be guaranteed. Please read these instructions carefully before switching on, taking note of the instructions being given. The information applies to usage of all electronic equipment.

Where to operate:

- The appliance must not be used outside, but only indoors - preferably in a dry closed environment. Avoid dirty and dusty conditions at all costs.
- Do not allow liquids or other electrically conductive materials to enter the appliance. In the unlikely event of this happening, the appliance must be immediately separated from the mains electricity supply and taken to a qualified electrician to be inspected, cleaned and repaired.
- Do not use the appliance at temperatures above 50 degrees C or under –10 degrees C. Before using the appliance make sure its temperature is not under 10 degrees C. Avoid direct sunlight or other heat sources nearby when using. Avoid overheating by not using the appliance in confined spaces, as a free circulation of air is necessary for cooling.
- Avoid strong vibrations when using.

Connection:

- Do not use the appliance near to possible sources of interference (e.g. monitor, mains adaptor, computer, mobile phones etc.) as they could cause interference with the SYNTHLAB.
- The appliance must only be used with the voltage indicated on the rear panel.
- Please use exclusively the mains adaptor supplied with the unit.
- Never make alterations or tamper with the mains adaptor or cable.
- Unplug the mains adaptor when the unit is not in use.

Operation:

- Make sure that the appliance (in transport or operation) stands on a firm base and is not in danger of falling, possibly causing injury to persons and/or damage to the unit.
- Do not put any heavy object on top of the appliance and do not subject it to vibration.
- Inside the appliance can be found dangerously high voltages – please make sure no objects fall inside – should some object nevertheless fall into the unit, switch off immediately and disconnect from the mains supply.
- This appliance can cause permanent damage to hearing and to loudspeakers if the volume is turned too high. Use only at a tolerable volume setting.

Care, maintenance and repair:

- Always disconnect from the main power supply before opening.
- All repairs, modifications or alterations should only be carried out by qualified specialists, thereby ensuring conformity with actual protection guidelines. Any interference of the unit by third parties will result in the loss of warranty cover.
- If the fuse has to be changed, only use a new fuse with **500mA quick fusing**. The fuse can be found inside the unit, fastened to the printed circuit board. Do not forget to unplug the unit before changing fuse.
- Please keep the technical information supplied with the unit in a safe place. They will be required if the unit is to be sent back for updates, repairs or inspection.
- This appliance must only be used in accordance with the documentation supplied. The unit must not, for safety reasons, be used for any other purpose.
- When using the unit in the Federal Republic of Germany, the valid VDE regulations must be adhered to.

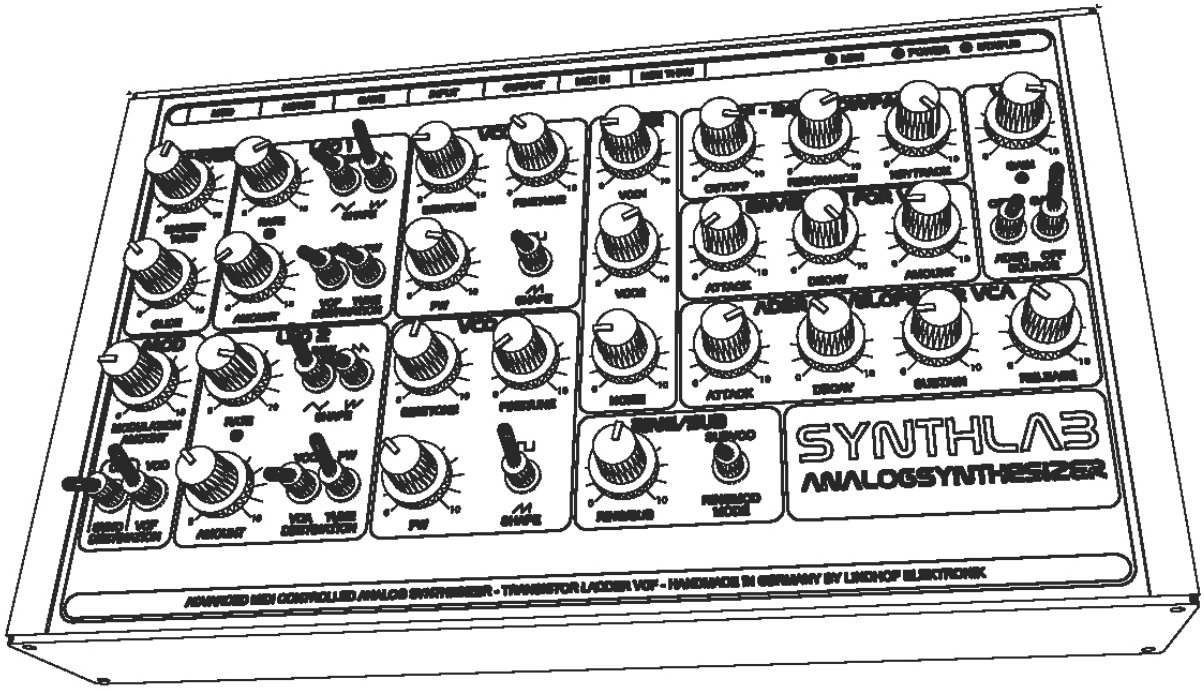
Rules of usage:

- This appliance is exclusively to be used for the production of low frequency audio signals in for the purpose of sound manipulation. Any other form of usage is prohibited.

Introduction

Dear SYNTHLAB owner,

You have purchased a monophonic MIDI music synthesiser with a completely analogue sound producing system, that does **NOT** rely on the many innovations in synthesiser technology, but in **the implementation of good old tried and trusted analogue synthesiser technology and this without compromise, w**ith all its possibilities but also its technological limits. But it is exactly this which makes the SYNTHLAB a "power Plant" which can be easily recognised in any mix. The 28 knobs and 15 switches make possible a comprehensive manipulation of sound from only "pocket-size" dimensions, making it a must for studio and live performances.



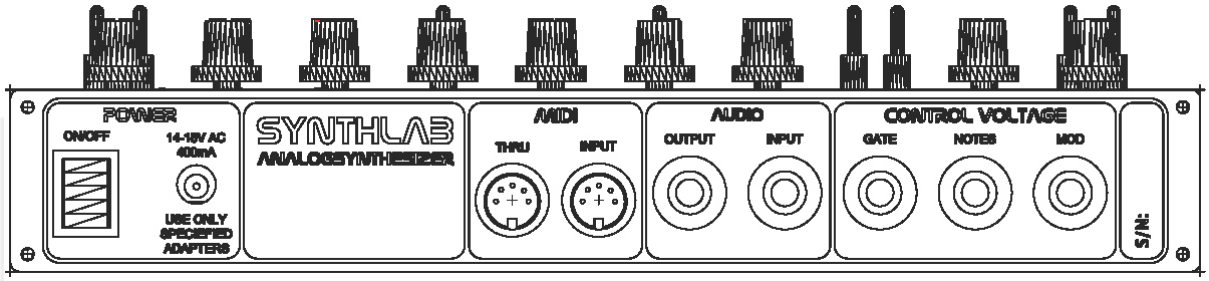
The SYNTHLAB produces sounds 100% analogically as found in traditional analogue synthesisers. The sound production is based upon classical switching systems that originated in the voltage controlled modular systems of the 70´s. The low pass filter is put together in the classic "Moog Cascade" tradition which lends the unit similar sound characteristics to Moog synthesisers.

The SYNTHLAB can easily be integrated into a midi-studio, as it contains an integrated MIDI interface, which is not always the case with traditional synthesisers without MIDI that require therefore at least a MIDI-CV-Converter, (which of course involves extra costs).

Due to the fact that pure analogue synthesisers are these days only to be found on the second hand market, prices in no way reflect the actual intrinsic value of the instrument. In such a case we are dealing purely with the value as a collectors item.

With SYNTHLAB we provide an instrument whereby the cost reflects purely the technical value and not its worth as a collectors item.

Added to this, SYNTHLAB provides 3 sockets for the incoming MIDI-in control signals which are converted to CV control signals, enabling a further analogue synthesiser without MIDI interface to be connected. Alternatively, the SYNTHLAB can be externally controlled through the CV and GATE sockets. For this mode of operation, three jumpers on the control board must be re-plugged, so that the internal MIDI-interface is disconnected from the sound production. (See appendix "Jumper & Trimmer")



Provided that you have already worked with analogue synthesisers previously, then the operation of SYNTHLAB is relatively easy to learn, as it does not differ to any great extent from other analogue synths. All controls are clearly marked and grouped according to the operation modes of the synthesiser.

If however, you are not familiar with the operation of analogue synthesisers, please read the chapter "Short introduction to Sound Synthesis" which will help you to achieve meaningful results.

SYNTHLAB is equipped with the following operational groups according to the modules of a modular synthesiser:

2x VCO (2 types of wave – saw blade and pulse wave)
1x VCF (low pass filter 24DB – Moog cascade)
1x VCA
1x Noise
1x Ring modulator (KORG MS20 style)
1x Sub-oscillator (2 Octaves)
2x LFO (Diverse wave forms and destinations)
2x ENV (ADSR for VCA and AD for VCF)
1x MIDI-CV-Interface with 2x CV and GATE

Every sound parameter is equipped with its own knob or switch and immediately accessible and adjustable in real-time. The module control elements are grouped together on the front panel and are visually clearly separated from each other.

The VCO´s and/or the external audio inputs, serve as the "Raw Material" of sound. The selected signal passes through, in turn, the VCF and VCA before arriving at the audio output. Both VCF and VCA are equipped with an envelope-curve generator. Additionally, LFO´s provide multiple modulation possibilities.

As can be seen from the aforementioned performance features, you are the owner of an excellent musical instrument. The SYNTHLAB can also be used in teaching, training and further education, to demonstrate physical sound interaction.

The following chapters will be of help, to enable you to quickly discover and utilise the almost endless capabilities of your SYNTHLAB.

Have fun!

Best wishes from the SYNTHLAB development team!

Short introduction to sound synthesis

Even if you are not really into definition, physics and "dry" theory, this chapter should nevertheless be studied carefully, then it contains the complete background knowledge necessary to fully understand the operating instructions. However, if you are completely familiar with the operation of analogue synthesisers, then this chapter can be left out.

Physical basics of sound synthesis:

The **tone** is the audible frequency of an harmonic resonance i.e. it is a single frequency.

A **sound** consists of the sum of at least two audible separate harmonic resonances. This means that the spectrum of sound consists of a collection of frequencies as a whole. The frequency with the largest amplitude determines the pitch of sound. The portion of the remaining frequencies are called main waves – they determine the timbre (characteristic quality of sound).

The **volume** of a sound or tone is primarily determined by the amplitude of the resonance.

The **sound characteristics** are made up basically of three main parameters: the time lapse of the amplitude (determines the volume of the sound.) The frequency of the basic tone (i.e. the pitch) and the nature of the spectrum (i.e. timbre or characteristic quality of the sound.) Our hearing recognises the timbre according to number, diversity and amplitude conditions contained in the foremost tones within the sound. The time lapse of one or more amplitudes can thereby alter. This effect can easily be heard when piano keys are depressed and released, the sound becomes not just quieter, but over time the level of the main tones is reduced, leading to a hollow ceasing of the sound altogether. The progress of amplitude is said to be the envelope curve.

The history of sound synthesis

Ever since mankind has made music, he was always searching for sounds which could be adapted to make music. Music has been made for thousands of years using mechanical instruments. With the discovery of electricity, a new method of producing sounds was born, leading to the development of new musical instruments. Already by the middle of the 1960´s, the synthesiser had been developed (by such people as Moog & Buchla) containing most of the features found in the instruments of the present day. Up until the development of the Minimoog (by the Moog company), all synthesisers were based upon the modular system. Even up to the present day, big companies use the modular system as the development platform for their instruments.

Basic modules of sound synthesis

The **three basic modules of sound synthesis** are considered to be the oscillator, the filter and the amplifier.

The analogue **oscillator (VCO)** is based on the principle of resonating circles. The oscillator produces, in the case of classic analogue synthesisers, the main-tone rich, basic wave patterns of square, saw tooth and triangle, that distinguished according to the type and number of main tones.

The **filter (VCF)** works on the principle of the RC-Framework. By switching the RC-Frame it is possible to configure the filter in the following forms: Low pass, High pass, Band pass or Band barrier. The filter affects the frequency spectrum of the tone produced by the oscillator. The filter is mainly used in "Low Pass" mode.

The voltage controlled **amplifier (VCA)** in the modular analogue synthesis affects the amplitude of the tone produced by the oscillator. In practice the amplification factor of the amplifier is between 0 and 1.

For the control of the filter (VCF) and amplifier (VCA) an **envelope curve generator** is usually employed.

LFO´s are usually employed for the continual functional control modulation.

Principal of the subtractive sound synthesis

The subtractive sound synthesis is based on the principal, that the foremost waves of the output signal are subtracted, producing a sound with a new spectrum, i.e. a completely new sound. The output signal mainly used is the saw tooth, as it possesses even and uneven main tones. The subtraction is attained using a filter. The complexities of subtractive sound synthesis was recognised by Bob Moog who built an instrument – the so called synthesiser.

The control of the instrument

Control of analogue synthesis is attained using a control voltage, which is divided into **GATE** and **CV**. Analogue keyboards use 5 volt on the GATE output when a key is depressed and is maintained as long as the key remains depressed (until the key is released.)

The CV voltage is independent of the pitch of the depressed key, mainly 1 volt per octave. One essential part of this invention is the fact that all parameters of a synthesiser can be controlled by the voltage.

The source of modulation

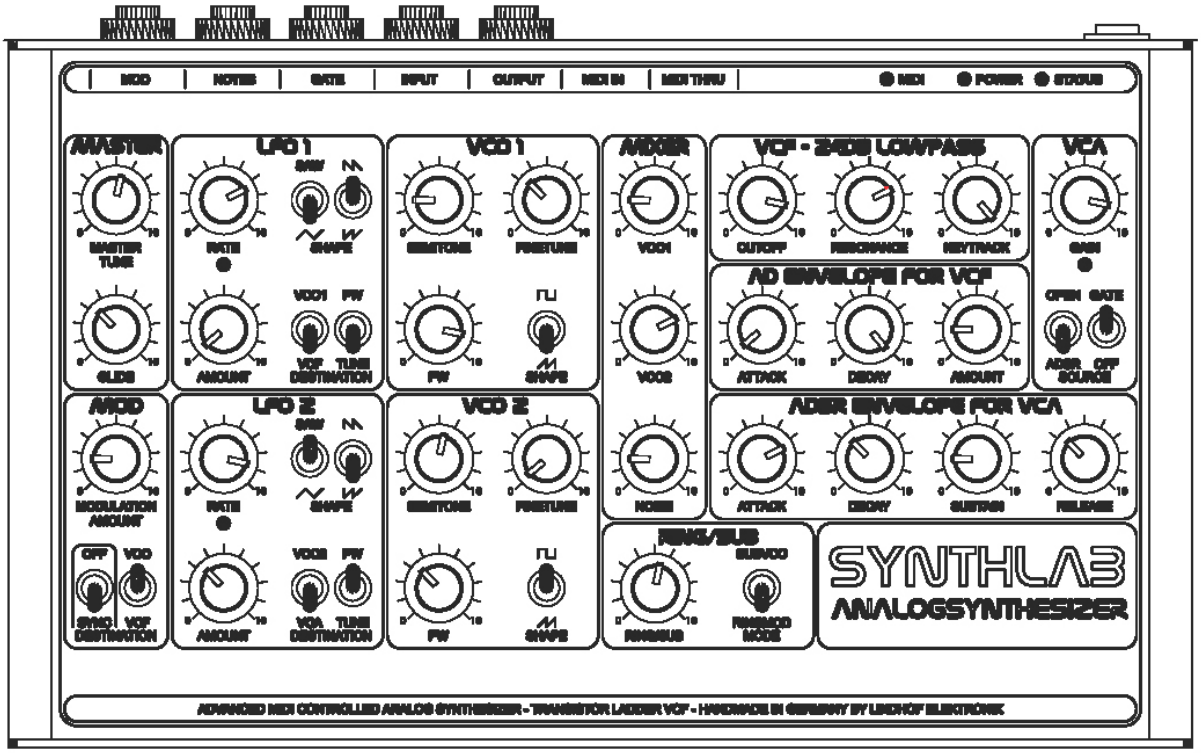
To be able to change the sound over a period of time, we need the possibility to influence the most important parameters relating to the sound. This is, in the case of the oscillator the pitch, for the filter it is the frequency limit and for the amplifier it is the level of amplification. The envelope curves are among the most important modulation sources.

The combination of other instruments

Every operation however small, is attained through the switching of single electronic components. Multiple switching operations are collected together and built up an a circuit board. Due to the fact that some operation groups are required more than once in a synthesiser, (e.g. oscillator) each one is assigned its own housing. The operation groups become modules. A synthesiser that is constructed using only modules is known as a modular synthesiser or modular system. The connection to the module is attained using a patch cable. Due to the fact that modular synthesisers are capable of such diverse connections, the modular system is considered far superior in its operational possibilities to synthesisers of today. Added to this, all parameters are directly accessible. A modular system can also be used to process audio signals. There are no boundaries between the synthesiser and other studio equipment.

The controls on the front panel

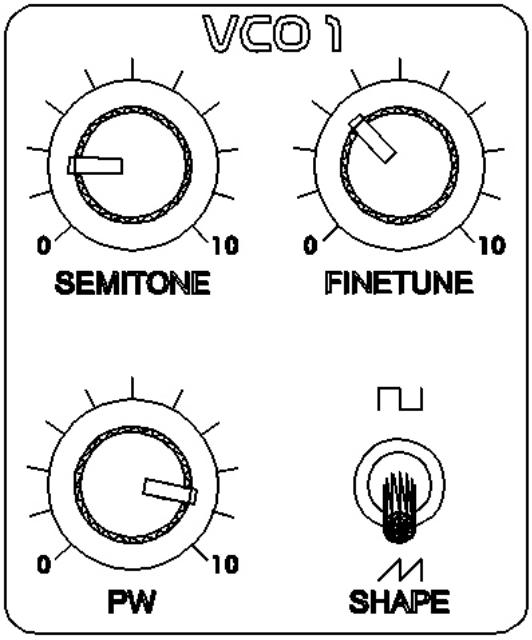
The arrangement of control elements within the work groups allows for a very intuitive operation. The labelling is self explanatory and allows even beginners to become quickly acquainted with subtractive sound synthesis.



The control of the instrument takes place exclusively using potentiometers and toggle switches, making possible an intuitive operation. Every parameter of the sound production can be altered using the potis or toggle switches, therefore allowing almost endless combinations, producing a multitude of sound and tone possibilities. Please keep in mind, that although so many settings are possible, they do not necessarily lead to usable results. A good starting point for personal experiments is described in the first steps in the basic settings. Regarding the operation of controls it must also be said, that the slightest alteration to the potis (and especially when changing the settings of two potis at the same time) changes the sound considerably – therefore in this case, less is more!!! Also, extreme poti settings should be avoided as they are uncontrolled and lead to overloading and, in most cases unusable results.

The above points are general hints regarding the control of the instrument. The following pages describe in detail all the control elements and their operation contained in your SYNTHLAB

The VCO1



The heart of every electronic musical instrument is the oscillator.

The "raw material" for the sound is produced in analogue synthesisers using a voltage controlled oscillator (VCO). A VCO can usually generate many curve forms. The curve forms generated by the SYNTHLAB oscillator are saw tooth and a pulse wave which can be linearly modulated. The different wave forms differentiate in the main tone spectrum, i.e. in the harmonic main tones contained within.

The saw tooth wave as well as the pulse wave contain many main tones. The curve forms triangle and sinus have only a very weak main tone structure (triangle), or have no main tones whatsoever (sinus) and therefore hardly suitable for using as output material for synthesisers.

It is worth mentioning however, that these curve forms also have a rightful place in sound synthesis. For most applications however, the two basic wave forms are sufficient.

For this reason the **two VCO** built into the SYNTHLAB use only **saw tooth and pulse wave oscillators**, because the main tone content of the output material determines the sound forming possibilities of the ensuing voltage controlled filter (VCF).The so called subtractive sound synthesis using the VCF (see below) only main tones already present can be filtered out or amplified.

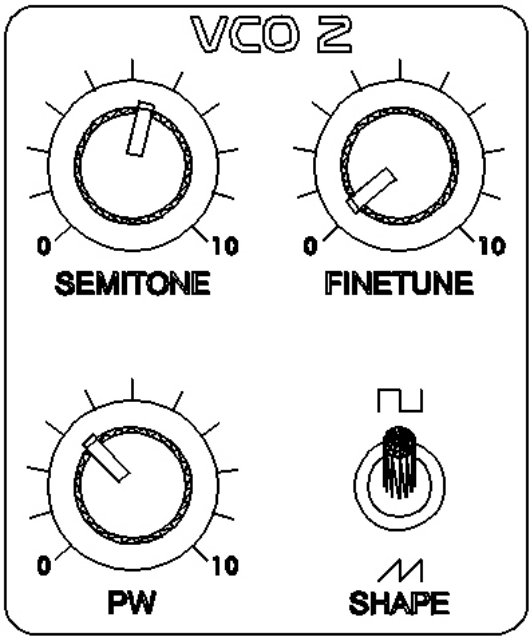
Es soll aber nicht verschwiegen werden, dass auch diese Kurvenformen ihre Berechtigung in der Klangsynthese haben. Für die meisten Anwendungen reichen die zwei Grundwellenformen aber aus!

The control of the VCO´s takes place using three knobs and one toggle switch. Using **SEMITONE**, the tone level of the VCO can be changed through several octaves**.** The **FINETUNE** knob is for the fine tuning of the VCO´s, and alters the pitch only within the octave. The choice of wave form takes place using the WAVEFORM toggle switch. In the pulse wave setting, the pulse / pause sequence can be adjusted using the PW control.

The VCO2

This VCO is exactly similar to VCO 1. In order to obtain "fat" or "wider" sounds, a second VCO is often employed that is slightly "de-tuned." Because of the disharmony with the first VCO, beats are produced adding a liveliness to the sound. The second possibility is to tune the second VCO to one octave higher or lower than VCO 1. The sound possibilities regarding the second VCO are increased immeasurably.

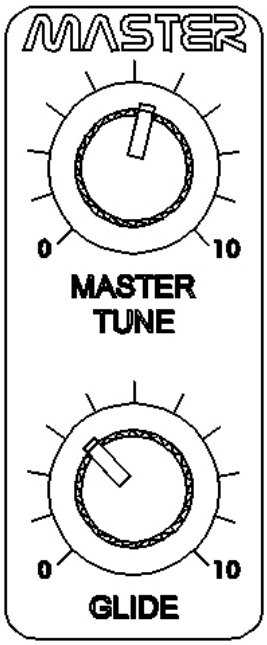
t is also possible to synchronise the two oscillators, which leads to interesting "fat" sounds. This can be obtained switching on the SYNC switch in the MOD section. This switch will be explained in more detail later.



Der Master area

Belonging to the two VCO´s is the MASTER TUNE control, which alters the pitch of both VCO´s simultaneously. This control therefore, can be used to control the whole tuning of the SYNTHLAB. Together with the pitch adjustments through the MIDI controls or CV voltage, a very wide frequency range can be covered.

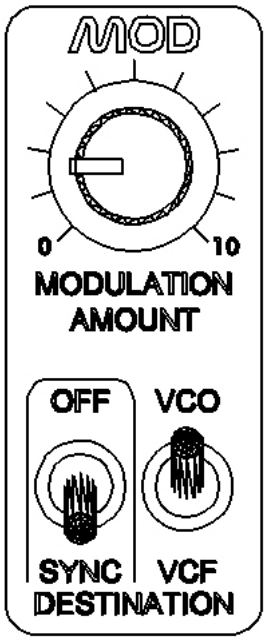
Also, using the GLIDE control, a continuous gliding from one frequency the next can be obtained. The glide timing can be adjusted from zero (tones jump abruptly) to several seconds of gliding time. This feature affects both VCO´s in the same way.



The external MODULATION

The modulation of the VCF´s and VCO´s can be effected using MIDI commands. The strength of the effective modulation can be adjusted using the AMOUNT control. The destination of the modulation can be determined using the DESTINATION switch.

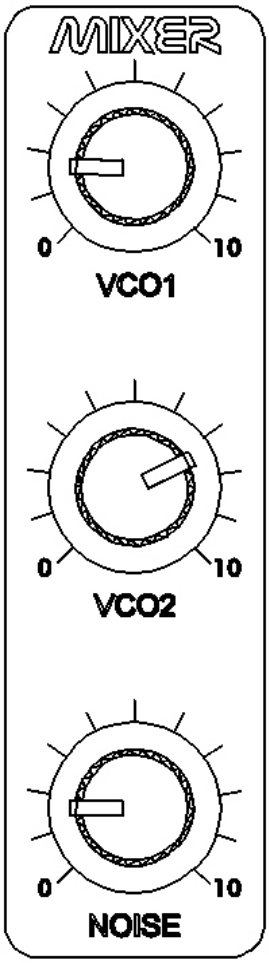
Using this set up, the VCO-SYNC feature can be switched on. Adjusted like this, the first VCO starts up the second one, at each new wave, producing interesting sound characteristics.



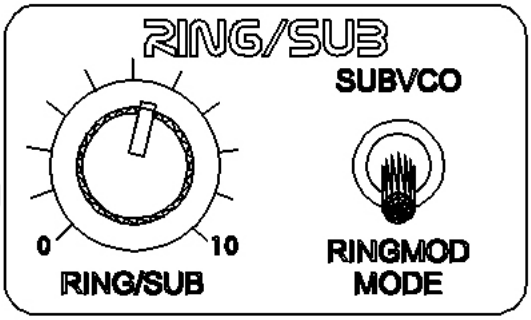
MIXER und NOISE

The mixer is the central control switchboard. Here is determined, which VCO at which volume is fed to the VCF. The volume of each VCO is adjusted individually using its own poti, thereby allowing control of all mixing variations and amplitudes fed into the VCF. It should be noted however, that the mixing of input signals using maximum amplitude leads to a high/overcharged signal feeding the VCF. It is possible however, to deliver a single signal (e.g. from just one VCO) amplified sufficiently to control the VCF.

Added to this, using the mixer, a noise signal from the internal noise generator can be mixed with the hum signal. The noise is theoretically, a mixture of all possible frequencies. The noise can be processed in many ways through the filter because of its wide frequency spectrum. The noise generator should however, be used sparingly.



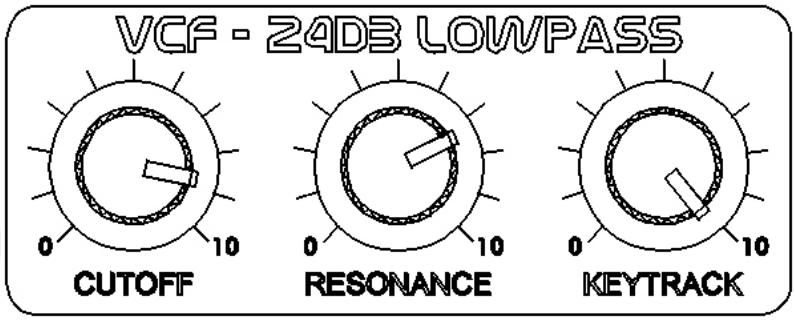
The RINGMODULATOR and SUB-OSZILLATOR



This group of features belongs to the mixer. Using the VOL knob, the portion of signal to be mixed with the hum signal can be adjusted. The signal can be the ring modulated signal from the two VCO´s or the signal from the sub-oscillator, according to the switch position. The sub-oscillator is a second oscillator that always resonates one or two octaves below the VCO1. Differences in the tone level of the VCO1 will lead to a difference in tone level in the sub-oscillator. The sub-oscillator can be adjusted to sub-octaves and their relationship to each other, using the trimmer which can be found on the circuit board. (See appendix "Jumper & Trimmer")

The VCF

For the further processing of the "Raw material sound" (VCO, noise, external input), the subtractive synthesis uses a voltage controlled filter (VCF), usually followed by a voltage controlled amplifier. There are different types of filter. They can be split into different filter types, low pass, band pass and high pass, according to the way in which frequencies pass through.



From a musical point of view, the low pass is easily the most productive filter. The low pass allows all frequencies below the so called frequency limit to pass through, cutting off frequencies above the limit. The frequency limit is adjusted using the CUT-OFF control.

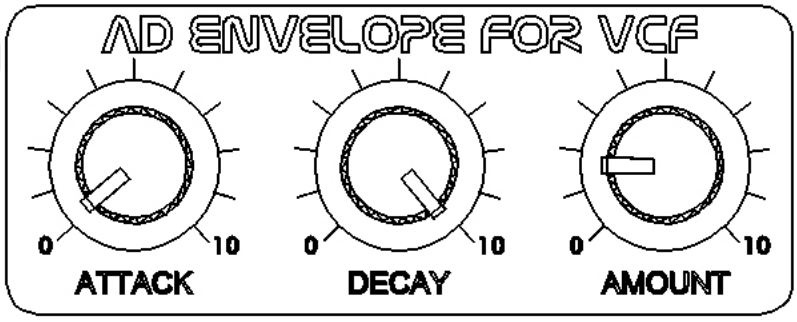
Another important characteristic of the filter is the gradient, usually expressed in dB/octave. A musical filter of quality should possess a gradient of 24dB/octave.

Another filter parameter is the resonance. If the filter is equipped with an adjustable resonance, then the frequencies at the filter cut-off point can be raised. The resonance adjustability is very important when using the filter for musical purposes.

The resonance feature accentuates the main tones that are closer to the filter frequency much more strongly, when the resonance is adjusted higher. This results in the well known resonance effects of an analogue filter. The resonance can be adjusted using the RESONANCE-control until "self resonance" is reached.

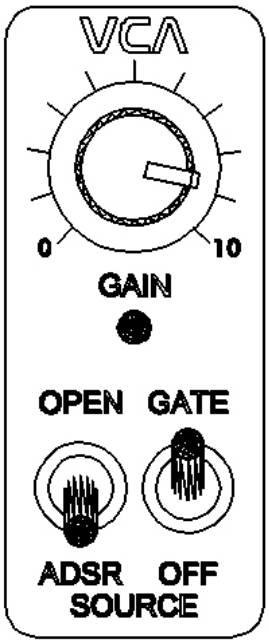
The VCO signals of the SYNTHLAB travel through the mixer to the voltage controlled low pass filter with 24dB curve gradient. The frequency limit can be controlled in many ways. Firstly, the filter frequency cut-off can be adjusted manually. Secondly, the envelope curve signal and the strike strength both affect the filter frequency. The effect of the envelope curve frequency on the filter frequency can be adjusted using the KEYTRACK adjustment.

The envelope curve for the VCF



The envelope curve for the VCF is made up (as opposed to that of the VCA) of only two areas, that of attack and release (or final decay).This feature is the same as that of the VCA, apart from the fact that it is not possible to form the curve envelope, which is not so important. As we do not possess the hearing to detect slight changes in frequency (as opposed to changes in volume), the VCF envelope curve is therefore in synthesisers generally not as complex as the volume envelope curve. Using the AMOUNT adjustment, the effect of the envelope curve on the filter frequency can be set.

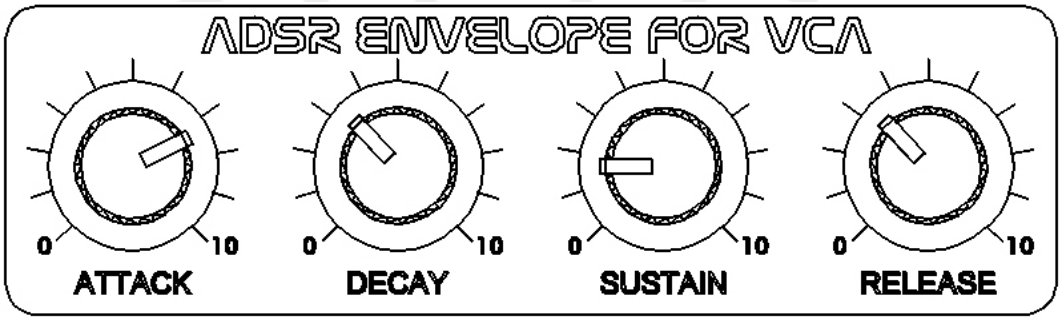
The VCA



The voltage controlled amplifier (VCA) is a module where the amplification is controlled by voltage. The VCF´s output signal travels through the VCA, the VCA output is the audio output of the SYNTHLAB. The VCA control voltage is provided by the envelope curve generator. Additionally, the velocity value of the arriving MIDI-note affects the control voltage to the VCA. To tune the VCO´s or to play without the VCA, the VCA can be switched off, this means that the VCA is fully portioned off and allows all signals in the amplitude to pass through unchanged. The VCA control voltage can be modulated using the LFO and/or the envelope curve. Additionally, the VCA envelope curve can be started using the LFO. In this way, gate effects can be produced according to the position of the toggle switch. The LED indicator displays the arrival of a MIDI-note.

The VCA envelope curve

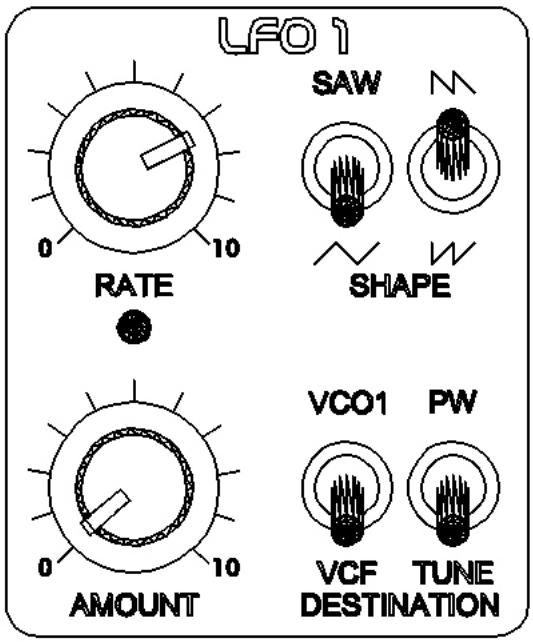
Envelope curve generators produce a signal path used to control of the VCF and VCA.



The envelope curve for the VCA can be divided into four areas: attack, decay, sustain and release (or final decay). The envelope curve climbs continually when a keyboard key is pressed (note on command / gate = on)which can be adjusted using the attack control. After reaching the maximum value, the envelope curve falls continually towards the sustain level, which can be set using the decay control. The envelope curve signal then remains at the sustain level until the key is released.(note-off command / gate = off). After key release the signal falls continuously towards zero, adjusted using the release control.

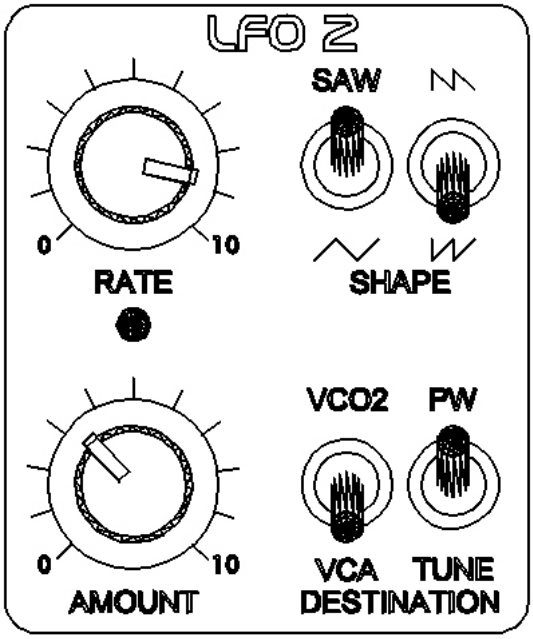
LFO1

Many different modulations can be obtained using the LFO. An LFO is, in principal, an oscillator with a very low frequency that can be used for modulation of the VCO, VCF and VCA. The modulation takes place using different wave forms, which can be selected using the SHAPE toggle switch. The LFO offers wave forms as triangle or saw tooth. Additionally you can choose between rising and falling saw tooth. The destination for these modulation signals can be the VCO1 or VCF. Additionally, using the VCO1, it can be determined whether the modulation affects the pitch or the pulse wave width.



LFO2

The LFO2 is equivalent to the LFO1 with respect to the operation and extent of wave forms. Differences can only be found in the destinations of the modulation. The VCO2 And the VCA can the modulated using the LFO2.The selection takes place using the DESTINATION switch. The VCO2 and the VCA can only be modulated using the LFO2, whereas the LFO1 controls the VCO1 and VCF. When using this LFO the destination for the modulation can also be chosen between pitch and pulse width. The available wave forms are the same as with the LFO1.



STATUS-indicator

The three LED´s in the upper right corner indicate MIDI activity, voltage supply and the actual status of the SYNTHLAB.

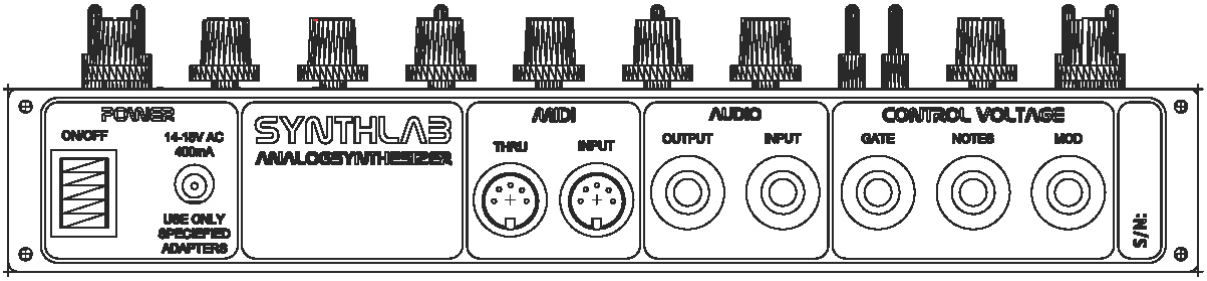
The **MIDI-LED** shows data at the MIDI-in connection. Here it should be noted, that the LED shows all arriving MIDI data, irrespective of which channel or which commands. Valid MIDI data arriving, is indicated by the LED in the VCA.

The **Power-LED** shows whether the SYNTHLAB is activated. If the LED does not light up, the unit should be connected to the mains supply using the mains adaptor. The unit must be switched on at the switch on the rear panel.

The **STATUS-LED** has many tasks. After switching on the unit, this LED indicates through blinking, the actual MIDI channel. When receiving MIDI-SYNC the blinking is in 4/4 time. When receiving valid SYSEX commands, the LED blinks quickly. After operating RESET the LED blinks three times quickly. A fault is indicated by fast continual blinking. In this case the unit should be reset by switching it off and on again. An exact description of the status LED can be found in the chapter MIDI-Interface.

Controls and connections on the rear panel

The connections for the SYNTHLAB are found on the rear panel of the unit.



Short overview of controls and connections on the rear panel (from left to Right)

POWER

ON/OFF	Main switch
NETZEINGANG	14-18V AC min 500mA

MIDI

MIDI THRU	Midi-output (Thru-feature!)
MIDI IN	MIDI-Input

AUDIO

AUDIO OUT	Audio Output
AUDIO IN	Audio Input

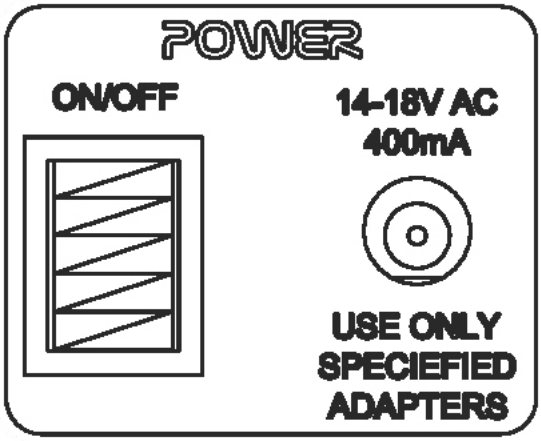
CV

GATE	Gate in/output (according to jumper position)
CV NOTES	Pitch in/output (according to jumper position)
CV MOD	Modulation in/output (according to jumper position)

To use the SYNTHLAB, it must be connected to other instruments in the studio. To avoid mistakes that could lead to the failure of the unit, the description of the connections should be studied carefully.

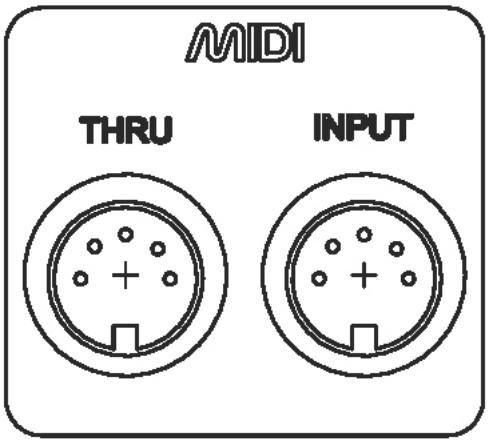
Power

Please make sure the SYNTHLAB is switched off before connecting it to the mains adaptor supplied. Should a different mains adaptor be used, please make sure this has a voltage of 14-18V AC (alternating current) that delivers at least 500 milliampere. Then the adaptor can be connected to a mains socket (230V – 50-60 cycles). Switch on the unit at the mains switch on the rear panel. PLEASE NOTE – if the SYNTHLAB is not to be used for some time, the mains adaptor should be disconnected.



MIDI

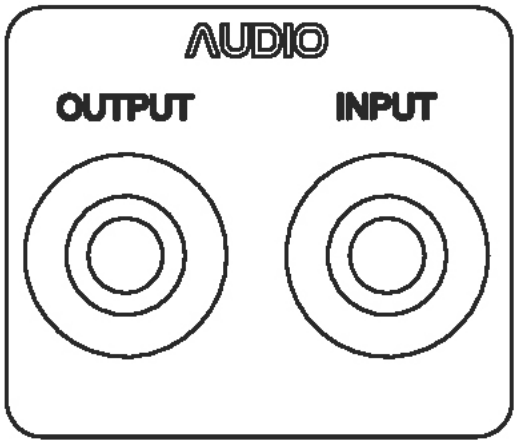
Connect the SYNTHLAB MIDI-IN socket with the MIDI-output socket of your MIDI-transmitters (e.g. MIDI master keyboard, sequencer,…….). If the MIDI data arriving at SYNTHLAB should be sent unchanged to another instrument, then the MIDI-THRU socket of the SYNTHLAB should be connected to the MIDI-In socket of the following instrument, otherwise the MIDI-THRU socket of the SYNTHLAB remains switched off.



AUDIO

Connect the audio output of the synthesisers to the audio input of a mixing desk, amplifiers or similar.

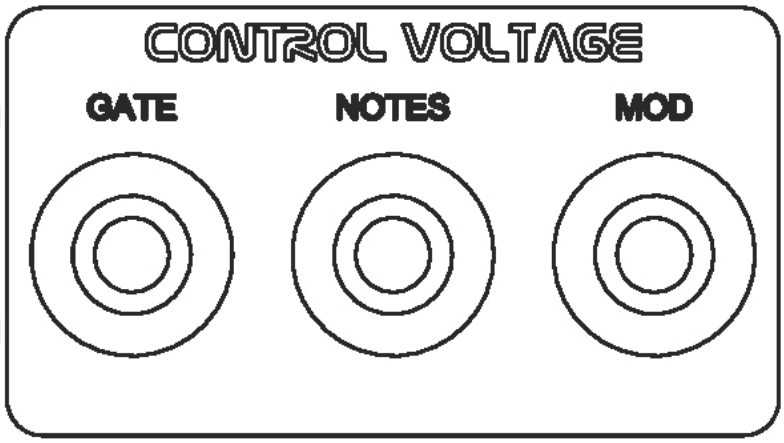
The audio input is used when an external audio signal is sent to the SYNTHLAB. This signal can be used instead of, or as well as the VCO´s as a sound source. **The level of the external audio signal must also be controlled externally.** In the case of feedback the level should be reduced.



The sockets are 6.3mm jack sockets (mono), making possible a simple integration of the unit with professional studio equipment.

CV

GATE, PITCH-CV, MOD-CV are also equipped with 6.3mm jack sockets (mono), where an analogue synthesiser can be connected that is equipped with necessary inputs and is required to be integrated into the world of MIDI. The control voltage characteristic of the CV output is 1V/octave, the gate output delivers a voltage level of +5 volts when activated and 0 volt in deactivated mode. (The controls signal at the sockets are always identical to internal tone production).



Using the jumpers on the circuit board, the sockets can also be configured as inputs. The SYNTHLAB can then be controlled through the GATE, NOTES-CV and MOD-CV. (The internal MIDI interface is then switched off).

The MIDI -> CV & Trigger Interface

In order to use the SYNTHLAB, it must be connected to other studio equipment. MIDI is the usual method and is also used in SYNTHLAB for the transfer of NOTE commands from a sequencer, keyboard or PC.

Because the SYNTHLAB is an analogue instrument, the control takes place using analogue control voltage in a range from 0 to 5 volts. For this reason two digital to analogue converters are built into the MIDI interface, one for the pitch and one for the modulation. Additionally, a GATE-SIGNAL from 5 volts is generated through the MIDI interface, when a valid NOTE-ON command is received. In NOTE-OFF mode the GATE-SIGNAL is reduced to 0 volt.

These three control signals are present at the respective sockets on the back panel, to be used for external modulation destinations.

There are no operating elements to be found on the front panel or the back panel. The configuration of the MIDI interface takes place solely through SYSEX commands. This can prove somewhat complicated, but the adjustments do not have to be made often and the range is very small.

Alteration in the configuration can be dangerous, which will now be explained. Many parameters can be altered, and a plausibility check will not be carried out. Adjustments can be made that are illogical (e.g. MIDI channel 50) or settings leading to unknown alterations in the configuration. In cases like this, there is a SYSEX command which resets the configuration to the factory settings.

The SYSEX - command

In the MIDI standard there is anchored a block of system exclusive information that cannot be disturbed by other data (for example by notes).

The bytes of system exclusive information are normally in a hexa-decimal language. A system exclusive information for the configuration is written for example thus:

F0 73 10 00 00 00 F7 (RESET)

The single bytes of the system exclusive information have the following meaning:

F0 hh gg nn bb dd F7

F0 Informs SYNTHLAB the beginning of system exclusive information
hh The manufacturers identification
gg Manufacturers appliance identification
nn Differentiates between two or more identical appliances
bb Configuration command
dd Configuration data
F7 Informs SYNTHLAB the termination of system exclusive information

Configuration using SYSEX commands

The configuration of the MIDI interfaces is carried out using through special commands, using the SYSEX system.

A SYSEX block is sent containing a command containing the appropriate data. In the following, the configuration of the MIDI channel is described, as this is probably the most important command used by SYNTHLAB to alter the configuration.

F0 73 10 00 xx 0F F7

Using this example, the SYNTHLAB is fixed to MIDI-channel 16. The command MIDI-channel is xx and is followed by the new designated channel number. Here it should be noted, that a hexa-decimal representation is selected and the MIDI-channel 1 is represented as 00. To make this quite clear, there follows a second example whereby MIDI-channel 5 is fixed.

F0 73 10 00 xx 04 F7

Here 04 represents MIDI-channel 5, the hexa-decimal method of writing has in this case no influence.

The STATUS LED

There are many different Parameters and conditions that can be displayed by this LED. Here is a list of the most common:

- Blinking (immediately after start up) -> Channel information
- Blinking (whilst in operation) -> 4/4 BEAT indicator
- 1 x fast blinking -> Store process o.k.
- 3 x fast blinking -> Factory settings after RESET
- Continuous blinking -> Fault indicator
- ….

First Steps

In case you are not familiar with analogue synthesisers, and/or you are using the SYNTHLAB for the first time, please read carefully chapters "General Safety Information" and " Short Introduction to Sound Synthesis."

SYNTHLAB MIDI-features

In normal operating mode, the following MIDI-commands are recognised and processed:

- NOTE ON at the MIDI-channel set
- NOTE OFF at the MIDI-channel set
- Velocity/modulation controller at the MIDI-channel set to control the VCF and VCA (and optional VCO)
- MIDI-SYNC (for BEAT indicator)
- SYSEX (For configuration or RESET)

The light diode on the front panel lights up when the SYNTHLAB receives a valid Note-On-Command and goes out when a Note-Off-Command arrives. The Gate-Signal controls both of the envelope curve generators. The LED "MIDI" indicates the arrival of those MIDI-Note and control signals, also the MIDI-channels that the SYNTHLAB is not programmed to receive. This provides a control of cable connections allowing an easier operation using MIDI.

The modulation of the SYNTHLAB using MIDI takes place through VELOCITY. The destination of the modulation is selected using the switch on the front panel.

If MIDI-SYNC is to be received, the STATUS-LED blinks in 4/4 BEAT.

SYSEX (system exclusive information) was created for the movement of data in the MIDI protocol. This way it is possible for the user to alter stored information within the unit, using the MIDI line. In the SYNTHLAB for example, the MIDI-channel can be altered. A detailed description can be found in the corresponding chapter.

Analogue sound synthesis with SYNTHLAB

To fully understand this chapter, it is essential that basics of sound synthesis are known (see chapter "Short Introduction to Sound Synthesis") as the theoretical basics of sound synthesis (subtractive synthesis) are described in detail and the setting of the SYNTHLAB sound parameters using practical examples is described. Additionally, this chapter can be used as a fault finder in case the SYNTHLAB does not operate as expected.

Connect the MIDI-input, the audio-output and the mains connection as previously described and switch on the SYNTHLAB.

Basic control settings

Adjust the controls of the SYNTHLAB to the basic settings to be used as the starting point for all further adjustments. If the SYNTHLAB remains silent, it may be that the controls are turned down or switched off – the basic settings will override this problem.

Feature	**Basic setting**
VCO1 SEMITONE	Middle setting
VCO1 FINETUNE:	Middle setting
VCO1 PW:	Middle setting
VCO1 WAVEFORM	Saw tooth
VCO2 SEMITONE	Middle setting
VCO2 FINETUNE:	Middle setting
VCO2 PW:	Middle setting
VCO2 WAVEFORM	Saw tooth
MIXER VCO1:	Middle setting
MIXER VCO2:	off
MIXER NOISE:	off
RING/SUB:	off
VCF CUTOFF:	Full on
VCF RESONANCE:	off
VCF KEYTRACK :	off
VCA GAIN:	Middle setting (oder lieber etwas niedriger)
AD ATTACK:	off
AD DECAY:	off
AD AMOUNT:	off
ADSR ATTACK:	off
ADSR DECAY:	Full on
ADSR SUSTAIN:	off
ADSR RELEASE:	off
LFO1 SPEED:	Middle setting
LFO1 AMOUNT:	off
LFO2 SPEED:	Middle setting
LFO2 AMOUNT:	off

If you now play on your MIDI-keyboard and have selected the correct MIDI-channel in the SYNTHLAB, (see MIDI-features) then you should now be able to hear something at the output of your SYNTHLAB.

Fault finding

Providing everything is working o.k., skip this chapter. If a fault is present, please check the following:

1. Does the POWER LED light up?

   No – Appliance is not switched on, Mains connection faulty, fuse blown.

   Yes – move on to 2

2. Does the MIDI-LED light up?

   No – Cable connection is defective, or the keyboard/sequencer isn´t working.
   Yes – move on to 3

3. Does the GATE-LED in the VCA section light up when the MIDI-keyboard is played?

   No – MIDI-channel does not correspond to the MIDI-keyboard (See "MIDI-features") – Change receiving channel.
   Yes – move on to 4

4. Is an audio signal from SYNTHLAB present, when the MIDI-keyboard is played?

   No – Connecting cable between SYNTHLAB and mixing desk/amplifier or similar, is defective – basic settings have not been followed (re-check settings).

Your SYNTHLAB is now ready to go and we would like to continue with an introductory lesson regarding analogue sound synthesis. We will systematically familiarise ourselves with each group of SYNTHLAB features.

The lesson will exclude basic theory, as it has already been covered extensively. This is a "hands on" approach dealing with actual examples of settings using SYNTHLAB.

Enough theory – we now wish to put the theoretical explanations into practice!

VCO

Turn the SEMITUNE-control forwards and backwards, you will notice that the pitch of the SYNTHLAB changes. Use this control to correctly adjust the pitch, so it is tuned to your other equipment.

The FINETUNE-control is used for the final pitch adjustments, whereby it changes only minimally – allowing an exact setting. Alternatively, the whole tuning can be done using the MASTERTUNE-control. If you have already turned up the second VCO in the mixer section, you can hear that the pitch of both VCO´s change together.

You should now turn up only VCO1 in the mixer, and switch over the VCO to between the two wave forms. Now you can hear the many different sound characteristics of both wave forms. Many sound variations can be produced using only these two (basic) wave forms.

If using VCO1 (or also VCO2) as the wave form for the pulse wave, it is possible to alter the pulse/pause relationship. You can hear, that the sound characteristic changes distinctly. A square wave with a fifty-fifty pulse/pause setting, sounds "fatter" than an uneven pulse/pause setting – which will sound more "sharp." If you alter the pulse width, be aware that in the mid-setting, a square wave with equal pulse/pause relationship will be produced.

Now turn on slowly the GLIDE control, and you will notice that the sounds that followed each other will begin to merge. The glide time is longer, the more you turn the knob.

As an alternative to the VCO, the SYNTHLAB can utilise an external signal as a sound source. The sound level of the external signal must also be adjusted externally. Set the level so that the VCO´s and the external audio signal have approximately the same volume. If the signal sounds distorted, then the level should be turned down. The external audio input can be used for example, when a very sterile sounding sample signal is to be enriched using the analogue resonance filter of the SYNTHLAB or when an additional filter and/or VCA envelope curve is to be added.

VCF

For the further processing of sound "raw material" (VCO/ext. input) using subtractive synthesis, a voltage controlled filter is employed, followed usually by a voltage controlled amplifier. There are different types of filter. The main types can be divided into 3 categories: Low pass, band pass and high pass, the basic difference being, the frequencies that are allowed to pass through the filter.

From a musical point of view, the most productive filter is the low pass filter. The low pass filter allows all frequencies below the so called frequency limit to pass through, and cuts of frequencies above the limit.

Another important filter feature is the gradient, mostly expressed in dB/octave. A musically high grade filter should have a gradient of

24dB/octave, for some certain applications is however a 12dB filter a good idea.

Another filter parameter is the resonance. If the filter is equipped with a variable resonance setting, then the frequencies on the filter cut-off point can be raised. The possibility for setting the resonance is very important for musical use of the filter. The resonance feature accentuates the main tones near to the filter

frequency more, as the resonance setting is raised, thereby producing the well known resonance effects of an analogue filter.

Within SYNTHLAB the VCO/INPUT-signal is fed to a voltage controlled low pass filter with variable resonance setting and selectable filter gradient. The frequency limit can be controlled in many ways. First of all, filter frequency cut-off can be set manually. Secondly, the envelope curve signal and the degree of key strike influences the filter frequency.

The filter theory will now put into practice using the LABVIEW. Turn the control for the VCF envelope curve height (ENVELOPE) to zero. At the output nothing more can be heard when playing the MIDI-keyboard, because the filter is closed. Turn the control of the VCF frequency (cut-off) slowly to on and listen how the sound is very dull to begin with, but then becomes brighter. By manually raising the filter frequency, more main tones are allowed to pass, thereby brightening the sound. Try out the same thing using different filter resonance settings. The further you turn up the resonance, the more the main tones are lifted on the frequency limit of the VCF. In the higher ranges of the resonance setting, the filter sounds become sharper (whistling). When the resonance is turned right up, then the filter begins to self-resonate as a sinus oscillator. Turn the resonance control to mid setting, so that the sound feels pleasant, then turn the resonance control so far down until the sound becomes dull. Gradually turn up the ENVELOPE-LEVEL control which determines the strength of the ADSR envelope curve arriving at the VCF. When playing the keyboard you will notice, that the frequency range passing through the filter with the ADSR envelope curve will be greater the further the control is turned up.

VCA

A voltage controlled amplifier is a module whereby the amplification is voltage controlled. The output VCF signal passes through the VCA, the VCA output is the SYNTHLAB audio output. The control voltage for the VCA is delivered by the envelope curve generator. The strength of the signal delivered, can be adjusted using the ENV-LEVEL control. Additionally, the velocity value of the arriving MIDI-note influences the control voltage for the VCA. The velocity feature can be switched off, allowing a non-dynamic playing mode and the accent can only be controlled through MIDI-volume. (See also SYNTHLAB MIDI-features)

The envelope curves

The SYNTHLAB is equipped with two envelope curve generators. Up to now, the envelope curve parameter has not been changed. Using the controls ATTACK, DECAY, SUSTAIN and RELEASE, the envelope curve operation for the VCA can be adjusted as required, whereby the possibility of adjustment of the VCF envelope curve are not as wide ranging. Try out different control settings and note the acoustic results. For percussion sounds, select short attack and decay times, setting sustain level to zero. For soft flowing sounds select longer times and a higher sustain level.

The LFOs

The LFO´s are the last group of features which need to be explained. Using the two LFO´s, you have the possibility to produce many variable modulations through the controls mentioned previously. Simply try out the variety of possibilities and listen to the results of the modulation in the output signal. The speed and intensity of the modulation can be easily adjusted using the corresponding controls. The frequency of the LFO´s can easily be observed on the LED, therefore there is nothing to prevent the production of complex modulations.

The LFO´s in SYNTHLAB offer three wave forms selected using toggle switches.

In order to modulate for instance, the pitch of the first VCO with a falling saw tooth, we use the first LFO. The first LFO influences only the first VCO. To do this, the wave form switch must be set to falling saw tooth and the modulation destination switch set to VCO1 and TUNE. The modulation speed can be set using LFO-SPEED. Using maximum gain, the pitch can be modulated through several octaves.

Jumper and trimmer – options and settings

Using the jumper, optional features, wave forms etc. can be selected. The trimmers are mainly used for equalising and need only under exceptional circumstances be adjusted.

Basically it is advisable not the alter the jumper and trimmer settings if you do not really understand what you are doing! Alterations should only be carried out by experts, as faulty settings can lead to complete failure of the unit – and no one wishes that! Additionally it must be mentioned, that any **warranty claim becomes invalid if the unit has been opened!!!** The operation of jumper & trimmer is dealt with below.

The Jumper:

The jumper can be relocated simply by means of a small pair of pliers, tweezers or fingernails. The alteration is quickly and easily carried out, but care should be taken that the jumper is correctly located to avoid a later loosening caused by vibration. The jumper is pressed onto two pins.

LFO1-Freq, LFO2-Freq (from circuit board V10.3) Using the two jumpers, the frequency ranges of both LFO´s can be selected. There are two frequency ranges to choose from. The factory setting is the low or slow range. This range is for most applications adequate, but if necessary, it can be changed to a higher frequency range using the jumpers.

LFO1-Waveform Using this jumper the triangle wave form of LFO1 can be changed to square. There are not many interesting applications for this wave form in the modulation, so this feature can only be applied using the jumper.

LFO1-Waveform 1 & 2 These two jumpers are also used to change the wave form as mentioned above, but for LFO2

GATE, NOTE, MOD If the SYNTHLAB is to be controlled by an external CV voltage control, then these three jumpers must be altered. In order to guarantee a fault free operation, the internal MIDI interface control leads must be disconnected using the jumper.

The CV sockets on the rear panel can be used, following this procedure, as inputs.

The Trimmer

The trimmer adjustments have been factory set. The trimmers should only be altered or changed in the case of repair, parts renewal, or deliberate change to the specification. Alterations to the factory settings should be avoided.

SUBOSC Oktave 1&2 he two trimmers control the portion of sub-octaves in the sub-oscillator. Each trimmer controls the first and second sub-octave respectively. Therefore it is possible to trim each sub-octave separately, allowing mixes to be made according to taste.

MIDI Note, Velocity These two trimmers are used to equalise the internal MIDI interfaces to match control voltage characteristics of 1V/octave (0-5V)

VCO 1 und 2 Scale These two trimmers are used to equalise the internal MIDI interfaces to match control voltage characteristics of 1V/octave (0-5V)

VCO 1 und 2 Init These two trimmers are used to equalise the internal MIDI interfaces to match control voltage characteristics of 1V/octave (0-5V)

VCA Init These two trimmers are used to equalise the internal MIDI interfaces to match control voltage characteristics of 1V/octave (0-5V)

VCA Offset These two trimmers are used to equalise the internal MIDI interfaces to match control voltage characteristics of 1V/octave (0-5V)

LFO Init These two trimmers are used to equalise the internal MIDI interfaces to match control voltage characteristics of 1V/octave (0-5V)

LFO Sinus Level These two trimmers are used to equalise the internal MIDI interfaces to match control voltage characteristics of 1V/octave (0-5V)

VCA Output Level These two trimmers are used to equalise the internal MIDI interfaces to match control voltage characteristics of 1V/octave (0-5V)

Technical Information

Specifications:

Voices :	1 (Monophon)
Audio Outputs :	1 (Mono)
Audio Inputs:	1 (Mono)
Output Level:	+8dB into 600OHM
Output Impedance	1KOHM
MIDI:	In, Thru
CV:	Gate, CV-Notes, CV-Mod (IN or OUT)
Dynamic Range:	>90dB
Signal to Noise:	>80dB
Frequency Response	1Hz-30kHz
Power consumption:	< 10Watt
Fuse:	500mA (flink)
Dimensons:	275x164x62mm
Weight:	ca.1,6 Kg

General Tips & FAQs

FAQs:

Tipps:

- Be careful! – overloading may make for a real dirty sound, but it should be used sparingly. The control units are easily overloaded and their outputs can produce a high amplitude. Sometimes less is often more!
- The LFO wave forms can easily be altered using the jumpers on the circuit board. A plan can be found in the technical appendix.

Now that you have familiarised yourself with the meaning of the control elements of your SYNTHLAB, there is nothing more standing in the way of the using your machine to produce music. We wish you much enjoyment with your “pocket size” SYNTHESISER LABORATORY.

Your Mode Machines Team

Appendix

All technical data, plans and supplementary information can be found in this section.

Appendix 1 : **MIDI command overview**
Appendix 2 : **MIDI IMPLEMENTATION CHART**

Anhang 1 : MIDI Befehlsübersicht

Command	command Byte	Data Byte	Description Range
RESET	00	00	Reset to factory settings
MIDI-KANAL	01	00 – 0F (00)	MIDIKANAL 1-1 (Channel 0 factory setting and after RESET)
OFFSET	02	00 – 3F (18)	OFFSET SETTING Start note CO is as MIDI No.18 (NOTE OFFSET 18 works + reset)
NOTE RANGE	03	00 – 3F (3F)	NOTE RANGE Extent of Note of MIDI 3F -> 63 Notes, is 5 Oktaves (RANGE 3F factory setting and after RESET)
Manufacturers recognition	04*	00 – 7F (73)	Manuctors recognition (Manufactor ID 73 factory setting and after RESET)
Appliance Type	05*	00 – 7F (10)	The Number of the Appliance (SYNTHLAB Appliance No. is 10)
Appliance-No.	06	00 – 7F (00)	The appliance number, different units, same type (Appliance No. 00 factory setting and after RESET)
ATTACK-TYPE	07	00 01 (00)	Stroke TYPE 00 -> STACCATO Stroke TYPE 01 -> LEGATO (STACCATO factory setting and after RESET)

NOTES:

- Commands marked * **not normally released for usage.** Alterations should also never be necessary for normal use.
- All figures used are **in hexa-decimal form**.
- There is no **built in plausibility control**, this means anything is possible, but only the commands listed, together with the areas of data belonging to them should be used. Non compliance leads to faults!!!
- Changes to factory settings should only be used in exceptional circumstances.

Anhang 2 : MIDI IMPLEMENTATION CHART

Function		Transmitted	Recognized	Remarks
Basic Channel	Default Changed	X X	1-16	00-0F hexadezimal
Mode	Default Messages Altered	X X X	X X X	
Note Numbers	True Voice	X	0-127	00-3F hexadezimal
Velocity	Note On Note Off	X X	0-127 X	
After Touch	Key's Ch's	X X	X X	
Pitch Bender		X	X	
Control Change		X	X	(later)
Program Change		X	X	(later)
System Exculsive		X	O	
System Common	Song Pos Song Sel Tune	X X X	X X X	
System Realtime	Clock Commands	X X	O O	
Aux Messages	Local On/off All Notes Off Active Sence Reset	X X X X	X X X X	
Notes				