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INTRODUCTION

PREFACE BY MATTHIAS GROB, INITIATOR AND DEVELOPER OF THE LOOP DELAY

I believe the coming together of a group of musicians to play for some listeners is the most important acoustical event on earth. But as a preparation for these events and for his own development, a musician spends far more time alone with his instrument. In this time he discovers most of the secrets about the construction of music, and the ways to express his own personality and taste. Although the LOOP delay has special features that facilitate playing together (or with a machine), it is first a mirror, or maybe a crystal ball, for the musicians studio.

There are quite a few musicians using delay machines to create simple loops, although available gear was very limited. Some people modified machines, others accepted that the loop time was short or unrhythmical. I was amazed in how many different ways people use loops. This is because the character of repetition belongs to almost all music.

Of course, loop music is not meant to remain at home and push the artists into loneliness. Recordings I made in Rio and Switzerland with various musicians who did not know my system yet and who probably never played with a delay demonstrate the variety of loop music. Now I am eagerly waiting for the results when initiated loop players come together and synchronize their LOOP delays.

I would like to exchange such recordings. Therefore, a Loop Group could help. Also, we could reach a point where, through information in the media, the public knows what to expect when going to a loop show.

My interest is not "to make money", but to lead an interesting life and create as much beautiful sound as possible and to help others in doing so. You are invited to profit from it by purchasing a LOOP delay that gives us the energy to do our development properly. You can help us by being a mirror for our work and send a word or tape to us. Whenever the machine does not do what you expect intuitively, we would like to know about it and try to get the obstacle out of your way.

Introduction to the Version 2.2

During the further development of the LOOP software, especially the communication facilities, two basic problems came to light:

1. There are two basic ways of building a loop:

a) The intuitive, playful, unconscious, spiralling, that makes one high. Such loops usually have no beginning and no breaks to disturb the player. He can interpret the spiral differently each time, with each pass he can hear a different beginning.

b) The conscious, composed, structured, organised way that produces a song. With this way, it is clear where the beginning of the theme is, and how the bars are organised. Therefore, it is helpful that the machine remembers these moments, and adjusts to them if the operator is not very accurate. Synchronisation also belongs to this category.

My goal was to pack those two contradictory principles into the same software package! It is important, because all kinds of mixtures and sequences of the two extremes are possible, like starting a structured song and getting off into the unknown, away from the defined rhythmic pattern of the beginning.

It is interesting how the project is growing from an intuitive into an organised way.

2. The big problem of rounding of time:

It is impossible to operate a foot switch to 1.5ms of accuracy. It makes a big difference whether the user presses the key right before or right after a mark (e.g. loop start). So rounding is a must. The most important improvements in the program have been in this area.

Now, what does it mean, to round in real time? Either the key was pressed too late and the past has to be changed, or it is pressed too early and the jump into the future should happen! It means that we always have to count on the possibility that a key will still be pressed and so all the parameters must be ready to pretend that the key was pressed earlier — or we keep the operations cool until the right moment has come to execute them. And all should be executed exactly at the same time! Another trick is to find the moment in the past that corresponds to the moment in the future we want to jump to. But is it really the same?

For the user it is helpful to imagine the loop as a train that is continuously driving in a circle, picking up notes at the locomotive end and leaving them by the last wagon.

But luckily we managed to design the LOOP delay so that in a standard application you will not notice these problems.

CREDITS:

Eric Obermühlner made the basic software and much more with his fanatic involvement and enthusiasm.

Willi Strehler of GEDDOP, Winterthur, is the tester of MIDI and SYNC section and brought fundamental ideas and energy into the tired last phase of development.

Marco Birchler of BIRCHLER ELECTRONICS, Zug, is the patient, sincere and responsible manager of the fabrication.

Thomas Bitterlin of DELFIN, Zürich, printed the housing carefully.

Ljubo Majstorović is the incredible guitar player who presents and explains our inventions to the public, but also contributed technical ideas, function tests and loads of good mood.

Boris Bögli sensibly made the prospect and manual understandable.

Dent-de-Lion DuMidi worked the english version of the manual through and kept digging us out of the dust with funny ideas and fantastic visions.

Thomas Oeschger is the supporting critic "outsider" judging from the listener's and reader's point. He made his thorough knowledge of human nature available to us – not only when correcting letters.

Rolf Spuler of PARADIS has been a perfect partner for many years. I learned so much about business and construction with. He still assists with mechanical competence and taste for design.

Hermann Hogg of ALPHA77 is the discrete master that years ago taught me everything about electronics and much more.

Thank you

Matthias Grob, June 93
Musician and Certified Electronics Engineer ETH Zürich

WHY READ THE MANUAL

The LOOP delay is unlike any existing machine. Therefore do not underestimate the difficulties you may encounter when using it - not so much in the ways to operate it, but in the musical applications. It will be an interesting experience!

Work yourself slowly through the functions. Study the musical applications and get used to them before you go on.

Most functions are explained several times in different chapters. Select the chapter most suited for your purposes and fill in the gaps with selections from other chapters.

WHY NOT READ THE MANUAL!

Even with one single footswitch (RECORD) you can realize many of your musical ideas. It is not necessary to read a lot. With courage and talent you can start immediately. The texts marked **Important** are recommended for everyone, though.

WHERE TO READ IN THE MANUAL

In case you just need a delay and you are not interested in loops, read the chapter **Just another Delay?**

We will explain in **Basics** what we mean by "loops" and define a few words necessary to talk about loops.

Straight into it shows you the quickest way to the LOOP delay.

Step by Step was written by Eric for those who would like to understand peacefully one part of the LOOP delay after the other. However, you will not know the whole machine once you have come to the end of this chapter.

Go on reading **From left to right**. All elements are explained in detail.

In **Communication facilities and deeper understanding**, we explain the functions that run behind the curtain and all the possibilities to connect and synchronize with other machines. If you are a MIDI freak, you are right here.

The **Playing hints** may not be necessary, because you will develop your own loop style. Soon we will be listening to recordings of different people and learning about the various styles. I simply describe the different styles so far for those who want to be as versatile as possible.

REPRESENTATION

Words in capitals refer to OPERATING ELEMENTS of the LOOP delay (for instance a switch). Often the same words appear in normal writing. Then we talk of the function of a switch.

Bold words refer to the respective **Chapter** in the manual.

Texts in boxes summarize the preceding chapter
--

Special! Inserted paragraphs are marked with **Important!** or similar titles and refer to specialities you should not miss.

Have a good loop!

BASICS

LOOP

A 'loop' is a repeating sequence in music. Elsewhere, the word is used for the prolonging of samples and for the inserting of effects. But first there was "Tape Loop Art", and this is the meaning we refer to.

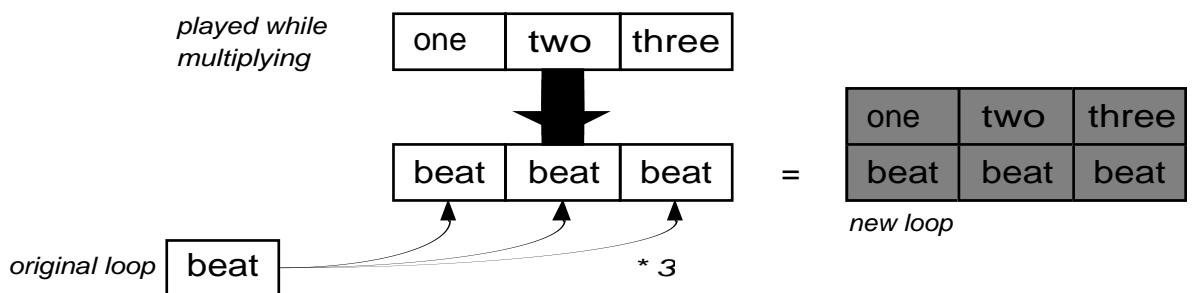
MULTIPLICATION

It is possible to build up long loops out of short units. We call this the multiplication of a stored phrase. See example with diagram in the following paragraph.

BEAT

The "beat" is the basic loop element. Without multiplication, beat and loop are the same. A loop is always made up of an integer number of beats. Often you will create a loop in a way so that one beat is made up of a musical beat. In the LOOP delay you start by recording a phrase, meaning one beat. Then create a complete loop length by multiplying the beat.

In this example we assume a microphone has been plugged into the LOOP delay. We call the first loop "beat". This beat is multiplied while we speak "one", "two", "three" into the microphone:



RESET

Reset is the state of the machine after power-on. You can also get to reset state while playing, in order to start over.

PEDAL

A pedal is not an on/off-footswitch (in this context) but a continuous controller similar to a volume control (see appendix).

THE QUICKEST WAY TO THE LOOP

For users experienced in electronic equipment

STRAIGHT INTO IT...

1. Confirm the right tension above the power socket. Connect a power cord.
2. Connect an instrument or a microphone to IN and an amplifier to MIX.
3. Regulate the INPUT VOLUME to ensure the LED is mostly orange and sometimes red when the music is loud.
4. Put MIX to middle position.
5. Turn FEEDBACK almost or fully up.
6. Connect the foot switch to RECORD.
7. Play a phrase or speak some words and hit the foot switch at the same time. Hit it again at the end of the phrase - here goes your first loop!
8. Press the switch longer - all is quiet again. That is Reset. Repeat point 7 or 7/8 until you feel secure.
9. Try the other switches while playing and observe the displays and LEDs. Be surprised. This is the shortest key we can give you to help you understand:

LED dark:	Key has no function
LED green:	Key is ready to start a new function with.
LED red:	This function is active
LED orange:	A special function is active
or:	The presently active function can be terminated in a special way.

RECORD > RECORD

Records a new loop. This loop is immediately played back.

Looping? Anything you do not understand and many tricks and ideas are in the back of the manual.

JUST ANOTHER DELAY?

If you want to use the LOOP delay like a regular delay, you do not have to know anything about loops.

1. Connect the machine as described in **STRAIGHT INTO IT** 1-5.
 2. Press MODE once to make the bottom LED turn green.
 3. Adjust delay time with two strokes on the RECORD switch: The interval between your two strokes is your delay time.
 4. Apply the feedback in the regular way.
- A pedal (CP1 recommended) controls the input volume — a practical medium of expression.

- The LOOP delay is not primarily developed for short delay intervals and modulation. This can be achieved with BROTHER- and BEAT SYNC, however.

You get more information in **FROM LEFT TO RIGHT**, especially in the chapter MODE.

IMPORTANT HINTS FOR BEGINNERS

Maybe you are not used to operating switches at an exact moment. So far, most footswitches have been used to switch programs. Precision was not a necessity then. In the LOOP delay, however, the **rhythmic precision** of the loop directly depends on your ability to communicate your rhythm to the machine. That is why we speak of rhythm switches. Most beginners forget at first that the breaks have to be recorded, too. Some of them press RECORD and start playing some time later or they press RECORD too long and bring the delay into Reset state again. Some end their recording too early by tapping the switch on the last note of the sequence.

Should you have problems, try using the rhythm in your leg that you feel anyway when playing. The switch should not be struck with too much force, because it may cause you to play the first note more loudly or to become imprecise in timing.

Guitar players are recommended to use the free *left* leg.

The first tap on RECORD defines the first note in your loop. The second tap terminates the recording and repeats the loop immediately .

Do not worry about the non-schematic organisation of the switches. Our practical experience has lead us to this arrangement. You can experience this "**musical logic**" only through playing. If you do not understand how the switches work, read the chapter **From left to right**. Maybe our diagrams can help you as well.

If you want to synchronize or sequence, you have to read the respective chapter in **Communication facilities**.

For sampling, read the paragraph **BREAK**.

The **playing hints** are interesting, if you do not have any more ideas or if you want to discover one of the many ways of musical expression.

Start with few keys and short loop times. Do not overcharge yourself.
You got a new instrument and now have to learn to play it. Without a process there is no quality. Take your time – it is nice to learn while playing. The LOOP delay should not burden you with work but relieve you of it.
Even with RECORD and MULTIPLY you can give great solo concerts.

STEP BY STEP

CONNECTING

Before connecting the *power cord*, confirm that the right voltage (220V or 110V) is showing in the display above the power socket (see also chapter **Fuse**, page 30).

Connect your instrument to the *input* IN with a jack cable. Connect the *output* MIX to an amplifier.

Hint! The simplest way of understanding the LOOP delay from our point of view is to connect a microphone and to build up a loop of short spoken phrases. While speaking it is easy to operate and control the LOOP delay. In our examples and diagrams we will often refer to this possibility.

Turn the LOOP delay on.

Turn the *input control* up so that the LED is often orange and sometimes red.

Set the MIX *control* to middle position.

Turn the *feedback control* up.

Compare your LOOP delay with the illustration in the appendix. There the three controls are set correctly.

Your LOOP delay includes at least one footswitch. Connect it with RECORD. In case you have ordered several footswitches, plug them into the OVERDUB, MULTIPLY, INSERT, BREAK and UNDO sockets. The frontpanel keys have the same functions as the footswitches. Therefore you can use all LOOP delay functions with only one footswitch, but the switches on the front can only be operated by hand — another reason for starting with a microphone.

Operate the footswitches (and of course the hand switches) rhythmically, i.e. only strike them gently. Do not relax on the switches. Many have special functions when pressed for a longer time.

The connected footswitches (FSP1) do correspond to the functions of the front panel switches.

Tap the switches shortly, do not press longer than one second for normal functions.

MEANING OF THE LEDS

The LOOP delay has three kinds of LED displays:

- level display
- mode display
- function display

Here we are only going to explain level display and function display which are LED dots. We will come back to mode display in the chapter MODE switch. All dot LEDs have three colours: green, orange and red.

Level display

The input gain LED displays the level of the incoming sound. It will often burn orange, driven by loud passages.

The loop level LED (also called feedback level) displays the volume of the running loop. If FEEDBACK is fully open, too much overdubbing will take it to burn red and to distortion.

Function display

The other LEDs serve as switch and function displays. The different colours generally indicate the following:

- Off The switch has no function at the moment.
- Green The switch has the function written on the front panel. Tapping the switch activates the function.
- Red The switch has been struck once before and the function is active. A second stroke ends the function.
- Orange The switch has a special function. Tap it only when you are sure (or to try it out).

Generally:

The green displayed switches (functions) are ready to be started, the red ones are active and ready to be ended.
--

RECORD SWITCH

- Tap the RECORD switch
- Play for a while (e.g. one beat)
- Tap RECORD again

Now you should be hearing the same beat over and over again.

This is what we call a basic **loop**.

As long as the LOOP delay is recording, the LED next to RECORD is red. At your second tap it turns back to green.

Now you can play on without changing the loop.

Once you have become sick of the loop tap again:

- tap RECORD
- playing
- tap RECORD

You have deleted the old loop and replaced by a new one.

This is the most important function of the LOOP delay. You would get the same result by recording the same sequence onto a tape recorder over and over again — with the LOOP delay you can do this live!

<p>RECORD > RECORD records a new basic loop. This loop is played over and over again.</p>
--

Red digits (digital display)

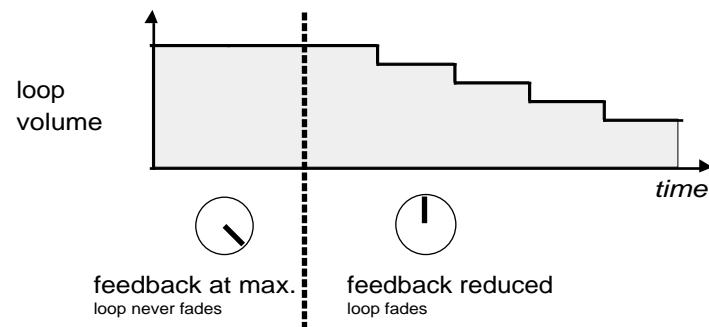
As long as the LOOP delay was recording, the red digital display kept counting. It indicates the current loop length in seconds. After the recording, the counting stops and shows the present loop time. It will change again when you record a new loop (or starts MULTIPLY or INSERT which will be explained later on).

Hint! Users may sometimes have trouble to realize whether the LOOP delay is recording or not. The red digital display can tell you. It is only counting when RECORD is active (or MULTIPLY or INSERT).

<p>Display LOOPTIME the length of the loop is indicated in seconds by red digits.</p>

FEEDBACK control

When feedback is turned up (FEEDBACK control on the right or pedal pressed down), the loop is repeated infinitely without loss of quality. When the FEEDBACK control is turned down, the loop fades out step by step (the steps depend on the setting of the control).



Feedback reduction does not react immediately, it takes one loop length to respond. Consequently, the loop is repeated exactly once when feedback is set to 0.

FEEDBACK determines the speed of fade-out.

Hint!

Long loops (> 20 seconds) need special attention for proper use of FEEDBACK. Since the reaction time takes one loop, it is not easy to control its decrease.

A fast fade-out of long loops could be rhythmically disturbing if FEEDBACK is reduced just somewhere in the running loop. We recommend to adjust FEEDBACK right at the starting point of a rhythmical loop.

For advanced controlling of FEEDBACK we recommend to use the CP1 pedal.

OVERDUB switch

OVERDUB gives you the chance to record anything *over* the old loop without deleting the old one. Thus you can record a second voice and more to a basic harmony. Such layers do not consume memory time, the basis loop time will not change.

Let us restart our example:

- tap RECORD
- play the basis
- tap RECORD
- play a second voice (without recording)
- tap OVERDUB
- play the second voice over the basis loop
- tap OVERDUB

Note!

Do not keep overdub active longer than necessary. Open it only when you are ready to record your additional phrase and close the function after that. Of course you can use OVERDUB all the time, but then you ought to reduce FEEDBACK. This is a very special style: Everything that you play is repeated in the loop and fades out slightly one by turns.

OVERDUB > OVERDUB

Everything you play between two taps is recorded **over** the old loop.

Important!

At this stage it is important to put the manual aside and to take a constructive break. Take your instrument and practice with the switches that you know by now. There are numerous variations with RECORD and OVERDUB. Maybe you will never need any more switches for your style of music.

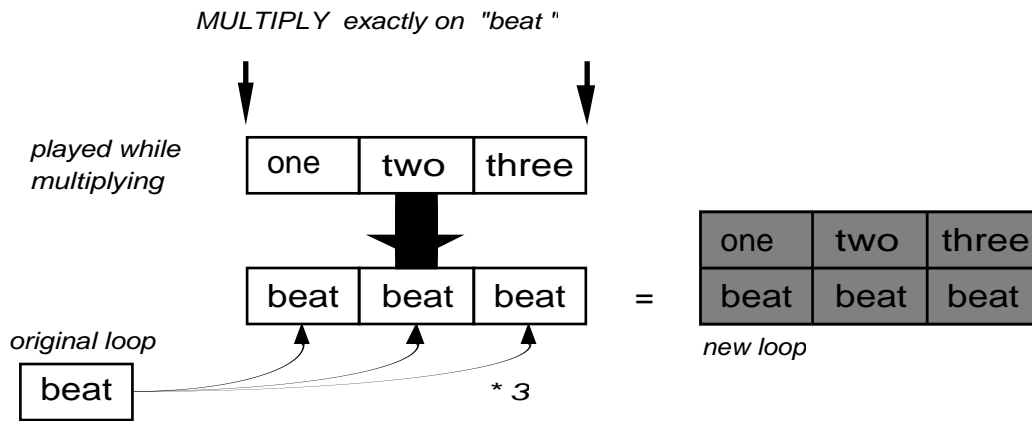
MULTIPLY switch

You have created your basic loop (beat) with RECORD > RECORD. With MULTIPLY you can now multiple that beat several times and join to an expanded loop. While multiplying, everything you play is also recorded, similar to OVERDUB.

The operating is simple: You tap the MULTIPLY switch to start the multiplication and tap it again to end it. The time passing between your two taps defines how many beats your loop is composed of.

- tap MULTIPLY
- play for a while together with your basic loop
- tap MULTIPLY

Let us call your basic loop (created with RECORD > RECORD) a **beat**. Tap MULTIPLY, speak "one", "two" and "three" into the microphone and tap MULTIPLY again. You will now hear this:

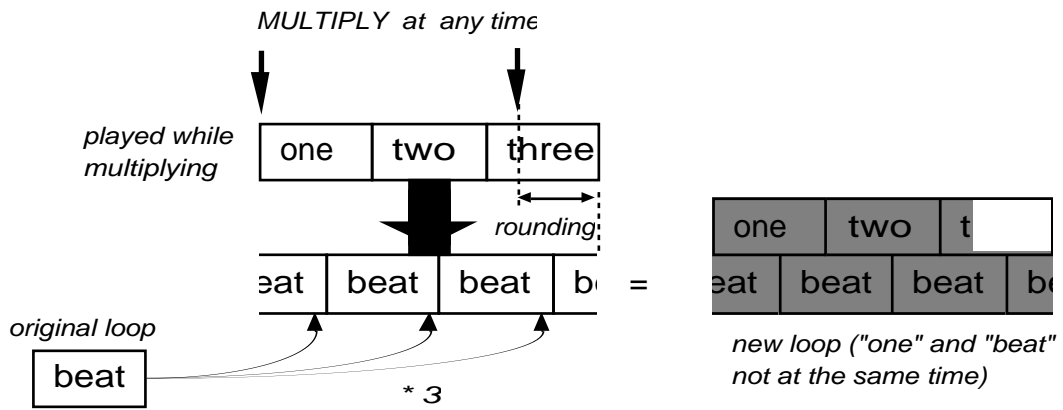


The LOOP delay has exactly tripled the basic loop "beat" and summed it up to a single loop consisting of "beatbeatbeat". "One", "two", "three" have been recorded over this tripled loop.

We said the expanded loop is **exactly** three times as long as the original loop. But what happens when you tap MULTIPLY inexactely?

- tapMULTIPLY
- play
- tap MULTIPLY inxactely
- the LOOP delay rounds to the next beat.

The LOOP delay automatically rounds to an integer beat. When you tap MULTIPLY quite precisely you probably won't even notice. Tap it in the middle of a beat and you can observe the rounding process:



During the multiplication the red loop time display continues counting. Do not panic when most of the LEDs turn off: The LOOP delay prevents false operation during the rounding process.

Note: MULTIPLY is possible only if the memory capacity is at least tree times the recorded beat. The MULTIPLY LED turns to dark if the memory capacity is insufficient. Three bars (--) in the display indicate an overflow of the memory.

MULTIPLY > MULTIPLY

MULTIPLY lets you create an expanded loop composed of a number of beats
The LOOP delay automatically rounds to an integer beat.

RECORD > RECORD = 1
MULTIPLY > 1...2...3...4... MULTIPLY

This is the usual procedure to create an expanded loop of 4 beats.

Green digits (digital display)

After RECORD > RECORD, the green digital display still is off.

0 1.2

Multiplying the LOOP delay counts each beat, shown in the MULTIPLE display (green). Note that the LOOPTIME (red digits) starts at 0 and counts up to a multiple of the basic beat until you tap MULTIPLY for a second time.

0 1.2 1 02.4 2 03.6 3

After terminating the multiplication, the MULTIPLE display (green) starts at 1 and counts to the last beat of your loop. This way you always know in which part of the loop you are.



Display MULTIPLE
The green digits tell you in which beat your music is.

LONG SWITCH PRESSING

Up to now you have only tapped the switches. Strange things happened when you accidentally pressed them for a long time. Most switches offer special functions when pressed long:

- long RECORD -> Reset
- long OVERDUB -> Overdub is only active while pressed

Reset is similar to a turn off / turn on of the LOOP delay. It takes the LOOP delay is in the original state and you can start over.

Long OVERDUB helps you to play single notes onto the loop. Press it while playing and release it when the overdubbing should end.

We will discuss the special functions of the other switches in the following chapters.

Long pressing of switches activates special functions.
 long RECORD -> Reset
 long OVERDUB -> Overdub as long as pressed

FROM ONE FUNCTION DIRECTLY TO ANOTHER

You normally end a function by tapping the same switch for a second time.

RECORD ... recording ... RECORD MULTIPLY ... multiplying ... MULTIPLY

With the LOOP delay you can end a function with another switch. In this case the second function becomes active at the same time:

RECORD ... recording ... MULTIPLY ... multiplying ... MULTIPLY

You do not only avoid one extra stroke but it also helps you prevent an interruption of your recording.

This principle goes for most switches. All active functions (the corresponding LED is red) can be ended by switches with green LEDs. This second function gets active immediately. You cannot use the switches with orange LEDs, however: they have got special functions.

Here a second example:

- tap RECORD
- play the basis
- tap OVERDUB
- carry on playing, the LOOP delay records over the old loop
- tap OVERDUB

An active function can be ended by another switch when its LED is green. The function of this switch gets active at the same time.

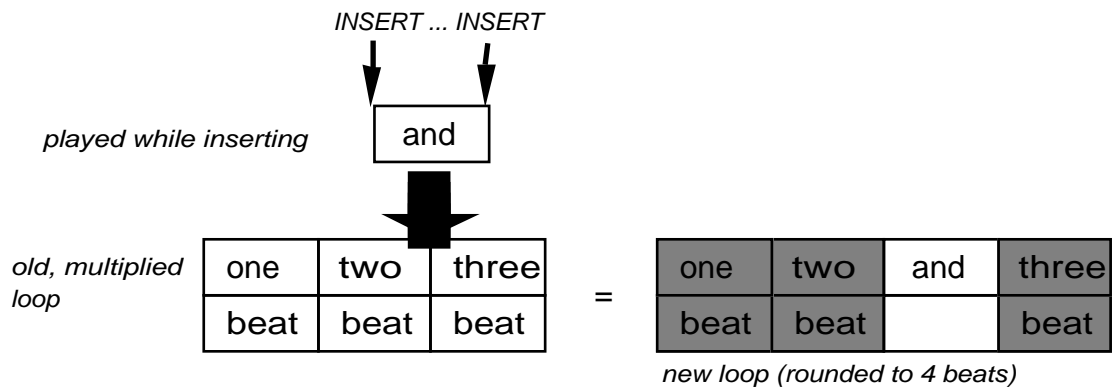
INSERT switch

With INSERT you can insert additional beats into your loop. Let us assume your a loop is composed of three beats:

one	two	three
beat	beat	beat

Tap INSERT after "two", play a beat and tap INSERT again.

- tap INSERT
- play one beat
- tap INSERT



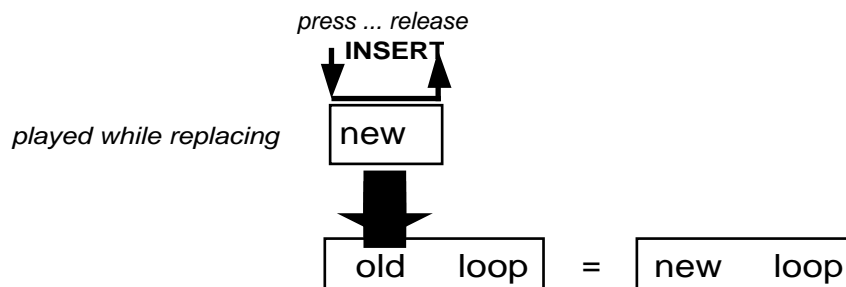
"And" is the new inserted beat. The LOOP delay automatically rounds up to the next beat. See **MULTIPLY switch** for "rounding".

INSERT > INSERT

What you play is inserted into the loop.
The LOOP delay automatically rounds up to an integer beat.

SPECIAL FUNCTION REPLACE

Replace is a special function. Activate it by pressing INSERT for a long time. As long as INSERT is pressed, the part of the loop currently running is replaced by what you are playing.



long INSERT (= REPLACE)

As long as you press INSERT, this part of the running loop is replaced by what you are simultaneously playing.

BREAK switch

Active BREAK turns the output volume of the loop off.

Tap BREAK causes silence from the loop until a second tap on the BREAK switch.

BREAK > BREAK

As long as BREAK is active, the output of the LOOP delay is muted.

The LOOP delay silently continues running when break is active. Thus, you keep the same rhythm after the break (e.g. when your drum machine plays on). When you press BREAK for a while, the output is only turned off while you press. As soon as you release it, the loop goes on.

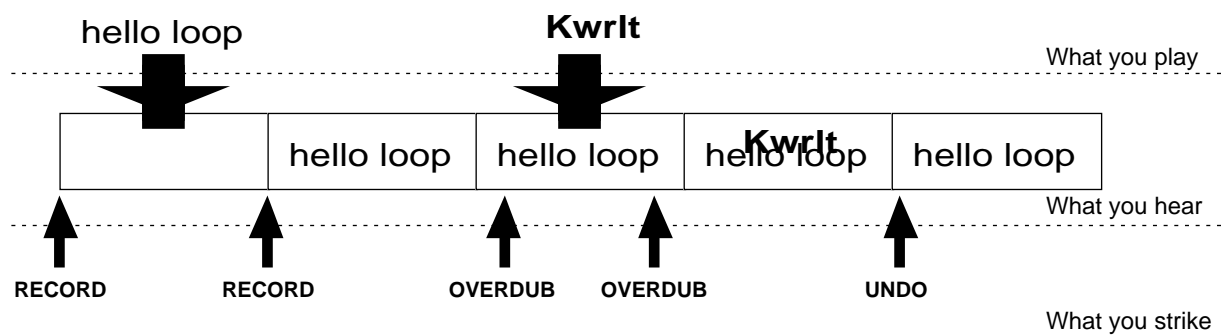
UNDO switch

UNDO has two different functions.

1. You have activated a function by mistake. Tap UNDO to cancel the function.
2. The previous movements in your loop can be cancelled when you are in regular play.

Try out the first case, for instance with MULTIPLY. Tap MULTIPLY, wait for a while, then tap UNDO. You have gone back to the old loop without multiplication.

The following diagram may help you to understand the second case.



You have, for instance, recorded a mistake with OVERDUB. Now you want to delete it but save the rest of your carefully composed loop. Tap UNDO and it will be gone.

UNDO

UNDO cancels the previous movements in your loop.
If a function is active, UNDO cancels it.

Note! It depends on the memory capacity how often you can strike UNDO successively. Cancelling a previous movement in the loop needs at least the half memory free.

The exact application of UNDO can only be learned through experience, because the machine has its own way to decide, whether you made a change in the loop composition or just played it. (See chapter **AutoUndo** if you want to know more)

MODE switch

The LOOP delay can do more than just recording and playing loops. As its name tells you, it can be used as a regular delay. Switch with the MODE button between *loop mode* and *delay mode*.

With the CP1 pedal connected, you have access to even four modes of operation: *loop mode*, *delay mode*, *output mode* and *advanced mode*.

The two LEDs next to MODE indicate the actual state of this function.

MODE (STANDARD)	
Pressing this button changes three modes of operation:	
• loop mode	top LED burns green
• delay mode	bottom LED burns green
• advanced mode	top LED burns red

MODE (EXPANDED)	
Connected with a pedal, the LOOP delay offers four different modes:	
• loop mode	top LED burns green
• delay mode	bottom LED burns green
• output mode	top LED burns orange
• advanced mode	top LED burns red

A long pressing of MODE sets it to *loop mode*.

Loop Mode (top LED green)

This is the regular mode of the LOOP delay.

If you have the CP1 connected, this pedal controls FEEDBACK instead of the front panel control.

Delay Mode (bottom LED green)

No looping, but regular delay. The pedal controls the input volume.

The OVERDUB switch now changes its function to **HOLD** that works as used to traditional delays.

Output Mode (top LED orange)

Similar to the loop mode, except the CP1 pedal controls the loop output volume.

FEEDBACK can be controlled with the front knob.

Advanced Mode (top LED red)

Similar to the loop mode, except FEEDBACK is always fully open although the front control is setted backwards. FEEDBACK reduction only happens if OVERDUB is activated.

If a pedal is connected, it controls the input volume.

FROM LEFT TO RIGHT

In case you are not sitting in front of the LOOP delay, we recommend taking the enclosed LOOP delay diagram when reading this chapter. Each operating element on the front corresponds to a connection on the back.

INPUT WITH LIMITER (INPUT / INPUT VOLUME / LED)

Connect any sound source by a jack cable. The sensitivity allows connecting microphones. At the same time the input has a sufficiently high impedance in order to conserve the sound quality of piezo pick-ups. For sensitive applications we recommend feeding the LOOP delay from an auxiliary output (AUX) of a mixing desk or a pre-amp. For electric guitars we recommend inserting the LOOP delay into an amplifier (Insert-socket) or controlling it from the output of effects. (See **Important** in the next paragraph). Connecting synthesizers is straight (There are connecting examples in the **appendix**).

Adjust the INPUT VOLUME so that the LED most often is orange, but sometimes turns red. Since there is a limiter you will not get a distorted sound even when the LED is red. The limiter can be used as well as an effect: This serves to make "loop carpets", (so called "sound clouds") formed out of non-dynamic sounds.

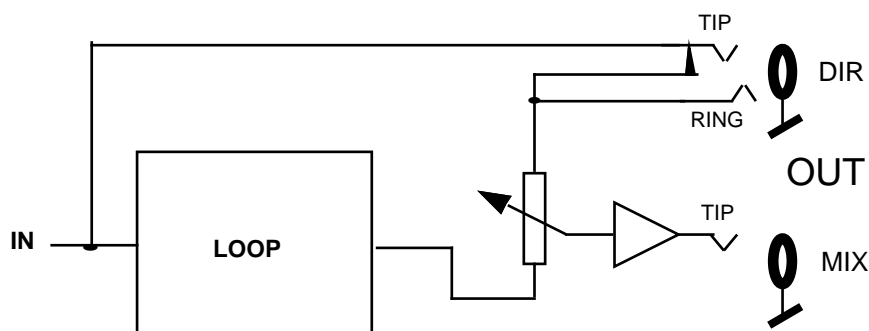
Note! The limiter works for the loop only. It does not affect the direct signal. The limiter provides no absolute security against distortion: you still can overload the loop with too many OVERDUB layers.

OUTPUTS (MIXOUT / DIR. OUT / MIX CONTROLLER)

Important! The output should not be connected to an overdriving guitar amp except if you want to build very dirty loops — so called "thick walls". We recommend connecting all effects before the LOOP delay except for reverb. Then you should connect a system that is as linear as possible, for instance a PA or HiFi system.

The MIX output is always in use. The DIRECT OUT is only in use when the direct signal is processed separately from the loop signal. This allows you to separate acoustically the loop from your current playing by panning them or using different amounts of reverb.

In case you have only connected the MIXOUT, the MIX knob controls the relation of direct and loop signal. If both outputs are connected, MIX controls the loop volume.



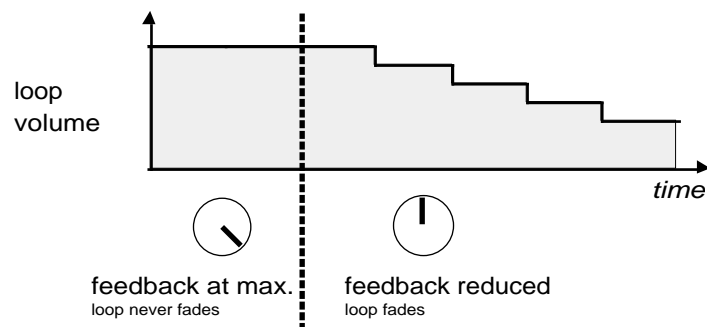
FEEDBACK

Feedback means sending information from the output to the input of the system. The amount determines:

- >1 high feedback. Continuous growth (e.g. population explosion).
- =1 consistent waves (e.g. natural growth in a healthy forest).
- <1 slow fade-out (e.g. echo in a valley).

The FEEDBACK control sets the feedback value between 0 and 1. Thus, you control the number of loop repetitions between 1 and ∞ . In intermediate positions the loop fades out.

The feedback/loop level LED indicates the volume of the loop and should hardly ever turn red. The limiter does not prevent the eventual distortion when overdubbing many layers. The feedback LED points this out by turning red.



Important ! When OVERDUB is active, the feedback will automatically be reduced to a maximum of 95% . (see OVERDUB, page 22)

Hint: If a loop is faded out and you want to discover it again, press UNDO several times - it will come up again.

MODE

You can switch between four modes. Each stroke switches to the next one. A long pressing of MODE sets it to loop mode.

Loop Mode

This is the default mode selected when the LOOP delay is turned on (top LED is green). Most of this manual is about the loop mode. An additionally connected pedal controls FEEDBACK.

Delay Mode

It is indicated by the bottom green LED. The LOOP delay becomes a regular delay. The RECORD switch now determines time setting. An additionally connected pedal controls the delay input. This is very helpful when extending or prolonging notes during solo play, or when playing short licks.

The overdub function is turned to a regular HOLD: Regular state (green) is delay. In HOLD (red), the loop just played is frozen and repeated infinitely.

Output Mode

The output mode (orange top LED) is close to the loop mode, the CP1 pedal controls the output volume, while FEEDBACK is controlled by the front panel control.

Advanced Mode

The advanced mode simplifies the use of FEEDBACK without pedal: The adjusted FEEDBACK reduction (on the front knob) only becomes effective by activating OVERDUB. If a pedal is connected, it controls the input volume.

FUNCTION SWITCHES

How to control a lot with a few switches!

We had to develop a new manner of operating switches: a combination of the well known radio-buttons (which start each other respectively) and of engaging press-buttons. The former have the disadvantage in that only one can be active at the same time; the latter that you have to operate several ones in order to achieve a certain state. We have done research concerning the question of what switch-combinations make sense at all, and what combination should be used in what situation. The resulting scheme while not appearing systematic, is highly practical.

The most important functions are turned on and off with one switch.

When turning off a function with another switch, there are two variations: In standard cases (LED is green), a new function is selected and the old function is terminated. You will never have to operate two switches at the same time. When the LED is orange, tapping the respective switch activates a less important variation of the function.

A third variation is the long pressing of a switch: The function is terminated as soon as you release the switch.

Each main switch function and its variations are now explained in detail:

RECORD

Operating this switch is the basis of each loop. It determines the beat length. A first tap starts the recording, a second one ends it, and immediately the recording is played. The interval between your two taps is called *beat time*. This replaces the circumstantial adjusting with "up - down" in regular delay effects. The LOOP delay takes up the rhythm directly from the musician's foot.

Long pressing causes reset.

Instead of tapping RECORD a second time, you can end the recording in any of the following ways:

RECORD > OVERDUB

Record is terminated, but the recording goes on uninterrupted and makes a layer over this loop.

RECORD > MULTIPLY

Record is terminated, the recording goes on uninterrupted and MULTIPLY becomes active.

RECORD > INSERT -> special function Rehearse

Record is terminated, but instead of activating INSERT, you go into Rehearse. In this state, all you play is repeated exactly once (as if FEEDBACK were turned down and OVERDUB active). Apply Rehearse to get used to the beat length: By listening to the single repetition, you will get used to the timing. Thus, you can try out different ideas until you feel comfortable with your starting theme. Once you have developed a musical idea, tap INSERT again to exit the Rehearse state and to continue in ordinary playing state. Pressing OVERDUB instead of INSERT allows you to exit the Rehearse state and continue simultaneously with active OVERDUB. (see chapter **Correcting**).

RECORD > BREAK

The timing (beat) is determined, your recording is finished, but remains mute — like a sample stored for later use.

RECORD > UNDO

You can regain an old loop with UNDO if you pressed RECORD accidentally! It will not continue straight in the rhythm — a limited miracle.

OVERDUB

OVERDUB records additional layers (background or lead tunes) as many as desired. All your playing is mixed to the existing loop. The loop increases its intensity but does not change its length, thus does not consume additional memory.

Long OVERDUB: overdub is only active while you press the switch — this is interesting when overdubbing single notes. You can always feel if you are overdubbing without depending on optical control. For most applications, however, it is annoying not to have a foot free. It is possible to operate OVERDUB exclusively in this manner. You would have to switch a miniature switch in the inside of the LOOP delay (see **DIP-Switches**).

The OVERDUB function is special, because it can terminate all other functions, but cannot be affected by any other function (Reset excepted).

Important! Infinite overdubbing cannot cause a sound quality decrease, but can cause an accumulation of noise and distortion. Therefore, maximal feedback is automatically reduced to 95% while OVERDUB is on. This minimal feedback decrease is of no consequence whatsoever.

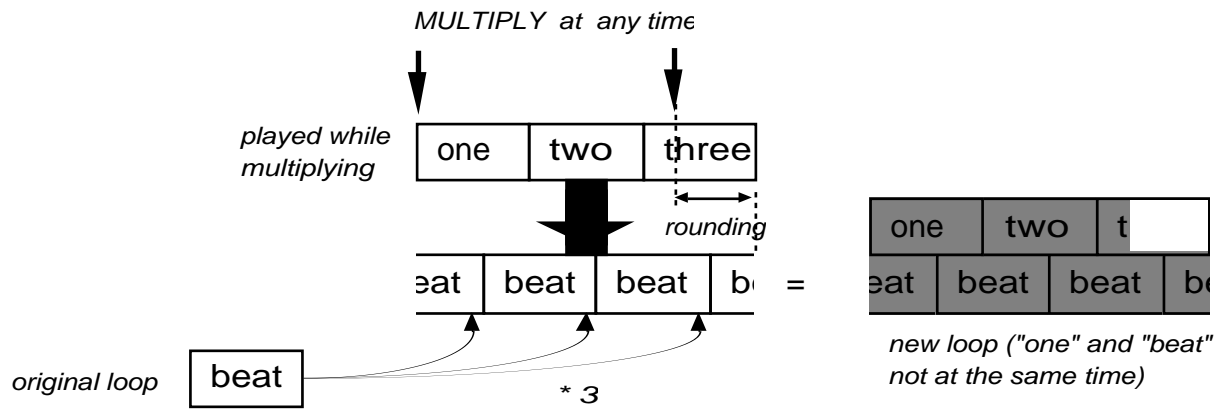
MULTIPLY

Just like OVERDUB, the recording continues, but MULTIPLY changes the loop length! Its length is always rounded to an integer number of beats. The rhythmic regularity is conserved and there are certainly no clicks!

The LOOP delay normally rounds *up* to the next multiplied number of beats and only rounds *down* when the exact multiplying is overshoot by less than 600ms.

The green display (MULTIPLE) shows in which beat your expanded loop currently is.

Let us assume for instance that a microphone has been connected with the LOOP delay. The first loop consists of "beat" and is going to be multiplied while you speak "one", "two", "three" into the microphone. You can even start MULTIPLY in the middle of "beat" without introducing rhythmical errors.



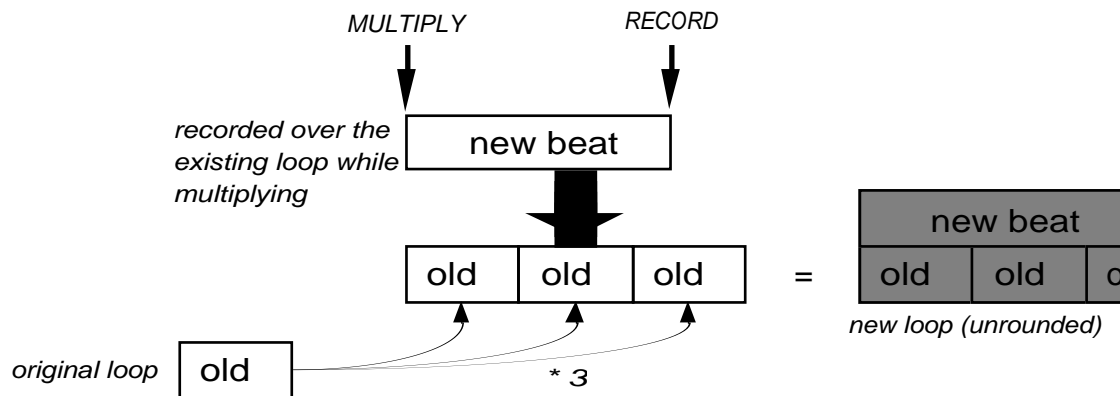
Hint ! An already multiplied loop can always be multiplied for a second time — to reduce or expand it again. Thus, you can cut any number of beats out of an expanded loop with multiply.

Important ! As you can see in the diagram, the beginning of the Loop does not necessarily coincide with the beginning of the beat.

Limitation: Multiplication is possible only if the memory capacity is at least three times the recorded beat.

MULTIPLY > RECORD -> special function Unrounded Multiply

The multiplication is finished without rounding, and a new beat is defined. The green display turns off. The new beat contains the music between your taps of MULTIPLY and RECORD. Thus, any part of the loop can be cut out from the loop. Completely new rhythms result from the repetition of this part — a new piece of music out of old sounds.



MULTIPLY > OVERDUB

Ends MULTIPLY and activates the state of OVERDUB.

MULTIPLY > INSERT

Switches from MULTIPLY to INSERT directly, no rounding is done. The green display goes on counting. Just FEEDBACK turns off internally so the following recording is without background. When you terminate with INSERT, the usual rounding is done.

MULTIPLY > BREAK

MULTIPLY is ended and the loop mutes after rounding.

MULTIPLY > UNDO

The loop goes on as if you never had pressed MULTIPLY.

Note again: With MULTIPLY you cannot fill up the whole memory, because the original loop has to remain in the memory — otherwise MULTIPLY could not be cancelled with UNDO.

The MULTIPLY LED turning dark tells you:

While Recording: It makes no sense to go directly to MULTIPLY, because more than one third of

the memory is used up.

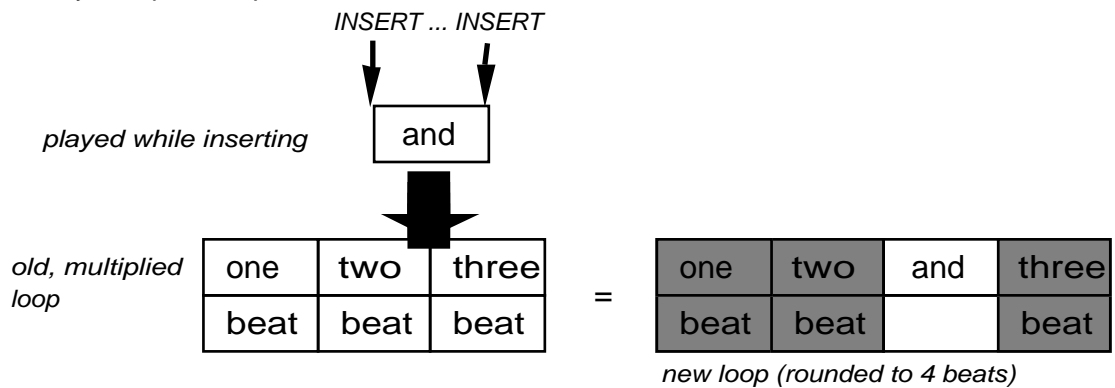
While Playing: It is not possible to *expand* the loop by MULTIPLY.

While Multiplying: It will not be possible anymore to add an intire beat. You should stop MULTIPLY

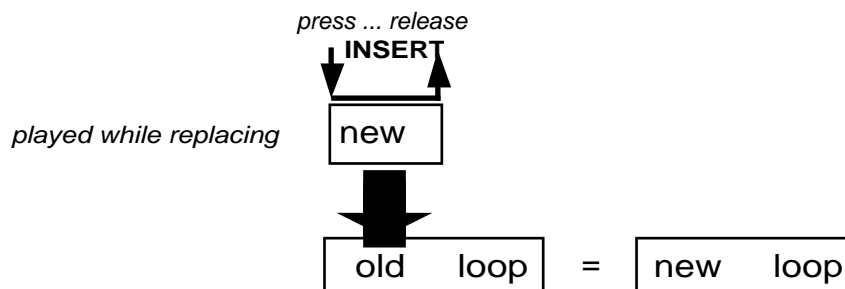
or better cancel it with UNDO.

INSERT / REPLACE

Additional beats are inserted into the loop. Tapping this switch stops the loop and starts new recording. The green display is counting. At a second tap, the loop goes on and the time is rounded as in MULTIPLY. This function is great to insert breaks or a B-part of your tune into already multiplied loops.



A long pressing of INSERT does not change the timing, but replaces the existing part of the loop with the actual playing. We call this function REPLACE. You can correct mistakes or insert variations in multiplied loops (see also **Correcting** page 39).



INSERT > RECORD -> special function Unrounded Insert

The inserted part is not rounded. Thus, a new beat is defined (similar to MULTIPLY-RECORD).

INSERT > OVERDUB

INSERT ends with regular rounding. At the same time OVERDUB reacts its state.

INSERT > MULTIPLY

Direct jump from INSERT to MULTIPLY. No rounding is done. Some part before or of the Insert comes back as background of the multiplication. Sometimes not very musical.

INSERT > BREAK

INSERT ends after rounding and the loop runs on mute.

INSERT > UNDO

INSERT is canceled.

BREAK

The loop goes on, but muted. At a second tap the loop restarts sounding. In fact, only the loop output is turned off and on.

After a long pressing of BREAK the loop restarts sounding as you release the switch.

BREAK > OVERDUB

BREAK is ended, and simultaneously OVERDUB reverses its state.

If you want the loop to start over, select one of the following special functions:

BREAK > MULTIPLY -> special function TriggerSample

Nothing happens until a SYNC signal comes. Then the loop will be played *once*. Subsequently it falls back and waits for the next SYNC.

If there is a new SYNC signal before the loop is played, it starts over.

Note ! This special function corresponds to a **sampler**. For SYNC read page 29 following.

BREAK > INSERT -> special function PlaySample

Nothing happens until a SYNC signal comes either from a BEAT SYNC or via MIDI. Then the loop is played once before returning to BREAK state. It is especially usefull with a regular SYNC signal like MIDI SYNC.

BREAK > UNDO -> special function Replay

The loop is set to its starting point and is replayed. (Only possible if the loop does fill at most the half of memory capacity)

UNDO*During a TIMING-function (RECORD, MULTIPLY, INSERT)*

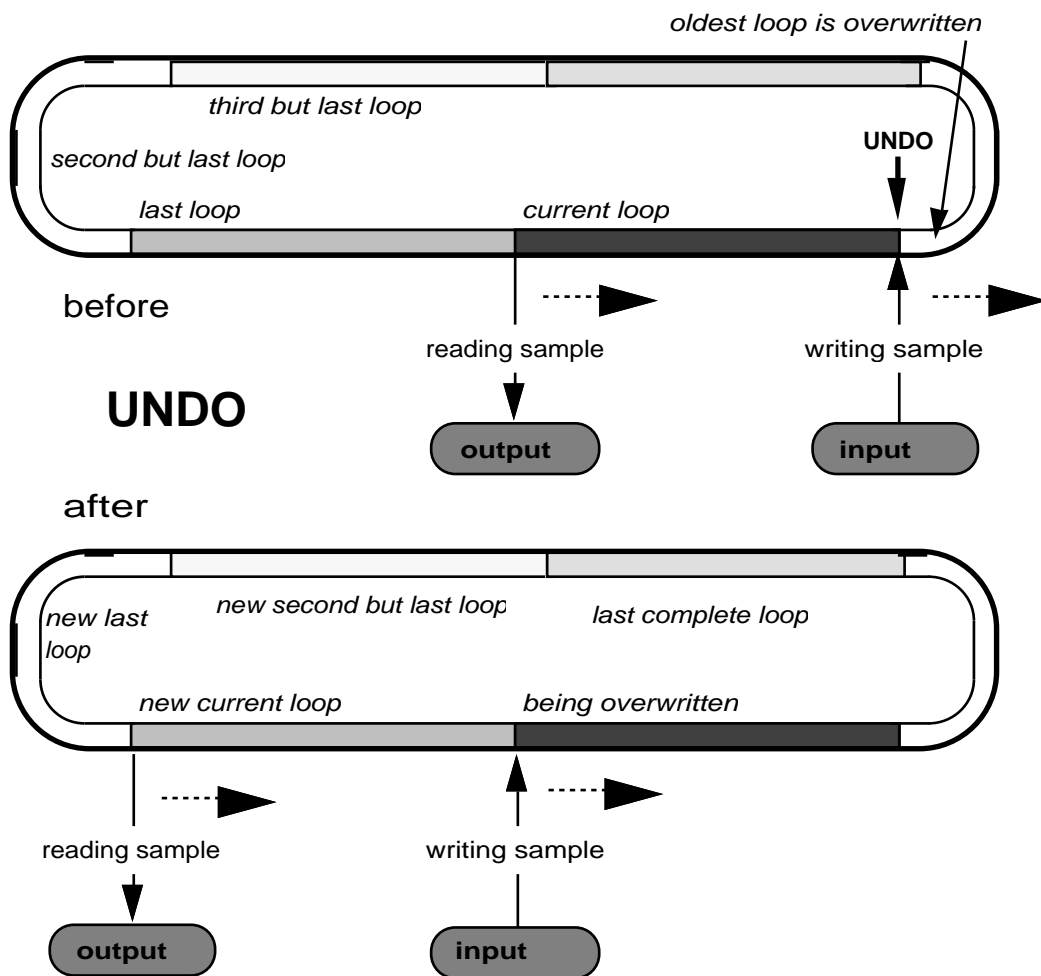
You may have pressed a wrong switch and you want to save the loop. UNDO was developed for this purpose.

During RUNNING state

When you press UNDO, you jump *one entire loop back* in the memory — all you recorded since you have been in the same part of the loop is erased. There is a rounding so that if you tap next to a loop start, you jump back to the start of the last loop. If you press UNDO long, it erases always the *current and the whole last* loop. So if you press it long, it does not matter when you press it.

This function is helpful if you have made a mistake in a carefully built loop. You can apply UNDO as part of your own creativity, too: try out different phrases onto an existing loop and delete them in case you do not like them (see also **Correcting** page 39).

Hint ! If your LOOP delay has sufficient memory, you can go back to the history of the loop composition by pressing UNDO several times. The same goes for FEEDBACK (see page 19).



Note! Changed timing cannot be reverted. As a consequence, UNDO goes back in different steps after a multiplication (try out!).

UNDO works together with **AutoUndo**. You may be amazed sometimes in what part of the song you end up, if you do not understand the co-operation between Undo and AutoUndo.

If it is not possible to execute this function correctly (maybe not a whole loop passed since the last change of beat time or maybe there is not enough memory capacity) the LED goes dark and nothing happens if you press the key. Sometimes the LED may blink, because the conditions for UNDO keep changing during the loop runs. Synchronisation can change the conditions, too.

DISPLAY

LOOPTIME (red digits)

The display shows the length of the present loop in seconds:



Three dashes in the display indicate OVERFLOW: The memory capacity was insufficient to go on recording. The function causing OVERFLOW is undone and the loop carries on unchanged. The display --- remains in order to inform you about your mistake. Press any key (preferably OVERDUB to change nothing) to get the previous loop time back on the display. The next change of the loop time is displayed normally.



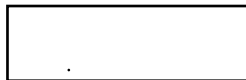
memory overflow

When turning the LOOP delay on, it will always inform you first about the total available delay time:



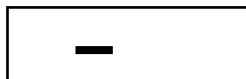
maximal loop time

In Reset state there is just a little dot



Reset

A dash in the center of the display (-) indicates that a BROTHER SYNC has been connected and that your LOOP delay is waiting for the brother to start:



waiting for brother

The display HLP 00 indicates that the memory modules have not been put in correctly (see **Memory expansion**):



no memory accessible

The display HLP 01 indicates that a switch has been pressed at startup. The LED of the corresponding switches sparkles red. The bottom MODE LED indicates a shortcut at the ring of BrotherSync, e.g. a mono instead of a stereo cable.



Switch pressed at startup

The right decimal dot

A green dot all right in the display flashes when the loop is passing its start point.

Note ! The flashing of the dot does not necessarily coincide with the changing of the beat numbers that depend on your last MULTIPLY action. For sampling and synchronising the beginning of the loop, the dot flashing is relevant.

MULTIPLE / MIDI (*green digits*)

when RUNNING

The number of the current beat is indicated. If you have not used MULTIPLY or INSERT, the digits remain dark.



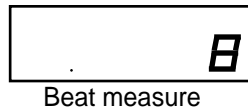
RESET > OVERDUB

shows the state of Quantize: 0.0 means OFF, 0.1 = ON



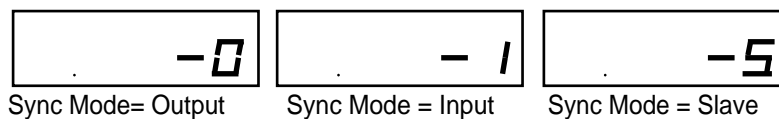
RESET > MULTIPLY

shows the number of eighths in the measure.



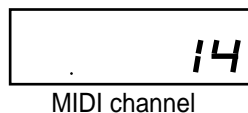
RESET > INSERT

With INSERT in reset state, the Sync Modes are displayed and changed. -O = output -I = input:



RESET > BREAK (UP) > UNDO (DOWN)

After turn-on or reset you can select the MIDI channel with UP (BREAK-switch) and DOWN (UNDO-switch). The green display shows the selected channel (e.g. Channel 14):



The left decimal dot

A flashing dot at the left green digit informs you about SYNC:

In *Reset* it indicates the incoming SYNC signal. Thus you can tell your partners beat before you start playing. If you are working with MIDI you can see whether you have chosen the right beat.

Furthermore, you know after the first flash that temporary quantizing is turned on.

While playing it indicates when synchronisation has its effects, i.e. the dot flashes each time there is a time change. If it does not flash does *not* mean you are playing unprecisely. However you will see that the dot never shows during OVERDUB — and in fact synchronization is impossible.

MIDI

The usual three sockets receive (IN), send (OUT) and transmit (THRU) MIDI control signals.

THRU is an exact copy of IN

All switch activities and FEEDBACK information are sent to MIDI OUT to register them on a sequencer or to control a second LOOP delay.

IN receives the same signals for reproducing the switch activities or to follow the master LOOP delay.

It is recommended to use MIDI channel 16 but it can be modified in Reset state with UNDO (DOWN) and BREAK (UP).

MIDIClock is received and can be used to synchronise with a sequencer or drum computer.

Further informations follow under the title **Communication facilities and deeper understanding.**

SYNC JACK SOCKETS

BEAT SYNC

BEAT SYNC can be used for the synchronization of non-MIDI instruments. In Reset you can choose with INSERT whether the BEAT SYNC shall be input or output. The MULTIPLE display shows -O when output and -I when input.

Beat Sync as input -I

BEAT SYNC reacts to a footswitch (we recommend FSP1) or to a sound signal with line volume.

When the loop is running, all signals near the beginning of a beat are interpreted as synchronization signals, and return the loop back to its start point. Thus, the loop can adapt to the speed of a signal (e.g. the bass drum).

In case the loop has been stopped with BREAK and set to TriggerSample with MULTIPLY, you can play it with each BEAT SYNC exactly once and wait again— just like a sampler.

When you tap INSERT while BREAK (PlaySample), the loop is played once and then returned to BREAK.

Note! We cannot guarantee the noise-free functioning of synchronization connections. In order to correct the beat time, blocks have to be deleted or inserted. Depending on the kind of music, clicks or blips can be heard. Usually, at the beginning of a loop, there is a sound attack that covers the cut.

Beat Sync as output -O

A digital impulse is given with each beat. The signal can be amplified directly and serve as a metronome, its sound is not very pleasant, though. It can trigger any sound producing machine.

BROTHER SYNC

By connecting several independent LOOP delays through a stereo jack cable, they can play on the same beat! Through the tip of the plug, the machines are synchronized on sample level. Therefore they have the same time basis. Through the ring the synchronisation signal is exchanged to allow the players to find a common beat. The player opening the session gives his beat to his fellow musicians by a recording. All can then build their own loops independently. If the Brothers follow each other, -O is recommended to avoid unnecessary synchronisation; if they follow an instrument, -I is needed.

Hint! The BROTHER SYNC input can be "abused" for modulation. With a variable generator producing a 5V signal with pulses at 20kHz to 45kHz the sampling frequency can be changed from the outside. Thus, speed and frequency of the loop can be changed — not much higher but more than an octave lower if the generator creates a short positive pulse. It is impossible to retain the sound quality, however.

POWERCORD / VOLTAGE / FUSE

The power socket is made for standard power cords. The voltage is displayed in the small rectangle above the socket (110V/220V). To change it, press the two clips at the short sides of the rectangle with your fingernails, remove the rectangle and turn the square containing the fuse by 180°, so that the correct voltage appears. Put the rectangle back in. This fuse is the only one in the LOOP delay.

DIP-SWITCHES

In the interior of the LOOP delay, there are five miniature switches. You can get to the switches by unscrewing the *bottom* of the LOOP delay. They are placed near the overdub plug. To switch them you need a good fingernail or a pen. These switches have the following functions:

DIP-switch 1

Calls test programs for service.

DIP-switch 2

Defines the start value for the SYNC MODE: OFF -> -O, ON -> -I. This is a help for users that work a lot with synchronisation. The values can always be achieved by INSERT, too.

DIP-switch 3

Switches off the normal toggling Overdub. OVERDUB is then only active when the key is pressed, with the advantage that the function never stays on by accident. The disadvantage is, that the foot is not free anymore, and that no other function can be called during OVERDUB (see **OVERDUB**).

DIP-switch 4

There is a rather logical and also a rather practical interpretation of UnBreak. So we give you the possibility to exchange BREAK>UNDO and BREAK>BREAK according to your taste. In position ON, the functions are inverted as follows:

BREAK > UNDO: The loop continues in the same timing pattern, as if BREAK had never been pressed.

BREAK > BREAK: The loop starts playing from its beginning.
(and may fall out of sync!)

DIP-switch 5

Switches the input on during rounding. In position ON, all you play during the rounding up at the end of multiplication is still recorded into the loop. The advantage is, that MULTIPLY can be pressed too early to terminate, the disadvantage is that you do not define the end of the recording with your foot.

Caution!

To switch the DIP-switches you will have to remove the bottom of the housing. Therefore unplug the power cord! Most DIP-Switches will have no effect if you switch them while the machine is running.

COMMUNICATION FACILITIES AND DEEPER UNDERSTANDING

RESET

After turning it on, the LOOP delay is in Reset state:

- Input off
- Output off
- loop time = 0, Max. available loop time is shown
- OVERDUB turned off
- MIDI channel 16
- SYNC MODE = input

After pressing the RECORD switch long, you also return to the Reset state and the following happens

- Input off
- Output off
- loop time = 0, red display shrinks to a dot
- OVERDUB turned off
- The SYNC input stays awake, but no SYNC is sent

The Reset Parameters

The parameters for communication are displayed by pressing the respective key in Reset state and modified at the second pressing.

Reset > *RECORD* = *RECORD*

The normal function — the only one to exit Reset.

Reset > *OVERDUB*

Quantizing off: O.O (at startup)
Quantizing on: O.I

Reset > *MULTIPLY*

MIDI Sync 1/1 Note: 8. (at startup)
MIDI Sync 1/8 Note: 1.
MIDI Sync 1/4 Note: 2.
...up to 20/8 Note:20.

Reset > *INSERT*

SYNC OUT BeatSync = Output: -O (at startup if DIP 2 OFF)
SYNC IN BeatSync = Input: -I (at startup if DIP 2 ON)

Reset > BREAK (UP)

MIDI channel up (at startup: channel16)

Reset > UNDO (DOWN)

MIDI channel down (at startup: channel 16)

To reset the Reset - parameters

All these parameters can be set to initial value with a *long* pressing on the corresponding key. This feature does not only speed up the operation but allows it to operate blindly: After pressing it long you know where it stands and how many times you have to press it shortly to get what you want. With MIDI programming this is essential because it allows you to set parameters in the beginning of your sequencer program in an extremely simple way.

Example: If the song is programmed in a 3/4 measure, and when the sequencer is running, do the following operations before you play:
long RECORD; long MULTIPLY; 6 times short MULTIPLY

MODE has the same function in Reset as while running.

AUTO UNDO

A big improvement for UNDO is a trick you do not notice when you use the other functions:

Each time an entire loop passes by without any move made, AutoUndo automatically jumps one loop back in memory. No move means: FEEDBACK must be open all the time and no other function has been activated — apart from BREAK. As a result, you can always erase the previous loop modification immediately although you have played together with your loop for several rounds.

In other words: Only modified loops are kept in the memory. The history of the loop composition is not erased any more by the repetition of a constant loop. UNDO always jumps back to where something was really different. UNDO permits you to go further back in the loop composition.

Remember the pattern of the beats. AutoUndo cannot be done continuously, it is done at the end of a beat or not, depending on the moves during that period.

Moves mean: FEEDBACK is reduced / OVERDUB is on / any other function that adds some recording to the loop.

SYNCHRONIZATION

What is Synchronization?

Synchronization is the coordinated swinging of independent systems. Synchronization of orchestral musicians is the basis to create a rhythm. It is not easy. We need a conductor or a drummer to give the beat. In small ensembles a conductor is not necessary. We think it is important to find similar forms in the technical synchronization between musical machines.

There are different levels of synchronization. An image may serve to illustrate this: You could even call the simultaneous showing up of the musicians in the concert hall as synchronization. If it goes deeper than the rhythm, the musicians may breathe synchronically. Even their heartbeat can get synchronical.

Synchronization levels in loops

Sample

Unfortunately, the word *sample* has two meanings in music. In this chapter we do not speak about recording and playing back short musical phrases, but about the resolution of the digitized signal that represents the sound. For CDs 44'100 samples/second is the norm.

Even though CD players are very accurate, they are not synchronized. Only when a CD is digitally copied to a DAT, synchronization happens. Then, the CD player is the master and dictates the sample clock to the DAT.

In the case of two LOOP delays playing together, synchronization at the sample level is important to avoid clicks and rhythmical inaccuracies.

Since no machine controls another one by nature we have developed BROTHER SYNC: All machines are connected by a so-called "open collector". Each LOOP delay informs the others when it is ready to execute the next sample. Only when all are ready, the connection changes state and all execute the next sample. Thus, all are waiting for the slowest "brother". Maximum synchronization is about 5 brothers (because the "pullup" resistors are in parallel connection).

Block

For technical reasons 64 samples have been collected into an inseparable block. Since a beat always starts at the same place in a block, the machines are synchronized at block level automatically when synchronized on sample *and* beat level.

Beat

An easy way of synchronization is to correct differences at the end of each loop (as in samplers). However, clicks can be heard, because information has to be inserted or deleted. Luckily, at the end of a loop the sounds are normally fading and at the beginning of the next loop the clicks cannot be heard because of the attacks.

The rhythm within a loop does not get corrected, only the end. Speed increases, etc. become meaningless.

At the very least the loop can be synchronized by strokes of a bass drum, a footswitch or the rhythm of a drum computer.

Concept for Synchronisation

Signals involved

SYNC is made up of the following synchronisation signals:

BEAT SYNC, BROTHER SYNC, MIDI BEAT SYNC or MIDI SYNC.

They almost do the same thing, but cannot be received and sent out all at the same time.

Therefore you can control the desired application with the 2 SYNC MODES -I and -O, that are selected with INSERT during Reset.

Limitation: For synchronisation, remember that each adjustment means a jump in the memory that can be *audible*.

Synchronisation can only happen *backwards!* In consequence, a SYNC arriving too early can only be satisfied by jumping almost one entire loop back. So it can only be executed if there was nothing new in the last loop, otherwise the addition would be erased.

As a result, during OVERDUB, MULTIPLY, INSERT, and when FEEDBACK is not fully open, synchronisation does not work properly.

Suggestion: If you need to have a fading loop synched to the sequencer, reduce the speed of the sequencer a little bit after you have made the first recording, so the SYNC signal is always late that makes correction possible.

Note! Synchronisation or triggering may be disabled if the loop takes more than the half the memory capacity, and jumping back is not possible. In BREAK this situation is indicated with a dark UNDO LED.

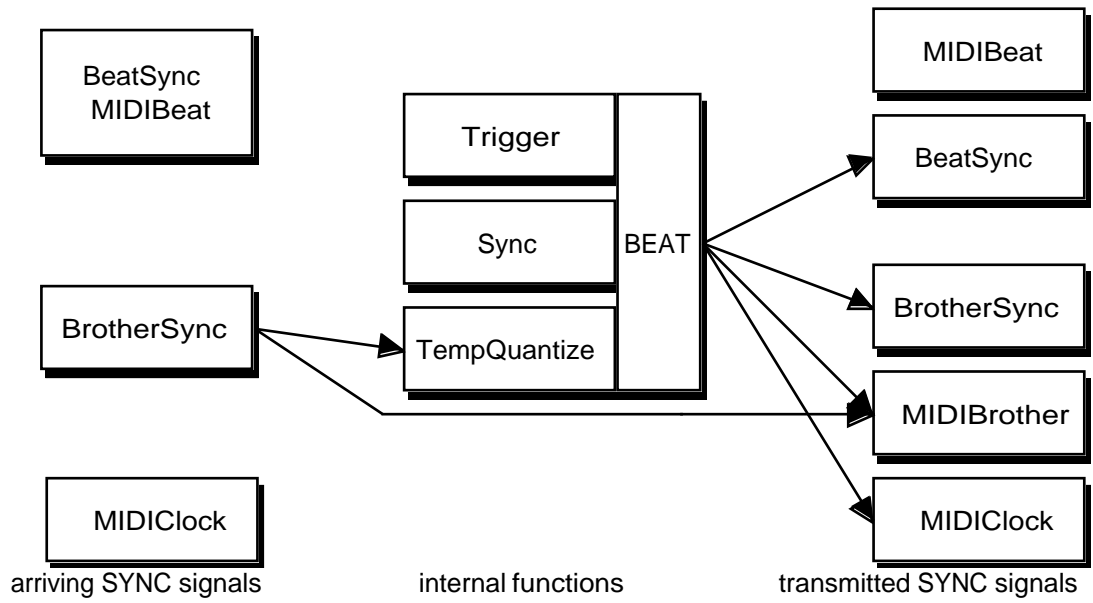
Temporary Quantisation of Record

In Reset, the first arriving SYNC makes the RECORD commands *temporary quantized*. Thus, it is possible to record any number of SYNC periods at any time and the beat length will be adjusted to the SYNC coming from the master. Afterwards, synchronised playing can go on, no matter whether you choose to quantize or not. The temporary quantizing is switched off when going to Reset (when RECORD key is released again after holding it).

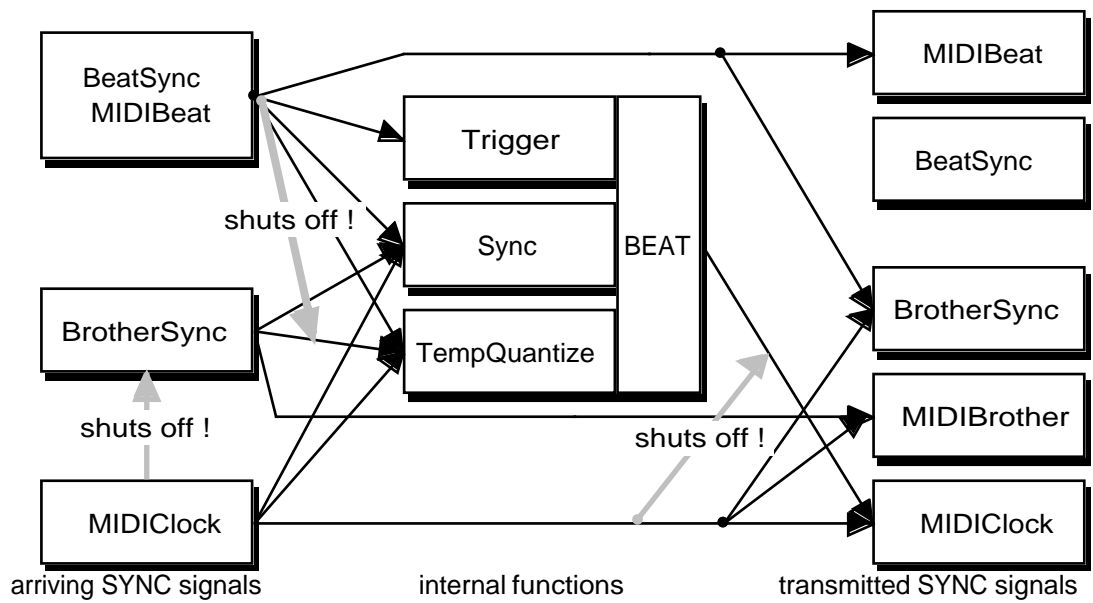
Hint: If you want to be free again from the beat of the sequencer or brother musician, go to Reset and hold the RECORD key until you start your new thing, so that no SYNC sets you to quantized while you release the RECORD key.

The connections of the SYNC signals

If you want to do special applications, you maybe need to understand the internal functioning of the SYNC. The following diagrams shows how delicate is really is to create something simple to use:



The Sync Output (-O) connection diagram



The Sync Input (-I) connection diagram

Arriving BrotherSync is ignored, when a MIDIClock or Beat Sync signal is received.
 Arriving Beat Sync is not used for SYNC, when a MIDIClock signal is received.
 Quantisation happens on internal BEAT except for the first RECORD.

The use of BROTHER SYNC and MIDI

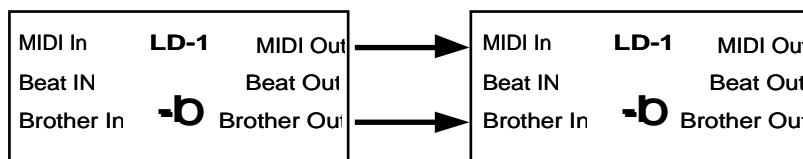
Between two LOOP delays BROTHER SYNC should be connected with a stereo jack cable. That makes the LOOP delays' hearts beat together and additional synchronisation between them unnecessary. Even so we transmit the SYNC through the plug's ring of BROTHER SYNC. With it, RECORD can be quantized.

Also, BROTHER SYNC transmits SYNC, in case you want several LOOP delays to follow the same external SYNC (-I).

So there are the following three applications of connections of several LOOP delays:

Stereo Connection

Both LOOP delays are set to -O so they do not sync each other but run in parallel. The MIDI Out of the main LD-1 is connected to MIDI In of the other to transmit the switch functions.

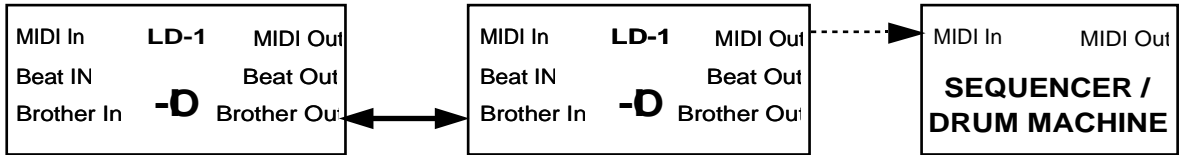


Through MIDIClock, it is possible to control the speed of a connected sequencer from any one of the LOOP delays.



Brother Connection

Several musicians each with their own LOOP delay play together in the same beat, but use the functions independently. All machines are set to -O to avoid SYNC. Through MIDIClock, it is possible to control the speed of a connected sequencer from any one of the LOOP delays.



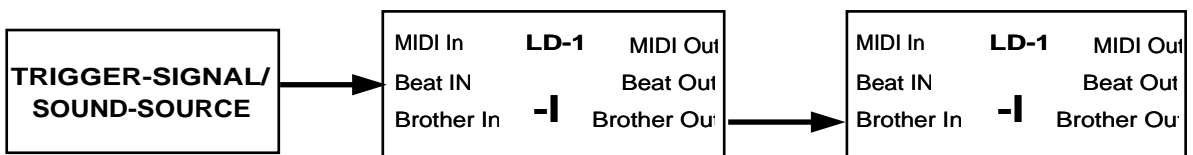
If one of the brothers wants to start his own beat, independent of the family, he only has to hold RECORD (reset) so that no SYNC comes in before his RECORD. Then he starts unquantized RECORD and creates a new time base. The other brothers can join by resetting, waiting for a SYNC (a flash of the left green decimal dot) and quantize into the new beat.

Brother Connection with external synchronisation

If the brothers are playing with a sequencer, all can follow the MIDI SYNC: One LOOP delay receives the MIDIClocks (-I), and sends the derived SYNC through BROTHER SYNC to the others, (also set to -I) - all brothers follow the oldest dancing with MIDI!



The same goes for synchronisation to a sound source or key connected to BEAT SYNC of one of the LOOP delays.



Note! The BROTHER SYNC does not trigger Samples (BREAK - MULTIPLY, see page 25). If you want all brothers to be triggered together when they are waiting in BREAK, you have to connect the sound source to all BEAT SYNC jacks or use MIDI BeatSync.

Hint: Connected brothers can be partly independent and partly mastered if you connect the LOOP delays through a MIDI filter. For example BREAK and BEAT SYNC could be transmitted to allow the leader to stop and start the band precisely, while MULTIPLY and OVERDUB is filtered out of the MIDI line to leave the musicians independent.

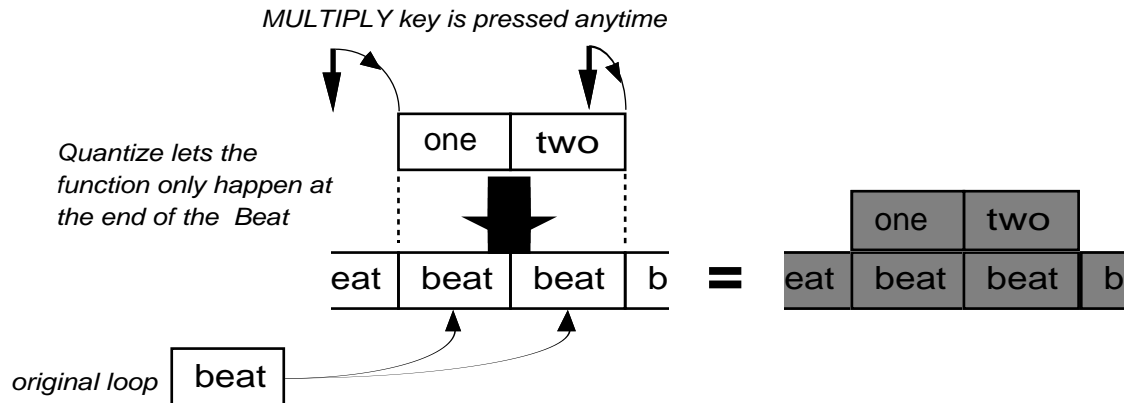
BROTHER SYNC is also transmitted through MIDI, but never received. So far, there is no concrete use for it, except that it is handy as a guide on the screen of the sequencer and a base signal for your synchronising creativity.

QUANTIZE

Users initiated a completely new way of operating the LOOP delay: All the commands can be quantized on the beat. It means that these commands are executed and terminated only at the start of the next beat. In the meantime the LEDs remain dark.

Turning Quantizing on: go to reset state (long RECORD), tap OVERDUB until the MULTIPLE/MIDI display (green) shows 0.1.

Turning Quantizing off: go to reset, tap OVERDUB until the display shows 0.0.



The following functions are quantizable: MULTYPLY, INSERT, RePlay (BREAK-UNDO), Replace.

Like a metronome, quantizing is a limitation of freedom and expression at first glance. It can assist structural composing in themes. Quantize allows to tap the LOOP commands prematurely and have the foot free again, knowing that the functions will be executed with maximum accuracy. For some musicians it will be interesting to learn to deal with the discipline of the beat.

Quantizing makes that some functions are executed precisely at the beginning of the next beat and they have to be called early.

Quantizing is switched in Reset with OVERDUB.
The green display shows its state:

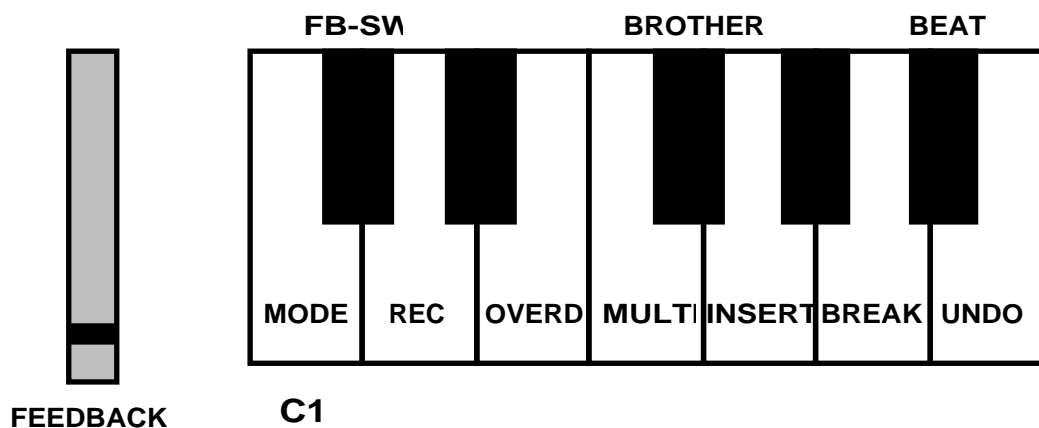
O.O (Q=0) Quantizing OFF
O.I (Q=1) Quantizing ON

Received SYNC signals are used to *temporarily quantize* the record function. (see page 34)

MIDI

MIDI coding

All keys are sent as white notes of the lowest octave of an ordinary keyboard (MIDI Notes 36...47). They are received as the same notes repeated over 4 octaves. FEEDBACK is patched to the Modulation Wheel.



The MIDI channel at startup is set to 16 and can be modified in Reset state with UNDO (DOWN) and BREAK (UP). A long pressing on one of them resets to channel 16.

Stop RECORD sends a StartSong, Start RECORD and Reset send a StopSong. StartSong is received to restart MIDIclock.

MIDI Notes 123...127 switch hanging notes off which could happen when you turn the sequencer off while the loop is running.

A further type of synchronisation works with the BEAT SYNC jack. Its signal is transmitted by MIDI key G#. Programming this note anywhere into the sequencer is helpful to call samples from the LOOP delay. (If MIDIclock is on, it is also used for synchronisation - rather chaotic)

Brother Sync is transmitted as F#, as a way of orientating yourself on the sequencer screen or for special purposes. It is not received.

For better understanding of the sequencer data, PEDAL MIDI controller additionally transmits a 0 at Start RECORD and a 127 at Start BREAK and so on.

Note! Don't imagine you could draw a Feedback curve in the sequencer to be executed during Insert, for example. It is internally fixed to 0 and independent on MIDI Controller

Quantizing is extremely helpful when working with MIDI SYNC, especially for fitting the loop into the sequencer timing.

MIDI Clock

MIDIClocks can be used to synchronise with a sequencer or drum computer, without any additional programming on these. A controllable beat counter divides the quick MIDIClock signal into a musically reasonable MIDI SYNC (usually 1 Beat). The switching between the various measures of beats is done in Reset with MULTIPLY. The number of measures is displayed in the green display.

Incoming MIDIClocks (LOOP delay setted to -I):

- They are passed directly to MIDI Out. The internal generation is switched off
- BrotherSync is not received at all
- Beat Sync is only received to trigger samples

If MIDIClocks are not received during 400ms (about the slowest possible application) we assume that none are coming and start the internal. At the next Reset, the Brother and Beat Syncs are switched on again.

To prevent overloading the sequencer, we do not send out the internal MIDIClock if it would push the sequencer beyond 300beats/sec. So for very short loops, use MIDIBeat.

Note: For low measures (Reset - Multiply: 1 or 2) the internal MIDIClock becomes very inaccurate.

PLAYING HINTS

IN GENERAL

Modesty

Start with a few switches and short loops. You have purchased a new instrument and you have to learn to play it. No quality arises without a process. But this learning can happen in a playful way. The LOOP delay ought to facilitate your playing — not render it more difficult. Let intuition grow through accidents and incidents.

Even with just the two switches RECORD and MULTIPLY you can give impressive solo concerts.

Do not forget to reset sometimes and just play alone.

Experience loopability

Not every tune sounds nice when repeated. In general, glissandos (gliding notes) soon get obtrusive. Take your time to experience the effects of different kinds of looped musical themes.

How to learn from mistakes

Not everything we think of as a mistake really is a deadlock. Often it is interesting to see which way you are going when starting with a mistake.

Therefore do not stop an "awful" loop immediately, but work with it or change it round by looking for a positive interpretation of your mistake. Once you have fought your way through the thicket you might arrive at a new area — and the great view you get will explain why you made the "mistake". In music we also express our faults and can be made aware of them by musical treatment. This is a way to wake up. Often the music expressing the break-through after a thorny thicket is extraordinary beautiful and can be published as an interesting result of a process.

The MIX - control

The relationship between loop signal volume and direct signal seems trivial. But think of it: if the volume is unbalanced, the first repetition of your loop is either louder or softer than the original.

In the first case you will have the tendency to play even more loudly. Then the next loop will be even louder! Thus, your loop will push you up and up, until it distorts or until you go mad.

In the second case you will probably play the loop more quietly — your music will grow more delicate..

Of course you can get used to an unbalanced volume. In polyphonic loops it is very reasonable to turn up the solo voice — turn MIX a little down.

RHYTHM SWITCH

Up to now there have been few footswitches to determine a rhythm. It has not been important to be very exact when switching an effect.

We have modified a regular footswitch to our purposes: FSP1 has an extremely short stroke requiring little force. No undefined time period will pass. In addition you have a better rhythm feeling when tapping than when pressing.

If you have trouble operating the footswitch, try taking advantage of the rhythm in your leg: Strike the floor as usual with the tip of your foot and move your foot over the switch at the beginning of the beat. You are able to tap the switch without any extra effort. Otherwise, you will have the tendency to play the first note more loudly and to lose your timing. Sitting electric- and western-guitar players are recommended to use their free left leg.

APPLICATION EXAMPLES

The Rehearse Trip

Traditional delays have commonly been applied in two ways that are helpful at the beginning of a song:

You start with a musical theme to be looped, but the rhythm is not yet perfect. When recording the theme it may be correct but it will not have the necessary drive. It has to be played over for a while until it is ready to be recorded. In Rehearse state you keep getting confronted with your own irregularities. Only when the LOOP delay and yourself are playing exactly the same, will the theme be ready to record. Leave Rehearse with INSERT and conserve the musical theme.

The other application is the exact opposite: You have no idea what to play but you feel the beat. Tap RECORD, play anything, then INSERT. First you have the impression of a great chaos. But each phrase will be a reaction to what you have just played before. Suddenly, you play a new theme. Maybe you could not even replay it. But it is conserved in the LOOP delay. In order not to lose it tap INSERT as soon as you have heard it once, or tap OVERDUB to continue directly with activated overdubbing.

Building up a groove

Select the most simple element to start with. In a salsa for instance, the bell. Record one or two beats at the most with RECORD. You could end the recording with MULTIPLY and immediately start recording a second instrument. Then multiply with four. You may use OVERDUB to record several instruments over these four beats. Then you will probably record bass line and harmonies, let us say over 16 beats (a second multiplication). This kind of music is often building towards a climax which is very convenient, because it is hard to simplify the groove.

End a groove

Using the CP1 as a volume pedal, you can reduce the loop volume while your actual playing undertakes the loop-theme, after fadeout you close with a coda. An other possibility is to reduce feedback and reoverdub several instruments while it fades out.

Weaving a sound carpet

Sound carpets have been the most common electronic loop until now. Use feedback, overdub and a volume pedal to construct sound carpets.

Start with RECORD (for this application, precision is not that important). Play a loop length of 2 to 5 seconds. End RECORD with OVERDUB in order to get a clean transition of the sounds.

Sometimes you do not want any attacks at all. The looped sound carpet will then be very even. Advanced MODE is recommended. Use the pedal to control input volume: Each note will be faded in, take also advantage of the dynamic of the instrument. This can also be done in Delay MODE.

The limiter is helpful when weaving an even carpet. Overdrive the input, so that with each attack the LED turns red. Then the limiter will even up your carpet.

In this application FEEDBACK is not fully open. Otherwise your carpet will grow too thick. Control the development: Quicker change requires a feedback turned rather down, opening feedback makes the carpet grow.

Composing a song

Build up a groove (as described before), multiply it to get a verse. Add a chorus with INSERT, maybe in several layers with OVERDUB. Append several verses and choruses with MULTIPLY. Record an intro or an end with INSERT.

The LOOP delay as "protocol"

It is possible to record the last few minutes of playing in the practice room in order to listen to new ideas or to settle arguments about what just happened. This is another application of the LOOP delay: Connect a mixing desk output or a room microphone. Tap RECORD, wait for the maximum recording time to elapse, then tap INSERT. In order to listen to it, tap OVERDUB twice.

Correcting

UNDO and Replace both are correcting functions.

Replace renews a part of the loop completely. UNDO deletes your last recording.

Replace is quite difficult to apply in loops with a great number of layers, often you can hear that there has been a correction. Sometimes this does not matter, because you may want to make some experiments. At least even your correction can be cancelled with UNDO.

You can apply Replace in a creative way: for instance, you have recorded a beat of two chords and have multiplied it by 4. Now you think this sounds too boring, so you exchange a chord with another one: press INSERT, play the chord and release INSERT exactly at the start of the next chord.

There is a risk with UNDO as well: Maybe you do not know where you are jumping back to when using UNDO. To prevent clicks, it is important to tap it exactly on an attack of your previous recording and not at any time after the mistake.

Sampling

If you want to record a sample, we recommend starting the loop with RECORD and ending it with INSERT. That way you get into Rehearse and you can play the sample until it is exact. Then you save it with BREAK. When tapping MULTIPLY, the LOOP delay is ready to play your sample each time it is told to by a MIDI or BEAT SYNC signal (TriggerSample). This is possible only if the actual loop does not fill more than the half of memory capacity.

You can connect any instrument to the BEAT SYNC input, for instance the drummer's second bass drum. He can then release your sample at his pleasure.

You can release it yourself with a footswitch (best is FSP1).

Leave sample state with BREAK to go back to your loop.

Polyphony in a band

In a band, the musicians often do not want to adapt to a machine and reject the LOOP delay as a rhythmic base — very understandable. However, you can transform your solo instrument to a multi-voice instrument for a short while.

You can either go into Delay MODE, tap RECORD twice in the short rhythm of the beat and control the doubling with the pedal.

Or you remain in Loop MODE and record a phrase (start with RECORD, end with OVERDUB) and immediately play a second or third voice. One singer can thus build huge soul choirs.

Leave that state with a long RECORD (Reset) pressing.

You can also record the first chorus with RECORD, end the recording with BREAK, and release this first chorus with UNDO to accompany it with a second voice.

The Loop band

The dream of synchronizing several LOOP delays (with BROTHER SYNC) was one of the greatest impulses to develop the LOOP delay. We are still unable to foretell the variety of sound to be made from this connection. It is very unique to be rhythmically connected and at the same time have all the liberties of a solo play.

Rhythm musicians could be overdubbing short loops, while the harmonic musicians might be multiplying long loops. While the harmonies and solos go on, the rhythm musicians continuously change their short loops.

You can experience polyrhythm, when one musician builds a loop of 4 beats, and another one of 5 beats.

A process of development — from music to therapy

I have discovered a very special, freely improvised musical style which obviously is connected to the effect of loops to audience and players. It may be very personal, but I would like to explain it, because it has become a ritual and oracle and has changed my life in a very interesting way.

I rediscovered music starting with the OM (for technical reasons — there was no LOOP delay!). OM is a carpet of floating notes. Then there were short tunes. The harmonies grew out of the notes I overdubbed, because they matched each other. Later there were rhythms. This process of the musical setup lasted about one year. At the same time I developed an application for this musical style you might try out as well.

As an important precondition you should not worry about the quality of your music. Start with simple rhythms and tunes and do not think of success. You see now why I started with OM, the origin, the emptiness. Meanwhile, OM is not the only way to start a loop. Often I doodle around with a few notes to get in the right state. For somebody not knowing the process I would recommend the OM. You can build up an OM by fading in a certain note or octave notes in different sound colours, over and over again, with overdub and much feedback into a loop of 2-3 seconds. No attack should give a rhythm. However the wave of slowly changing sound colour will give you the feeling of the exact loop length. The OM calms you down and opens the channel to another world, flowing over with tunes and rhythms. You can play them until you find an interesting theme to be overdubbed with multiply (and reduced feedback). This theme might come from your interior and express a momentary state of mind. Thus it can start thoughts and feelings that may consciously or subconsciously worry you. This first theme of course is not the last. It may be simply a trifle: you fade it out and search on. Probably you find a second theme which may be even deeper in your mind. With feedback you control how long you want to remain in that theme and how quickly you go on to the next one.

In the beginning there are often nice thoughts to lead you onto a long journey with deadlocks, obstacles, yes even an accident — awful sounds and chaos. I used to interrupt the loop, until someone pointed out to me that such chaos is also a part of myself and interesting. So I started working with these shocks and vales of tears. I started colouring them, making them even more awful and learning to feel what actually is going on inside of me. When playing or listening to the loop I can think of my problems, because I consistently create the proper climate for myself. The reverb serves for the same purpose, because it creates the proper space which I consistently change by adapting reverb time and intensity with the foot pedal. Using phones you can put yourself into an acoustic prison and free yourself to fly on a wave of long reverb.

The continuous repetition can be something harassing. Often this hurricane can calm down without knowing what has happened. Then it is easy for me to continue to play beautifully, honestly, without cheap simplicity — while a new solution might come into my thoughts — and a new story.

Normally I play between 20 minutes and infinity without stopping!

In that way I have taken all my essential decisions in the past few years, have digested sorrow and problems in order to overcome them more quickly and have even solved technical problems — for the LOOP delay.

The LOOP delay grew under the influence of loops.
The effect of acoustic feedback has fed back to the material world.

TECHNICAL EXPLANATIONS

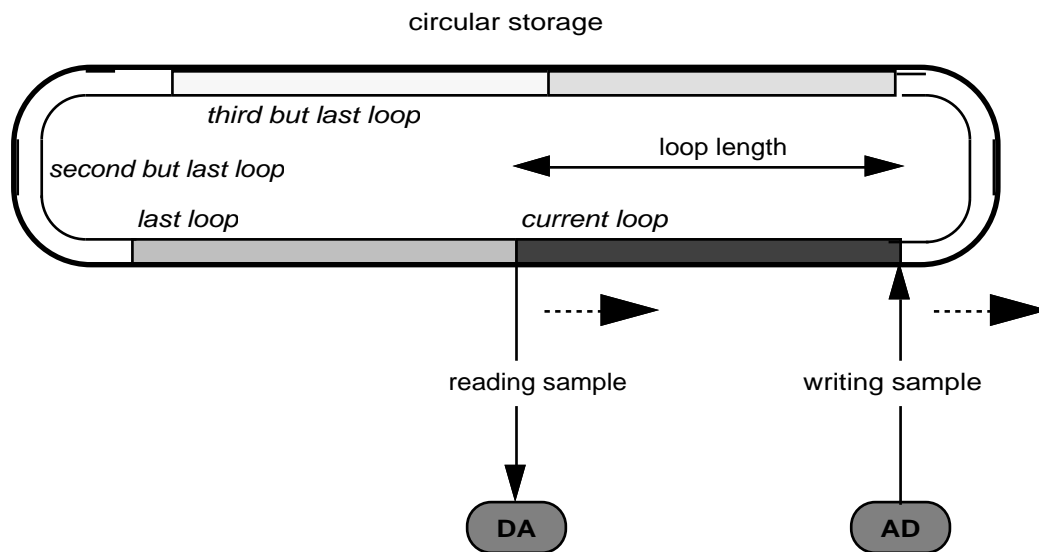
LOOP ORGANISATION IN THE MEMORY

The register medium of the LOOP delay is circular. i.e. it starts over when reaching the end. Imagine an endless tape. It depends on the SIMM memory configuration how much space there is in your LOOP delay.

Digitized music is written into memory on one spot. On another one the digital information is read and transformed back into music. In computer slang we call these two spots reading address and writing address.

In a tape recorder you could realize the same with two heads. One of them is recording, the other one is playing back the same data. The tape runs over the heads, while in the LOOP delay, reading and writing address move over the memory.

The distance between writing and reading address defines the loop length. The LOOP delay displays the loop length in seconds. Maximum reachable loop length is defined by the memory capacity; of course shorter loops can be made.



Tape delay machines work the same way. Feedback is done by writing the value from the memory, added to the new sample, back into the memory. Modern machines as the LD1 do this in the digital plane, in order to not lose sound quality with each repetition.

SAMPLEMACRO

The samplemacro is the heart of the software: A single sample is read from the analog-digital-converter (ADC), saved in the memory, and read out to the digital-analog-converter (DAC).

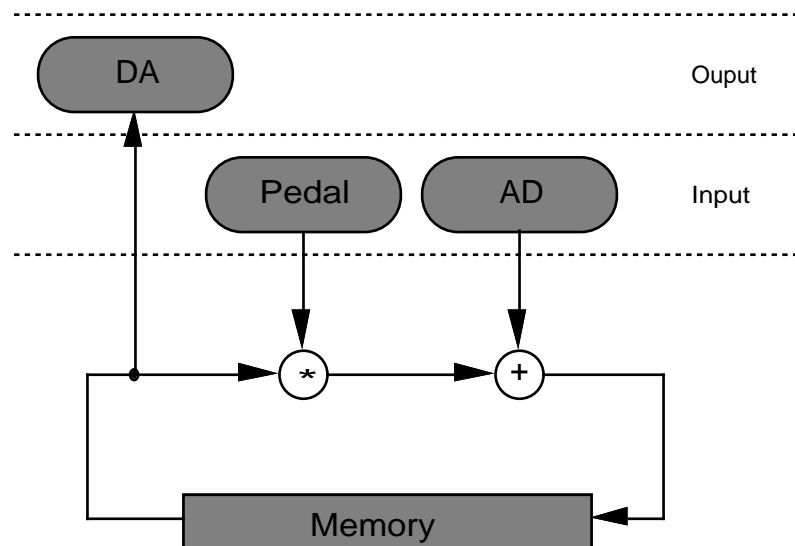
- read sample from memory
- send value to DAC
- multiply with feedback value
- read sample from ADC
- add both samples ($ADC + memory * feedback$)
- write result into memory

Since the family of computer users has grown tremendously, here the same in a simple PseudoCode:

```

MemSample <-- Memory
DA <-- MemSample
MemSample <-- MemSample * FeedbackPedal
NewSample <-- AD
NewSample <-- NewSample + MemSample
Memory <-- NewSample
  
```

and now graphically:



ACCESSORIES AND EXPANSION

FOOTSWITCHES

For the rhythmic application we have developed a new kind of footswitch, the FSP1. It looks normal, though, inside it is completely different. The switching action is ultra short and sensitive, a precise switch element has been placed directly underneath the lever.

The LOOP delay includes one FSP1 for the RECORD function. For further functions as MULTIPLY or synchronization, additional FSP1 switches are recommended. The FSP1 is made as an edgewise case that allows to couple several boxes together to one switch panel.

Depending on your loop technics, some of the functions maybe are less critical and can be operated with normal footswitches (close contact when pressed).

PEDAL

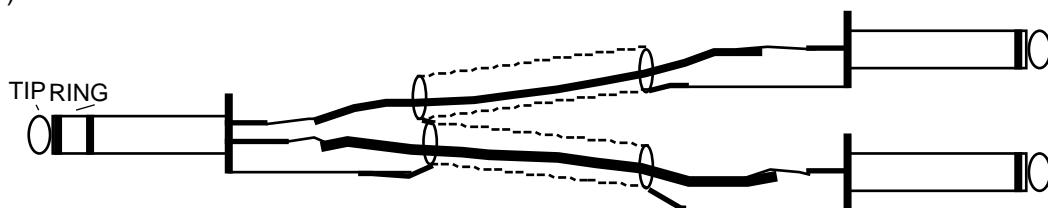
For an enhancement of expression, we designed a multi functional pedal application. The pedal jack socket at the back panel can be used in four ways:

- connected with a controller pedal
- connected with a controller pedal with switch
- connected with a switch only
- not connected (functions accessible at the front panel)

Controller Pedal CP1

With our pedal you can bring your loop music into action more expressive - either as volume or feedback controller (depending on the MODE, see page 19).

If you want to recycle your old volume pedal (we love recycling): here is our hint to modify it!
Control the potentiometer value: 10K - 100K resistance (20Kohms mean). Make a special Y-cable that unites two mono jacks to one stereo. Note: The pedal jack socket is stereo: One lead (tip) conducts the power and test voltage (5V), the other one (ring) the control voltage (0-5V).

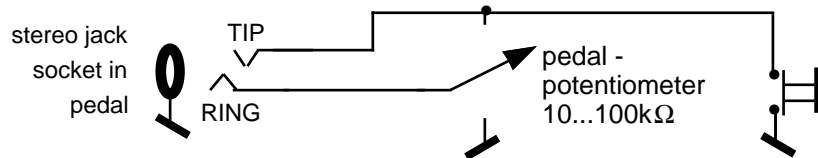


More elegant would be a directly inserted stereo jack cable.

If the range of the potentiometer does not work properly, try to adjust it by changing (maybe just taking out) the resistor R28 (close to the DIROUT socket) inside the LOOP delay.

Pedal with switch

Connecting the tip of the jack with ground switches the MODE. With some skill you can modify your controller pedal and add a function:



MEMORY EXPANSION

The LOOP delay is equipped with RAM-memory modules, that are also used in PC, Macintosh and certain samplers: SIMMs. Various sizes and prices offer different memory capacities: 256k, 1Meg, and 4Meg fit to the LD1. Their speed is uncritical, it should not be more than 120ns.

Configuration

The LOOP delay contains of four SIMM places, which are fitted with 256 k SIMMs (=12.5 seconds) in the standard version.

To expand the loop capacity, 'bigger' SIMMs have to be installed. The modules must be replaced by pairs of identical SIMMs (we call them sets), but two different sets are accepted. The maximum of 199 seconds results from four SIMMs of 4Meg.

Inserting

The exchange of SIMM modules is quite a bit difficult and needs some practice. It shall be our pleasure to replace them for you.

In case you are far away from PARADIS: also in computer shops and in certain music shops you can get assistance.

Do not hesitate to order your LOOP delay with the desired memory already fitted.

Instructions to replace the SIMM modules

Disconnect the power cord! Then unscrew the *bottom* of the LOOP delay and open it.

At the left front corner of the print you find four module places with installed SIMMs.

The two sockets at the edge of the print have always be fitted with SIMMs, otherwise the red display would show HLP 00 as error after turn-on.

To take out the SIMMs from their upright sockets you need a fine screwdriver and patience. The modules have a hole at both length sides in which a small hook locks them. Insert the tip of the screwdriver through the left hole, unlock the hook and simultaneously lift this side slightly. Change to the right hole and repeat the process. Change again alternating left and right, untill it looses gradually.

Inserting SIMMs is much easier and needs no trick: simply push them down into lock position. Make sure that the part side of the modules looks left, to the prints edge.

SOFTWARE / UPDATE

The software is burned into one pair of EPROM. In case of an update this EPROMs have to be replaced.

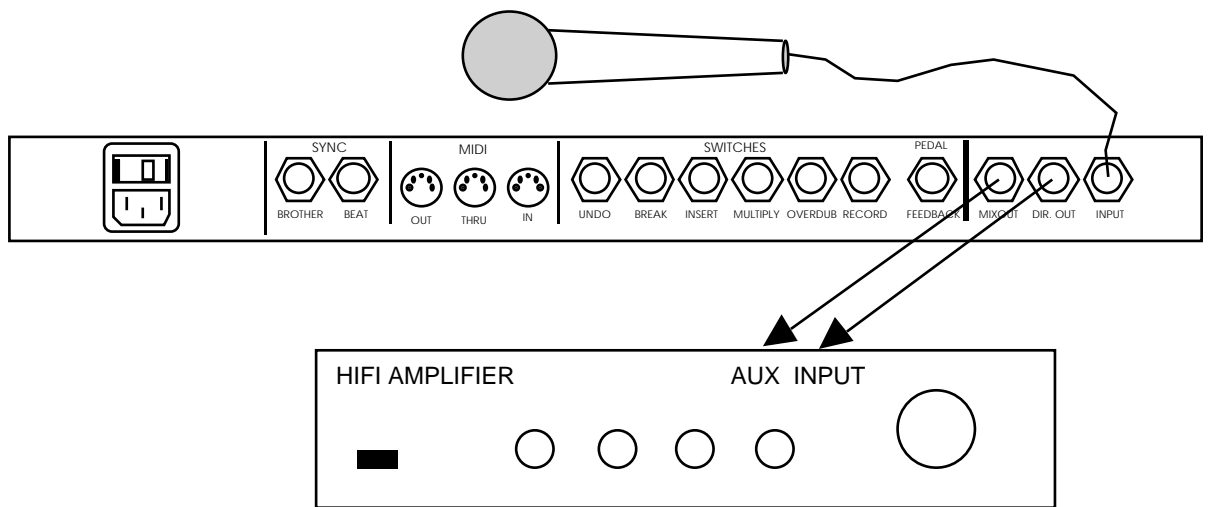
Open the box like described before. You find the two EPROM chips at the rightside of the SIMM places, towards the center of the LOOP delay. Use the lever that you get together with the update. Put it under an EPROM and lift it slightly but not fully, then change to the other side and lift it the same way, change again... Take care to not put the lever under the socket but only between socket and chip.

Push the new EPROMs down into the sockets. Take attention to the polarity: EPROM 'A' to socket 'A', the notch at the front of the chip must look to the front panel.

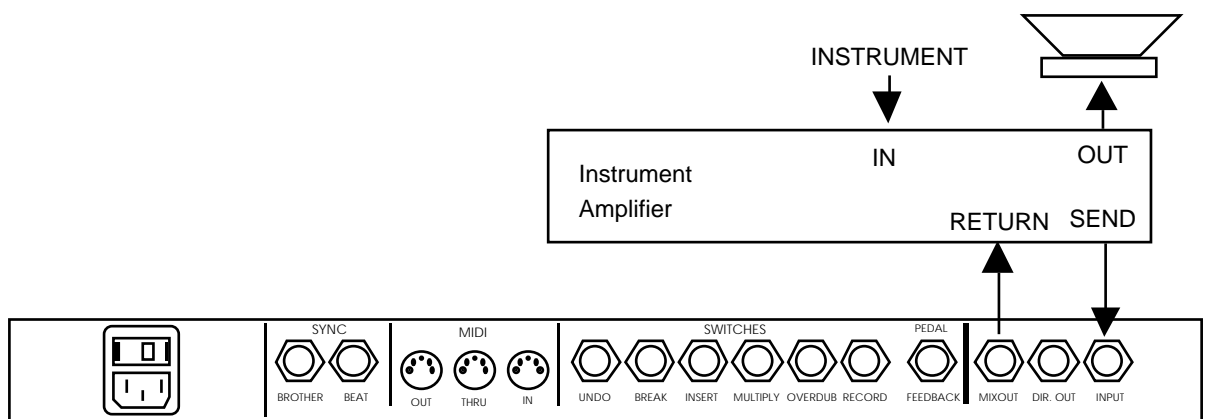
APPENDIX

CONNECTING EXAMPLES

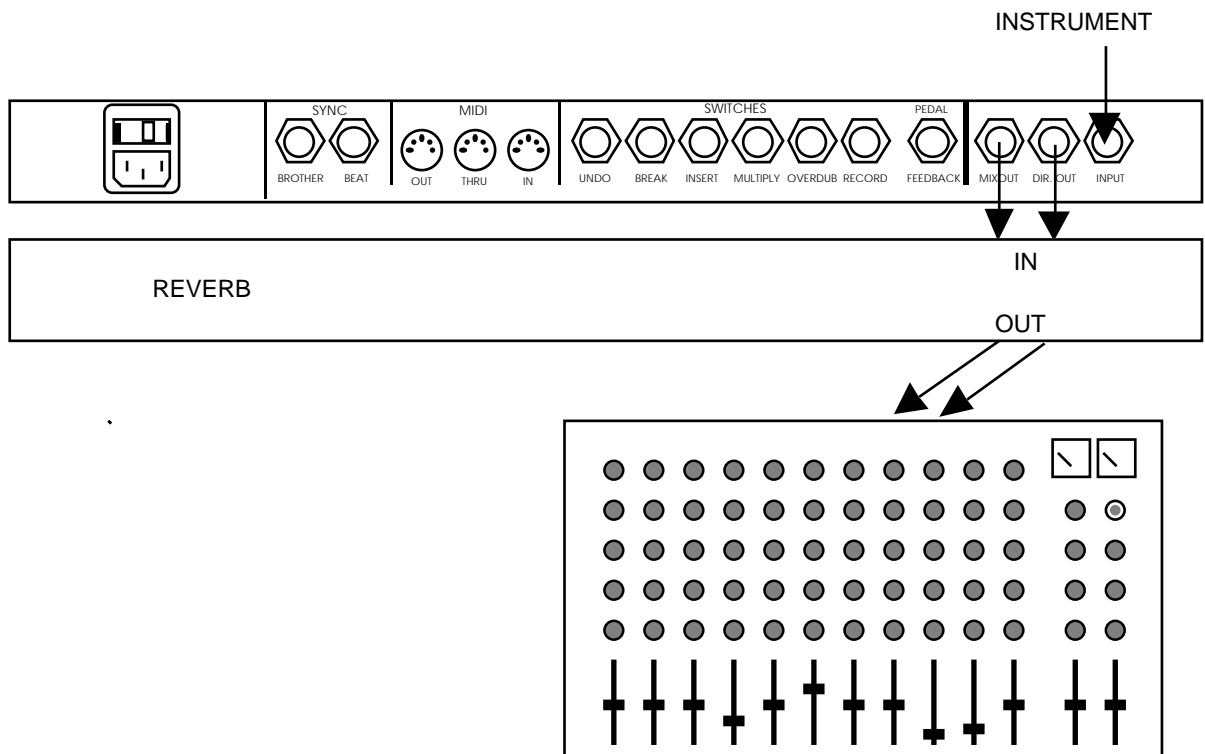
At home, using the stereo equipment



With an instrument amplifier



From the instrument rack to two channels on the mixer



Inserting to a mixing desk

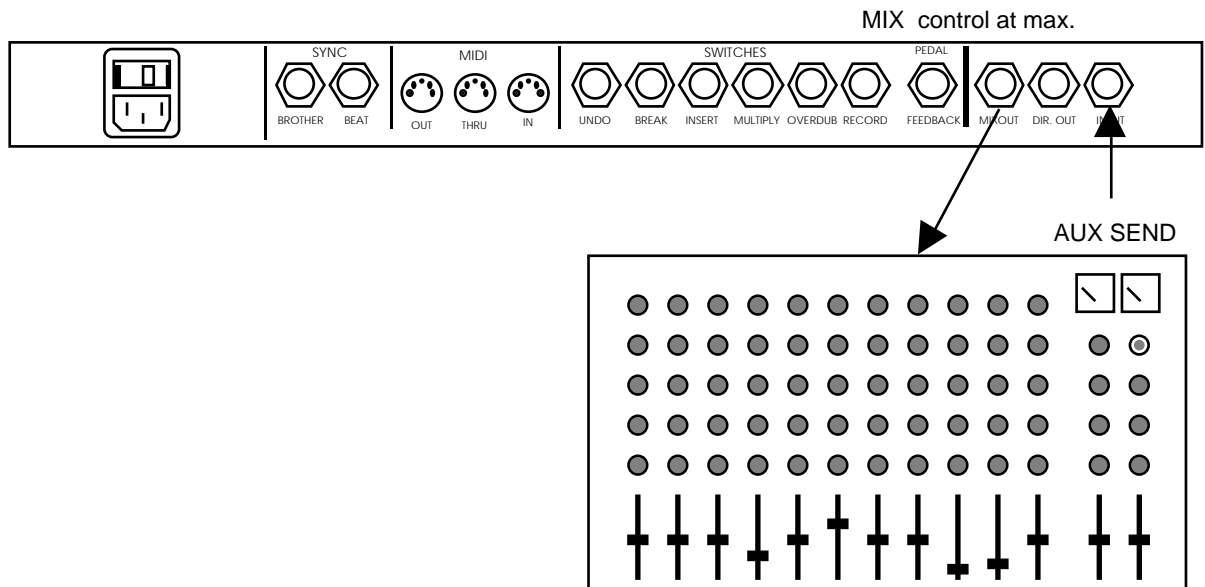


TABLE OF LOOP FUNCTIONS

The following table is a summary of LOOP delay functions after a certain switch activation.

StartX	starts the timing function X, LED goes red.
StopX	stops the timing function X, LED becomes green again. The functions 'Multiply' and 'Insert' automatically round to the next beat.
UStopX	stops the timing function X without automatic rounding. LED becomes green again.
YOn	starts the running function Y, LED goes red. Running functions do not get influenced by timing functions.
Yoff	stops the running function Y, LED becomes green again.

These functions are executed when the respective switch gets tapped.

Record	Overdub	Multiply	Insert	Break	Undo
StartRecord	OverdubOn	StartMultiply	StartInsert	StartBreak	JumpBack

These functions are executed when a switch is pressed **long**.

	Record	Overdub	Multiply	Insert	Break
Press:	StartRecord	OverdubOn	StartMultiply	StartReplace	StartBreak
Release:	Reset	OverdubOff		StopReplace	PlayOn

These functions are executed when another function has already been activated:

	1: Record	1: Overdub	1: Multiply	1: Insert	1: Break
2: Record	StopRecord	StartRecord	UStopMultiply	UStopInsert	StartRecord
2: Overdub	StopRecord OverdubOn	OverdubOff	StopMultiply OverdubOn	StopInsert OverdubOn	PlayOn OverdubOn
2: Multiply	StopRecord StartMultiply	StartMultiply	StopMultiply	StartMultiply	TiggerSample
2: Insert	StopRecord RehearseOn	StartInsert	StartInsert	StopInsert	PlaySample
2: Break	StopRecord StartBreak	StartBreak	StopMultiply StartBreak	StopInsert StartBreak	PlayOn
2: Undo	UndoRecord	JumpBack	UndoMultiply	UndoInsert	RePlay

MIDI IMPLEMENTATION CHART

Function	Transmitted	Recognised	Remarks
Basic Channel	1-16	1-16	Default 16
Mode		poly	
Notes	36-46	1, 24-82*	
Prog. Ch.	-	-	
Controllers	1	1	Mod wheel
		123 - 127	All keys off
Sys. Ex.	-	-	
System Common	-	Start Song	to start sync
System Real Time	MIDI Clock	MIDI Clock	

* Notes interpreted as Control Keys:

Key	Sent and received		additionally received
MODE	36	C1	C0, C2, C3
RECORD	38	D1	D0, D2, D3
OVERDUB	40	E1	E0, E2, E3
MULTIPLY	41	F1	F0, F2, F3
INSERT	43	G1	G0, G2, G3
BREAK	45	A1	A0, A2, A3
UNDO	47	B1	B0, B2, B3
FBSwitch (MODE)	37	C#	C#0, C#2, C#3
BROTHER	42	F#1 (only sent)	
BEAT SYNC	46	A#1	A#0, A#2, A#3
FEEDBACK	Contr 1	Modulation wheel	Note 1 = C#-1

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