Table of contents

Welcome to the family!

Thank you for purchasing this groundbreaking electronic musical instrument. To this day, I recall the thrill that reading words much like these gave me when I brought my brand-new synthesizer home. I devoured the pages that followed in that first manual - it would become my bedside bible for many days after acquiring that cherished machine. Years have passed since; as a musician, I owned many instruments and as a designer, I contributed to the making of many more. With Neuron, I was able to make my personal dream come true - an aspiration that would not have been attainable without the close cooperation of one of the brightest minds in the music business. Neuron's synthesis engine embraces the imagination and comprehensive knowledge of Stephan Sprenger, who in March 2000 set out with me on an adventure of designing what is certainly the most powerful new development in synthesizers in recent years. Before you stands the hard-won result of this shared vision. I would like to take this opportunity to thank everyone who worked so hard – sometimes to the limits of human endurance – to blast through barriers and turn this vision into a product that satisfies your and our standards for quality.

As you get to know Neuron, you will come across a range of innovative functions. Many of these are the fruits of a Herculean development effort, and a goodly share has been implemented for the first time in an electronic musical instrument. I am certain that you will soon come to appreciate the depth and breadth of neural synthesis; its sonic potential is, in fact, tremendous. And its unique control features make it so easy to shape this instrument's jaw-dropping sounds.

Here's hoping that you will become acquainted with your new instrument in no time at all. This manual will help you understand this machine. You will find familiar features in some areas and be confronted with completely novel features in others. However, in order to make the most of your synthesizer's potential, I recommend that you make this manual your bedtime storybook in the days ahead just as I did years ago and still do today.

Thank you for the confidence in our product and in our new company.

Welcome to the family!

Axel Hartmann

The Neuron Team

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  UI Soft, Bios: Josef Pogadl (Management), Jürgen Fornoff
  UI Hard, Bios: Puschmann Engineering, Marcus Werner
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  Dr. Hans-Georg Nowak (Management)
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- Sound design: Arnd Kaiser, Bernhard Bouché, Ray Legnini, Christian Ledwig, Peter Gorges,
  Yellow Tools, Uwe Zahn, Peter Kuhlmann
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Thanks to:

(In alphabetical order): Werner Bernd, Melisande Bernsee, Bernhard and Heidi Bouché, Thad Brown, Charlotte Clare, the Design Box Team, Wolfgang Düren, Joachim Flor, Gerd Gehrke, Detlef Glißmeyer, Uli Gobbers, Andreas Hafen, Christian Hellinger, Martin Herbst, Russ Jones, Joachim Keil, Tony Kostanjsek, Lothar Krell, Stephan Leitl, Heiko Meerz, Drew Neumann, Jörg Pauly, Susanne Pennewiss, the Prosoniq Team, Stefan Rapp, Rapp Architekten, Peter Ries, all the comp.dsp regulars, Frederic "Bo" Schelling, the Schlafhorst Electronics Team, Boris Schneider, Dieter Strobel, Terratec, Manfred Tillmann, the TSI Team, Drazen "Wanzinn kuhl(tm)" Vlahovic, Hans Zimmer

Copyright

The manual ...

If all you had needed was more reading material, you would have bought Bukowski's collected works or Keith Emerson's biography but not a neural synthesizer.

We are well aware that reading operating manuals is a pain. So the question begs, "Who should read what in this manual?"

... for pros

If Neuron is the latest in a long line of synthesizers owned by you, if you're a seasoned sound programmer, and if you're familiar with the theory behind envelopes and filters, you will need this book merely as a reference for individual parameters, for guidance in navigating the menus, or because you want to look up something about this or that control feature. Not so: Even if you are a bona fide synthesizer expert, its controls are sure to be new to you!

This manual also offers a parameter table for every Neuron module, a list of control features and menu diagrams for quick reference – plenty of stuff to ponder even for the synthesizer expert.

Our Quick Start Guide starts on page 16 . Its purpose is to give the eager synthesist who wants to dive right into the Neuron pool a friendly shove.

... and for not quite so professional pros

In the event that you are an (absolute) beginner or are not quite sure what an envelope is good for and what a chorus does, this manual offers an explanatory and hopefully enlightening introduction for every module.

... with an index to boot!

We invested considerable effort into referencing terminology in the **index** starting on page 195 so that you can access any desired information in a hurry.

Style conventions

Most of us are creatures of habit. That is why in this manual we have opted to use distinctive typeset to denote control features, parameters, and displays.

Control features such as buttons, knobs, wheels, and stick controllers appear in **bold**. Parameters that can be selected or edited in a module as well as LEDs appear in *italics*.
Display read-outs are shown in `typescript`.

In order to describe how to use the navigation stick located next to the main display in as few words as possible, we use the following shortcuts:
Stick.down means that you should move the stick down once in order to perform the given operation. **Stick.up/left/right** means move the stick in the given direction.

Icons

Our couch potatoes will accompany you through this manual:

You will find couch potatoes lounging about all over the book. They pop up wherever a need for further enlightenment arises, marking passages containing a key fact, cross-referencing a related topic ...

...or offering valuable tips on good-to-know stuff like tweaking sounds or programming Neuron.

The confused couch potato turns up because something discussed on that page seems unclear!

Heads up if you see the couch potato and his friends listening intently. If you take the hint and "listen up" too, you will discover an interesting or unusual fact.

The stick controllers are Neuron's hallmark features. They enable effective, intuitive, and easy handling. The stick icon appears wherever a stick is mentioned in the text.

Specified use

Neuron® is a neural synthesizer to be used exclusively for generating low-frequency audio signals for creating sounds. Any other use is improper and prohibited. Hartmann GmbH is not liable for inappropriate or improper use of the device and such use voids the manufacturer's warranty.

Safety first - notes on safety

The following guidelines are crucial to your safety and the longevity of the device. Read and heed!

Consider also the notes on safety printed on the device's connection panel.

Failure to heed the guidelines below can lead to fatal injuries through electrical shock or to the destruction of the device!

CAUTION Lethal electrical shock hazard!

- Keep the device out of the rain and away from any other splashing water. Under no circumstances, allow water to seep into the housing. Do not place any receptacle containing liquid on the device - even if this means you must do without your traditional chill-out drink during your combo's last number!
- Always set up a safe distance from water; that means bathtubs and swimming pools too. Bathers and swimmers are in danger of electrical shock!
- Do not operate the device in a moist environment. Humidity may not exceed 75%.
- If you place the device on a stand or other platform, make sure it and the floor you are standing on are dry!

CAUTION Lethal electrical shock hazard!

- Never use faulty mains, audio, or other connecting cords. If the included mains cord is damaged or lost, use a suitable replacement cord only.
- In countries in which the included mains cord cannot be used, turn to a qualified specialist for help.
- Never connect the device to a socket that is unsuitable, damaged or improperly installed.
- Always unplug the mains cord from the socket by pulling the plug and never the actual cord!
- Do not touch the mains cord with wet hands!
- Never sever the mains cord's green/yellow earth or ground wire. It serves the essential function of protecting you and the device.

Failure to heed the guidelines below can lead to the damage or destruction of the device.

- Connect Neuron to alternating current power supplies rated from 100 to 240 V and with a frequency of 50 to 60 Hz.
- Do not operate Neuron in extremely dusty or dirty environments and only up to an altitude of 2,000 meters above mean sea level.
- Do not operate Neuron near heat sources. Do not expose the device to direct and intense sunlight. Do not operate it outside an ambient temperature range of 15 ° and 35 ° C.
- Always ensure air can circulate freely around the device for purposes of heat dissipation. Never cover or obstruct the ventilation ducts on the **side** and particularly on the **bottom panel** of the enclosure!
- Do not expose the device to powerful vibrations or mechanical shocks.
- Unplug audio cords and connectors by pulling the plug rather than the cord.

CAUTION Danger of damage or destruction!

Safety during operation

- Ensure the device is set up in a stable, level position.
- Make sure that no objects make their way into the device's interior. If this does occur, switch the device off immediately and pull the mains plug. Do not open the device. Take it to an authorized service center and have a qualified technician remove the foreign object.
- In combination with a connected amp, mixer, speakers, or headphones, Neuron can produce volume levels that may lead to irreparable hearing loss. Always keep a close watch on volume settings and make sure you operate your setup at a reasonable level.

Notes on care, maintenance and repair

- Do not open the device. There are no user-serviceable parts in the device's interior.
- Users are prohibited from replacing the lithium batteries in the device. Have an authorized service center do this. Note that batteries may explode if not handled properly!
- Users are prohibited from replacing fuses. Have an authorized service center do this. The mains cord must be disconnected before replacing fuses.
- As a rule, only qualified and authorized specialists may open the device strictly for repair purposes.
- Use only a dry, soft cloth or brush to clean the housing. Do not clean the device with alcohol, solvents, or other chemicals.

Get yourself connected

Unpacking / standard accessories

After unpacking, inventory the standard accessories. The package should contain

- Neuron,
- a mains cord (suitable for your country's outlets),
- this operating manual (sad stab at a joke),
- and the registration card with warranty.

Please turn to your authorized dealer if any of the standard accessories are missing!

We recommend that you keep the original packaging for future transportation purposes!

It is our solemn duty to keep all registered owners abreast of the latest developments and system updates! You too will enjoy this wonderful service after you fill in the warranty card and send it to your local distributor or to the address printed on the card.

Once we receive your registration, we will send you ModelMaker, a software application that lets you create your own models from samples!

Setting up

Place your Neuron on a clean, smooth surface, making sure the device resides on a firm, stable base. When choosing a location suitable for setting up, read and heed the notes on safety on page 5.

Neuron's connectors and ports

The connector panel is located on the left side of the device! That is a nice touch because your audience can admire the handsome Hartmann trademark – a very distinctive on button – rather than a rat's nest of cords.

The ports are shown in detail in the illustrations on the following pages.

Before cabling up ...

- switch off all devices in the signal chain!
- read the guidelines on the following pages first and heed the notes on safety on page 5.
- turn the volume on the connected amp / mixer all the way down.

A word on audio quality ...

To allow your Neuron to unleash all the awesome might of its sonic powers and our innovative resynthesis technology to work its magic, be sure to use premium audio devices (amps, mixers, speaker). In other words, plug into the best gear you can reasonably afford. Also, be sure to run Neuron in stereo; better yet, in surround mode! Read the comments on master volume on page 35.

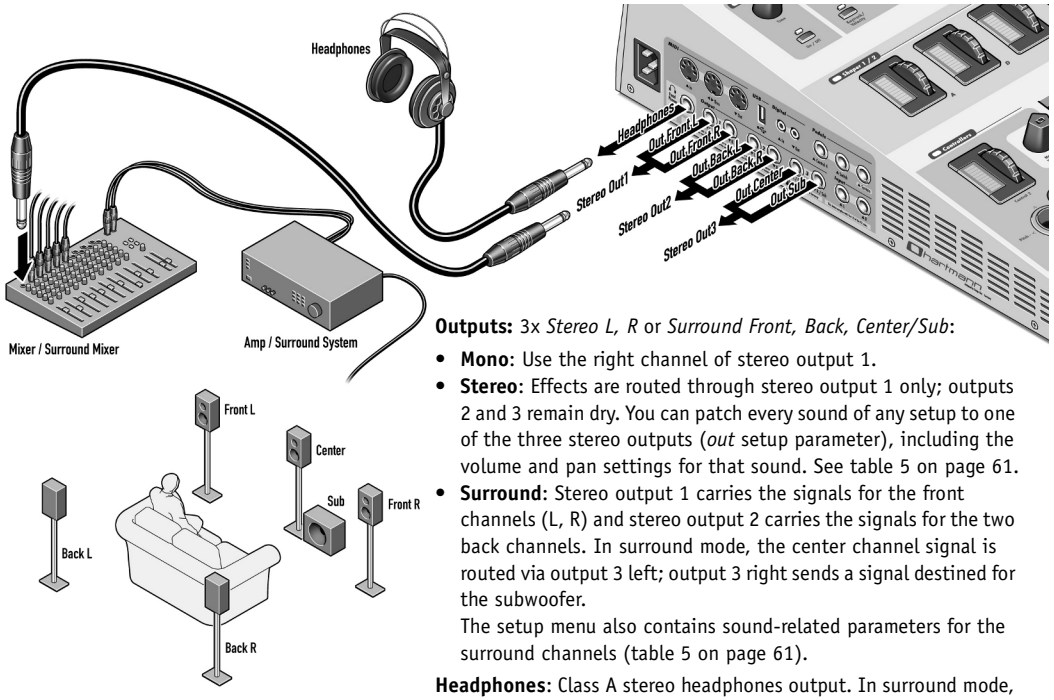
Mains cord

Ensure both the mains cord and the given outlet are the right type and in a state of good repair before plugging the mains cord into the socket. Read also the notes on safety starting on page 5.

Neuron may be operated at mains voltages ranging from 100 V AC to 240 V AC only.

The device is not equipped with an 115/230V selector, it automatically adapts to the mains voltage if available within the aforementioned range.

Stereo setup, surround setup, headphones



Outputs: 3x *Stereo L, R* or *Surround Front, Back, Center/Sub*:

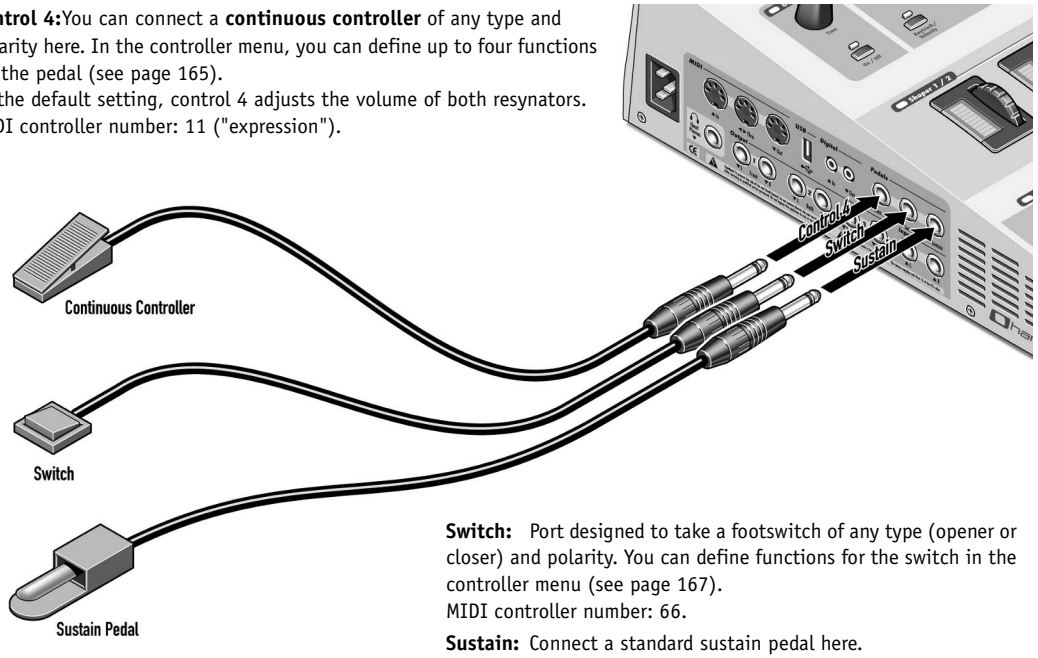
- **Mono**: Use the right channel of stereo output 1.
- **Stereo**: Effects are routed through stereo output 1 only; outputs 2 and 3 remain dry. You can patch every sound of any setup to one of the three stereo outputs (*out* setup parameter), including the volume and pan settings for that sound. See table 5 on page 61.
- **Surround**: Stereo output 1 carries the signals for the front channels (L, R) and stereo output 2 carries the signals for the two back channels. In surround mode, the center channel signal is routed via output 3 left; output 3 right sends a signal destined for the subwoofer.
  The setup menu also contains sound-related parameters for the surround channels (table 5 on page 61).

Headphones: Class A stereo headphones output. In surround mode, you will hear the two front channels in your headphones.

The volume of all analog audio outputs and the headphones output is controlled via the **master volume** knob. Whenever you work with headphones, be sure to check the volume before you strike any keys!

External controllers: Footswitches and pedals

Control 4: You can connect a **continuous controller** of any type and polarity here. In the controller menu, you can define up to four functions for the pedal (see page 165).
In the default setting, control 4 adjusts the volume of both resynators.
MIDI controller number: 11 ("expression").

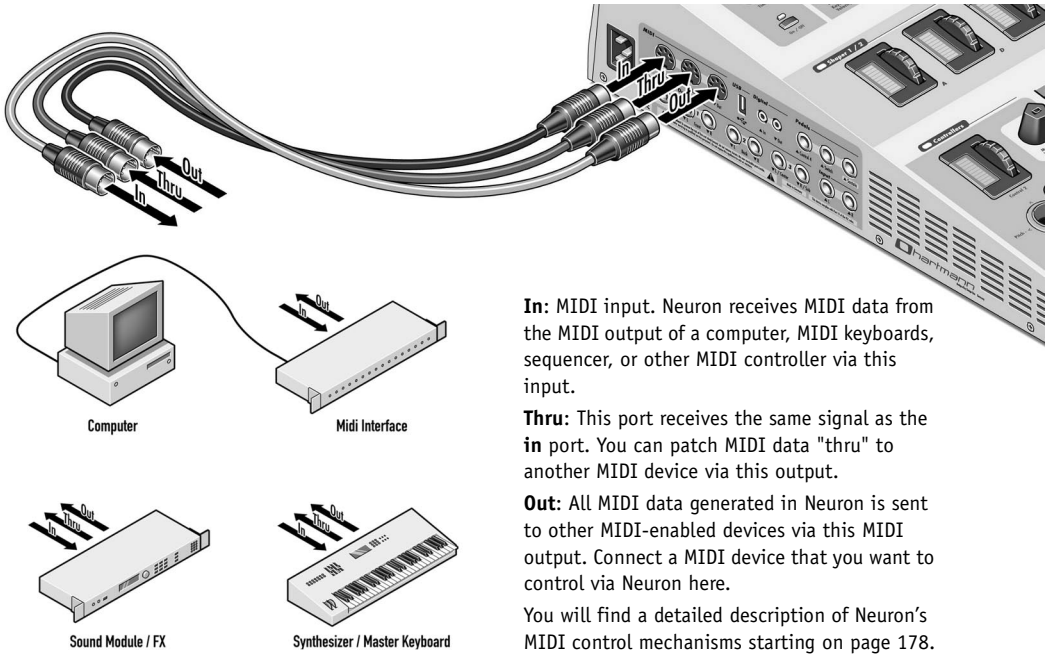


Switch: Port designed to take a footswitch of any type (opener or closer) and polarity. You can define functions for the switch in the controller menu (see page 167).
MIDI controller number: 66.

Sustain: Connect a standard sustain pedal here.
MIDI controller number: 64.

Neuron automatically identifies the type of connected footswitch and sustain pedal when it is powered up. If this is not the case, you can provide that information to Neuron via the *basic settings* parameters *footswitch* and *sustain ped*

MIDI setup



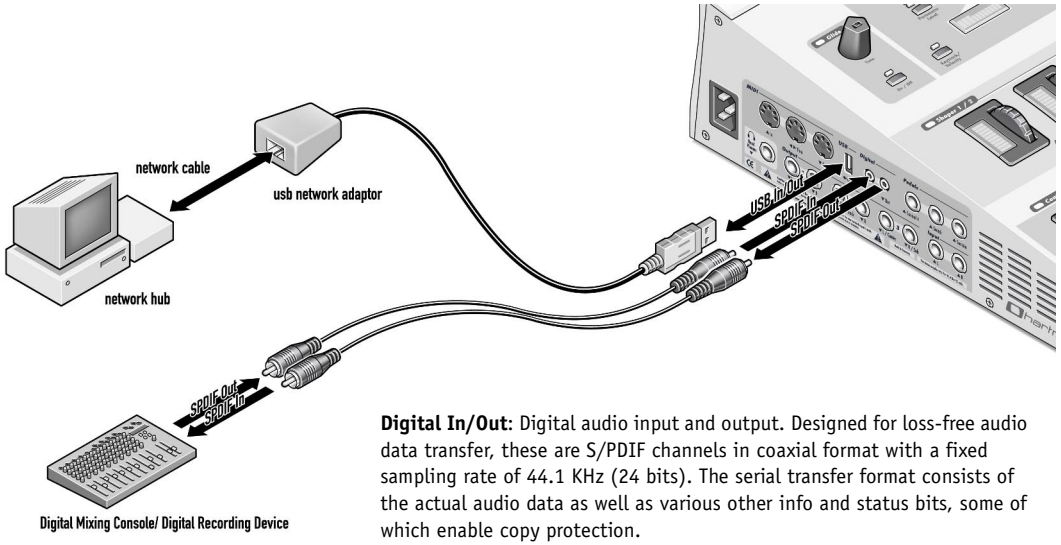
In: MIDI input. Neuron receives MIDI data from the MIDI output of a computer, MIDI keyboards, sequencer, or other MIDI controller via this input.

Thru: This port receives the same signal as the **in** port. You can patch MIDI data "thru" to another MIDI device via this output.

Out: All MIDI data generated in Neuron is sent to other MIDI-enabled devices via this MIDI output. Connect a MIDI device that you want to control via Neuron here.

You will find a detailed description of Neuron's MIDI control mechanisms starting on page 178.

Digital inputs/outputs, USB connection



Digital In/Out: Digital audio input and output. Designed for loss-free audio data transfer, these are S/PDIF channels in coaxial format with a fixed sampling rate of 44.1 KHz (24 bits). The serial transfer format consists of the actual audio data as well as various other info and status bits, some of which enable copy protection.

For example, you could use a suitable coaxial cable (75 ohms, RCA connectors) to connect Neuron to a hard disk recording system, DAT recorder, or digital mixer. Note that the content of the digital signal sent via this port is identical to the analog signal routed out via stereo output 1.

USB: Standard USB interface for connecting a PC/MAC (via USB network adapter!). For details, see page 185.

Let the games begin...

Set up your gear as follows: Connect stereo output 1 (L/R) to the inputs of your mixer or audio interface. For purposes of MIDI control, connect the MIDI In/Out ports in the standard manner used for other synthesizers.

To learn more about Neuron's connections and interfaces, see page 8.

Powering up (finally!)

The on/off switch is the Hartmann logo located at the rear of the housing.

While the Neuron is booting (that is, loading all data required for operation), the main display reads

Then Neuron's software is initialized.

This launching process can take some time.

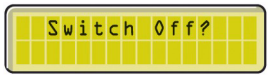
When Neuron comes on line, it is in sound mode with sound 0 loaded.

The switch lights up continuously when Neuron is up and running.

Switching off

To switch off Neuron (though we're keen to know what reason you might have to ever shut Neuron down...), briefly press the handsome mains power switch.

If you have defined the option *ask* for the *switch off* parameter (which is the default setting) in the basic settings, the following question appears in the display



Press **enter** (that's the knob next to the main display) in order to shut Neuron down. This process takes several seconds and is indicated by the display reading, `Switching off ....`

If you reconsider at the last moment (very sensible of you), press the **exit** button so that Neuron remains powered up.

If the basic settings parameter *switch off* is set to *quick*, Neuron will switch off without further inquiry.

We recommend that you have Neuron prompt you before it powers down; that is, set *switch off* to *ask*.

We endowed Neuron with this option to prevent it from being switched off inadvertently (say because in his on-stage frenzy your easily excited vocalist tends to mow down everything in his path).

Emergency off

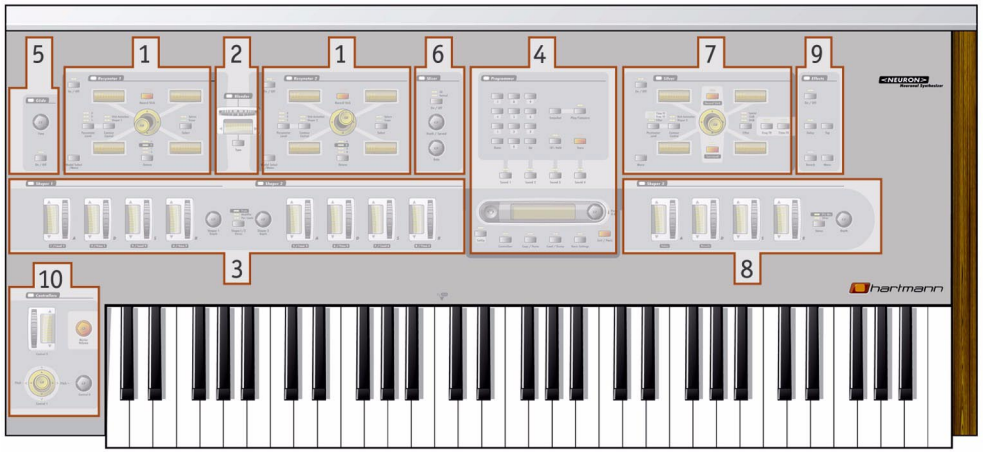
In the unlikely event that Neuron refuses to power down in the normal "orderly" fashion, you can always use the emergency off function. Do this by pressing and holding the mains power switch for five seconds.

This option is your last-resort. It is comparable to pulling the mains plug. So, use it in emergencies only. Oh, and that telltale popping noise that indicates a connected device has been switched off while the sound reinforcement system remains? You will hear it in all its sonic glory through the audio outputs!

Beyond that, there is the possibility of data integrity problems on the hard disk, though chances of this occurrence are remote.

Quick Start Guide

Have you set up your gear at least in a rudimentary configuration, connected Neuron, and switched it on? Good; now, let us take you on a whirlwind tour. First let's take a peek at Neuron's modules:



(1) Resynators (see the description on page 69). This is where the sonic revolution starts! Resynators are the interface between Neuron's models and your creative powers. **(2)** The **blender** is the arbitrator between the two resynators (see the description on page 93). **(3) Shaper** 1 and 2 are flexible envelope generators (page 99). **(4)** The **programmer** is Neuron's command and control center and administrative headquarters (page 45). **(5)** Lurking beneath the **mod**'s unassuming exterior is a powerful LFO generator serving as a freely assignable modulation source (page 114). **(6)** The slicer is an unusual variation on an LFO (page 119). **(7)** The **silver** module is a multi-effect sporting a top-flight multimode filter (page 123). It is also the home of the **surround** controls. **(8) Shaper** 3 lets you define a filter envelope (page 149). **(9) Master effects** put pro quality delay and reverb at your fingertips (page 154). **(10)** And finally we give you **free controllers** for free-thinking citizens (page 162)!

If you cannot wait to find out the order and hierarchy of modules in the signal flow, check out page 43/44 where you will find a detailed diagram that should answer all your questions.

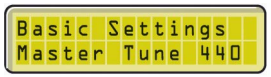
And now back to our guided tour.

The following Quick Start Guide caters for seasoned keyboardists and producers who have plenty of experience with synthesizers. Follow along with these steps and you will gain an initial impression of Neuron's powers without delving into detail. So let us get down to some hands-on fun and leave the theory for later...

Local on/off

You will find the *Local on/off* MIDI parameter in Neuron's basic settings. To adjust it,

- Press the **basic settings** button located below the main display. The display reads



- Use the navigation stick at the left of the display to scroll down (we call this little exercise **stick.down**) until the Local parameter appears in the display:

- Readjust the parameter value by twisting the knob at the right of the display.

You will find the purpose, use and handling of all basic settings parameters described in the section starting on page 36.
You will learn more about MIDI control on page 178.

Loading and playing sounds

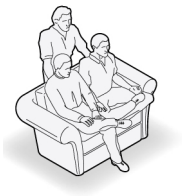
You have three options for loading sounds:

- Type in the three-digit sound number on the numeric keypad (the sound loads immediately after entering the third digit),
- or press the **up**/**down** buttons to load the next/previous sound,
- or dial in the sound number by twisting and then pressing the knob located next to the display (pressing = enter).

For more insight on sound mode, check out "Programmer: Programming sounds" starting on page 49.

Exit/panic

If you get lost in a menu, simply press the **exit** button located at the bottom right of the main display. Sound loader will reappear. Pressing and holding it activates the panic function, which restarts Neuron. The device reports back with the most recently selected sound or setup activated.



Something old and something new

You will find that though Neuron features many new and different things, its structure is largely familiar and certainly very clear. Filters (though in the Neuron the silver module does the filtering) and envelopes (that would be the Shaper) are old acquaintances, as is the LFO (called "mod" in Neuronese). However, instead of conventional oscillators, Neuron features two resynators. One or two models provide the source material for every sound. They can be processed in a variety of ways in the resynators. Sound processing options are so extensive that you will seldom use the filters and effects. In fact, many factory sounds do without filters altogether.

Effects on/off (silver effects + master effects)

- There are two effect units in Neuron. Located in the silver module, freq FX and time FX are available for every sound. They remain assigned to each sound even in setup mode. You can switch them on and off separately via the **freq FX** and **time FX** buttons. You can also opt to switch the entire silver module on and off via the **on/off** button.
- Master effects (delay and reverb) are global, which means they are available once only for each sound/setup. You can switch them on and off via the effects **on/off** button.

For a detailed description of the silver module, see page 123. For more on master effects, see page 154.

A controller for every season

Neuron's free controllers are assigned to many of the preset sounds. These are

- the modulation wheel (control 2),
- the stick controller (pitch bend and control 1)
- and the rotary encoder (control 3).

When you are checking out sounds, be sure to try on the controllers for size. This will give you a first impression of their amazing sound-shaping possibilities. Read "Free controllers" starting on page 162 to learn how to integrate controllers into the modulation matrix.

Resynators, scape/sphere, editing via stick

The resynators are the heart of Neuron's synthesis engine. A single model in a resynator offers astonishingly versatile sound-sculpting possibilities. Neuron's fundamental sound source, the model is divided into a scape (that's the sound-generating section) and a sphere (the sound-shaping section). For a piano sound, for instance, the strings are represented in the scape and the body in the sphere. There are six sound parameters distributed over three levels for each scape/sphere. Parameters differ from model to model and are provided with descriptive names and functions.

To experiment with resynator parameters, first determine whether you want to edit the scape or the sphere using the **scape/sphere** button. Then select the desired parameter level by pressing the **parameter level** button. Your best bet is to start with parameter level 1.

You will find an in-depth explanation of resynators and all their parameters and control features as well as a bunch of tips on all key "how-to's..." starting on page 69.

Storing snapshots and sounds

Neuron's stick controllers are highly responsive tools, making it easy for you to manipulate parameters very subtly. Often very different sounds are just a figurative "hair" or nudge apart, so you may find that a touch too much relegates the desired sound to some digital hell. But help is near in the form of the snapshot function. Best try it out now and use it frequently:

- After you have discovered a hip variation on a sound, simply press the **snapshot** button located in the programmer module. Presto, the current panel settings are assigned a number and stored. You can store up to 50 snapshots.
- To retrieve a stored snapshot, press the **play/compare** button and twist the knob next to the display to select the desired snapshot number. Use **enter** (press the knob) to load the snapshot.

Snapshots and the play/compare function are described in detail on page 52.

Please bear in mind that snapshots are not stored with the sound and that they are deleted when you change sounds.

For this reason, make a habit of storing hip sounds immediately!

Press the **store** button to save a sound. Then twist the knob to select the desired memory slot (or sound number). Scroll to the second line of the display using navigation **stick.right**. Fiddle with the knobs and navigation stick to assign a name (**stick.up**/**down** changes between uppercase and lowercase).

Conclude the storage process by pressing **enter** (the knob, that is). You have 1,000 memory slots available for storing sounds.

To learn more about this, read the section "Programmer: Programming sounds" starting on page 49.

Loading and playing setups

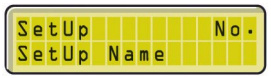
Setup mode is Neuron's multimode. Four sounds can be played on four MIDI channels, or assigned to the keyboard in the form of a split/layer. 512 memory slots are available for setups.

Activate setup mode by pressing the **setup** button, then load stored setups using the same three methods used to load sounds stored in the sound mode - via the numeric keypad, **up/down** or rotary knob (see section above).

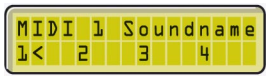
Setting and assigning MIDI channels

Assign MIDI channels to the individual sounds of a setup in the setup menu:

- Neuron is in setup mode.
- Press the **exit** button twice briefly to activate the setup loader:



- **Stick.down** repeatedly to scroll to the MIDI menu option:



  The MIDI channels of the four sounds in the current setup are listed side by side. **Stick.right/left** moves the cursor "<" from one sound to the next. The name and number of the sound you just edited appear in the first line of the display.
- Twist the knob to set the channel number for each of the four sounds.
  A value of 0 denotes "omni."

In Neuron, the MIDI global channel (as defined in the basic settings) applies exclusively to sound mode. The aforementioned settings apply in setup mode.

You will find a detailed description of Neuron's MIDI control mechanisms starting on page 178.

Storing setups

Setups are stored in the same way as sounds. Note that actual sound data is not stored in the setup. Instead, the system stores references (or links) to the sounds contained therein. If a sound is edited, moved, or deleted, all setups in which this sound is used change accordingly.

For a closer look at all parameters and the handling of setups, please refer to the section "Programmer: Programming setups" starting on page 58.

Creating your own models

You can load additional models or make your own models from samples to add to Neuron's 200 factory models. This is done on an external computer (Mac or personal computer) rather than on Neuron.

You will require a software application called ModelMaker to do this. It analyzes samples or multisamples and converts them into Neuron-specific resynthesis models. These are transferred via USB to Neuron's internal hard disk.

To learn how this works and which software and hardware are required, read "The load/dump function" starting on page 187. You will find further information on ModelMaker on page 192.

Neuron basics

The philosophy behind Neuron

Contemporary music productions have benefited from computer assistance for years now. Though computers have assumed the role of the actual recording equipment, they come in many other musical guises. Case in point: Where in the past synthesizers and samplers were made up of discrete electronic components, today they run as programs on a DSP (digital signal processor).

The past five years have seen the advent of a technology so powerful that it allows emulations of musical instruments to be integrated into computer-assisted music systems in the form of software plug-ins. This lets you enjoy the convenience of accessing virtual instruments right there on your computer.

The instruments appear on a graphical interface on your screen, alongside the actual recording software. This view depicts the various control features – faders, knobs, buttons, switches, and so forth – that serve to "play" a virtual instrument such as a sampler or synthesizer.

It is safe to say that today this technology is the industry standard. However, despite the unassailable convenience, ever more users are voicing their dissatisfaction with the ergonomic shortcomings of playing an instrument via screen, computer keyboard, and mouse. Musicians and producers alike feel that this uninspiring working method is an encumbrance, hampering creativity and the all-important impelling force of musical intuition. The growing success of specialized remote controllers – outboard gear sporting real control features - attests to the fact that many musicians miss the touchy-feely vibe of a real instrument.

The irony of this retro yearning is that most virtual instruments are computer-generated emulations of what were once real instruments. But the allure of the corporeal is compelling, and savvy users have come to appreciate that tactile sensations play a part in making music, and that hands-on handling of an electronic instrument's man-machine interface gets the creative juices flowing.

Though this bias towards the palpable assisted in the birth of Neuron, tactility is just one of many aspects. Taken in its entirety, it is nothing short of the next logical step in the ongoing development of synthesis engines. And thus its man-machine interface is an organic extension of the synthesizer's heart and soul, the synthesis engine, and a remote control designed specifically to afford direct access to its formidable powers.

A short trip down memory lane

An explanation of the true breadth and depth of the concept behind Neuron requires a trip down memory lane to recap the history of electronic musical instruments and synthesizers.

Almost a century ago, the pioneers of electronic music began experimenting with colossal synthesis engines powered by electricity. On a quest for new sounds that classic instruments were incapable of producing, these musical modernists spawned devices that would inspire many great tunesmiths and composers of film scores. The driving force behind this crusade was the desire to explore the great sonic frontier. That would change over the course of the coming decades. Commercialization and corporatization changed the way music was perceived and made. Technological advances, particularly strides made in the past 30 years, made it possible to produce entire compositions using electronic instruments called synthesizers and samplers.

The new market paradigm for instrument builders was to fashion "authentic" sounds – timbres and tones as close as possible to those produced by traditional instruments.

Imitation gave way to innovation in the last decade or so when musicians began to see the tremendous creative potential that the all but forgotten classic synthesizers harbored.

Concurrently, a new musical style emerged that celebrated the sound of electronica as such.

Today contemporary productions are for all practical purposes musical hybrids in which synthesizer sounds typically share sonic space with the time-honored instruments of pop music. That explains the modern-day renaissance of archetypal synthesizers, albeit in the guise of the aforementioned digital emulations rather than as a box full of complex discrete circuits.

In every era of sound synthesis, half-mad audio scientists toiled away in their labs, concocting all manner of approaches to synthesis. Key technologies emerged and held sway over the synthesizer market for many years. Hordes of companies embraced them and incorporated them in proprietary products. A handful of technologies prevailed – to this day, they provide the coordinates by which every manufacturer charts his synthesizers' course.

A case can be made for the point that a trailblazing technology arrives every 15 to 20 years and, equally important, spawns generations of commercially successful products:

- Subtractive synthesis
  Pioneers: Moog™, EMS™, Buchla™, Sequential Circuits™, Oberheim™, ARP™
- Additive synthesis
  Pioneers: Fairlight™, Synclavier™, PPG™, Technos™
- Hybrid synthesis / digital synthesis
  Pioneers: PPG™
- FM (frequency modulation)/PD (phase distortion) synthesis
  Pioneers: Yamaha™, Casio™
- Virtual sound synthesis / physical modeling
  Pioneers: Yamaha™
- Sampling
  Pioneers: Fairlight™, EMU Systems™, Synclavier™

... and today: Neuron!

We are convinced that with Neuron, we have created a technological force sure to drive a sonic revolution of the same order. Neuron employs a technology that in the near future will reshape the perceptions of the entire computer industry. Adaptable computer algorithms power it. Its sound generation system is rooted in the overwhelming potential of resynthesis. The term is easily defined: resynthesis is a process by which an original exemplar is artificially replicated - in this case, creating a digital mirror image of a sonic event – with all its characteristic features remaining intact.

We applied the principles of an adaptive program that has evolved and been refined over many years. Now for the first time in the history of synthesizers, it is possible to access resynthesized sounds with astonishing accuracy and radically reshape them to dramatic, even spectacular effect.

Like a sentient being, Neuron recognizes a sound. But more than that, its intelligence is such that it puts at your disposal parameters whose structures are adapted dynamically to suit this sound. And that makes Neuron the first synthesizer with a brain full of responsive synapses, that is, variable rather than fixed parameter assignments.

A new sonic dimension in the age of the remix

Neuron is an instrument of the remix era. Contemporary pop music no longer clings to the notion that musical sounds or themes must be newly developed or composed. Instead, music-makers mine the rich seam of our musical heritage for material; good ideas are recycled and developed further. A drum loop is sampled to create another - the fact that the first drum loop was already sampled from an old record notwithstanding. And so it goes ad infinitum.

Neuron captures the musical spirit of the time. Rather than dipping into a single well – a particular form of synthesis or sound source - Neuron draws buckets full of musical material from every well. It has the power to develop every sound further. It does not matter if the source is a lone flute sound or an entire song. What for the conventional synthesizer is the end of the sound generation chain is only the beginning for Neuron. There are no more rules or boundaries.

Like the remix changed the face of pop music, Neuron's unique powers of resynthesis open up a new dimension in creative musical endeavor, offering unprecedented opportunities for individual expression to both musicians and non-musicians.

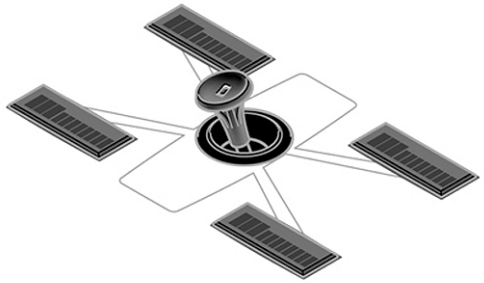
A look at control features in general

Neuron's extraordinary user interface is another crucial feature alongside its innovative synthesis engine. Our philosophy dictates that every Hartmann instrument is easy to understand and use, that it handles intuitively, and that it makes discovering new technology fun. To live up to that promise, we were compelled to invent several new control features. The tactile experience of generating sound via Neuron is something entirely apart from what you have encountered with conventional synthesizers.

The layout of the external operating panel mirrors Neuron's internal signal flow and provides a vivid visual reference to how individual modules interact. Its control features are arrayed logically. Striking visuals draw your attention to key functions and fundamental settings. The graphics of secondary functions incorporating several control features are homogenous, denoting their common ground and shared purpose.

Stick controller

The resynators' and silver module's principal control features are stick controllers.



Every stick is surrounded by four cross-x displays showing individual parameters and current settings. Parameter value changes are indicated directly. Opposite parameters (for example, *big* and *small*) are arrayed diametrically. Logic dictates that the sum of their values is always equal to the peak value. Parameters that are not opposite each another can be edited independently.

The jaw-dropping power and finesse of this unprecedented set of control features is definitely unmatched. They enable everything from the subtlest to the most drastic modulations.

The stick's mushroom-like contours facilitate handling. A stick may be gripped with the thumb and (index) finger or guided by inserting a finger into a trough-like groove on its surface.

When you move a stick, the first of the parameters that you have just edited (generally at the top left) appears in the main display. Use the rotary knob and navigation stick located next to the main display to edit the values directly and in numeric increments. Experience has shown that this method of using the stick intuitively to make a rough adjustment and then fine-tuning the setting numerically works well.

Calibrating stick controllers

Owing to their physical makeup, the resynators' and silver module's three stick controllers and control 1 / pitch stick have certain mechanical manufacturing tolerances. The sticks must be calibrated to compensate for these small deviations. The process of calibration adjusts the stick's mechanical travel to match the value range it is designed to cover.

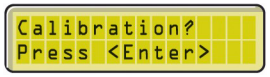
When is calibration necessary?

All sticks and aftertouch are factory calibrated so you do not have to do this under normal circumstances. However, we recommend that you re-calibrate (as described below) if:

- you are unable to access all parameter values via stick;
- parameter values jump when you move sticks;
- the center position of the pitch bend (control 1) is no longer true to pitch;
- the keyboard aftertouch value peaks out **despite** the fact that the basic settings parameter *aftertouch scale* (see page 40) is adjusted properly.

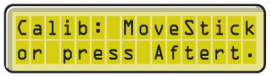
► **How to calibrate stick controllers (and aftertouch)**

- Press the **basic settings** button. The main display shows the menu offering Neuron's basic settings.
- **Stick.down** the navigation stick located next to the main display to scroll to the basic settings menu option

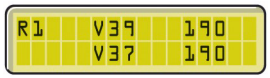


At this point you can cancel the calibration process by pressing **exit** or by operating any other module.

- The following prompt appears:

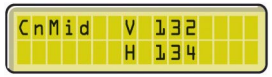


- Rotate the first stick that you want to calibrate several times, stirring like you would sugar into coffee. Be sure to move it to the **full** range of travel. Do this until the values shown in the main display no longer change. This stirring action serves to measure the stick's maximum range of travel. These physical values are then mapped to the value range that is to be covered, meaning that they are converted.
  The display for resynator 1 could look something like this:

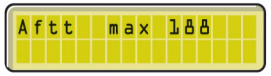


- Move the two resynator sticks, the silver module's stick, and the stick labeled **control 1** one after the other as described above.
- Because the **control 1** stick also serves as a pitch controller, you can also calibrate its center position (pitch = 0). The idea is to prevent unintentional detuning when it is set to the zero position.

  In order to determine the center position of **control 1**, move the stick **very lightly** around the center. While Neuron is doing the calibration, its display shows the values measured by the device.
  Example:



- Here is how to **calibrate aftertouch**: Strike any key on the keyboard and then bear down with increasing pressure until the measured maximum value appearing in the display does not change anymore.
  Example:



- Once you have calibrated everything to your satisfaction, confirm the values by pressing the rotary knob next to the main display (**enter**).

  The Neuron software's current version number appears in the main display.

Basic parameter *stick mode*

While on the subject of sticks, let us look at the *stick mode* parameter in the basic settings:

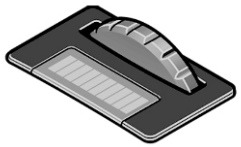
When you switch to another parameter level or load another sound/model, the four cross-x displays indicate the stored values, but the stick will rarely be in a position that corresponds to these values. Using the *stick mode* parameters, you can determine how the sticks respond when this is the case. You will find a detailed description of the parameter on page 37.

Stick animation

You can record the stick controllers' movements and play this stick animation back to manipulate parameter values on the fly.

For a detailed description of stick animation, check out page 89.

Data input wheels (wheels)



Envelopes are controlled using rotary encoder wheels and adjacent bar displays. This enables effective hands-on tweaking and swift access to all parameter values of entire groups of control features. What's more, this approach to handling is ideal for ascertaining envelope settings. Note that several wheels can be operated simultaneously.

The wheels' value ranges are scaled on the fly. This means that the faster you turn a wheel, the greater the range of values it steps through.

Knob

The pentagon at the top morphs into a circle below. This five-sided design affords a sure grip. Though the visuals of this simple control feature are asymmetrical, the knob's axis evinces symmetry. The tug of war between the two signifies dynamism. The knob lacks a pointer because it is a rotary encoder, meaning that its range is infinite. You will find that this control also responds on the fly so that you can adjust values in individual incremental steps as well as sweep across greater value ranges.

The knob next to the main display also serves the function of an **enter** button as found on the computer keyboard (see page 31).

Menu navigation in the main display

The central control unit contains the main display (two lines with 16 characters each); the parameters of all Neuron modules appear in it. If you activate a control feature on the device's panel, the display also indicates the corresponding parameter changes. This gives you the choice of editing parameters using the given module's dedicated control features or controlling the module via control unit.

The navigation stick lets you access all menu options swiftly and efficiently.

A rotary encoder with a built-in button serves to input data and confirm entries (**enter**).

Note that Neuron is not endowed with a master menu that starts at a common root and extends throughout the modules. Instead, each module has its own menu that is accessed like this:

- Press the **menu** button of the given module to call the most recently edited menu option into the main display. Press the menu button while the menu is active to access the top level of the menu (for example, model loader in the resynators).
  Or:
- Manipulate any of the module's knobs or buttons. The main display will immediately display the appropriate menu option. You can then scroll through that module's menu using the navigation stick (on the central control unit) in order to edit other parameters.

Total recall: Neuron "remembers" menu options!

When you begin designing sounds, you are sure to work with several Neuron modules simultaneously. For this reason, Neuron remembers the most recently edited option of every menu. So, if you exit a menu and return to this menu later by pressing the menu button, you will arrive at exactly the same point. In order to jump to the top level of the menu from there, press the **menu** button once.

Navigating menus

After you retrieve the menu of a given module, you can edit using the navigation stick and knob (located to the left and right of the main display, respectively):

- **Stick.down** and **stick.up** to scroll through the main menu options. **Stick.right** and **stick.left** to jump to and scroll through submenus if on hand.
- The **rotary knob** edits the current parameter. Depending on the parameter, you can either select among predefined settings or adjust a numeric value.

Neuron's enter button

For some menu options, pressing the knob has the same effect as pressing an **enter** key: When loading models, sounds and setups, first select the number (it appears in the display) by twisting the knob and then pressing the knob to confirm the selection. The desired data is then loaded.

The **enter** button is also required for operations such as storing calibration and loading/dumping data. The settings of typical value-based parameters take effect without having to press **enter**.

While editing a parameter value, you can reset the value to the given default value by simply pressing **enter**. For parameters that can have both negative and positive values, this is generally a value of 0.

Exit. But do not panic.

Press the **exit** button briefly to quit the current menu option.

In sound mode, this returns the display to the top level of the sound menu, which is sound loader. In setup mode, pressing **exit** either jumps to the most recently edited menu option of the setup menu or, if you are already working in the setup menu, to setup loader.

In some cases, **exit** also serves to cancel the operation that is currently underway, for example, when storing a sound/setup or when Neuron asks you if you really want to switch it off.

If you press and hold the button until the LED extinguishes (three seconds should do), you will activate the **panic** function. This generates an *all notes off* command, and that spells immediate silence, say, in the event of a hung note. It tells both Neuron's internal workings as well as the MIDI setup to shut up. After rebooting, Neuron comes back on line in the same mode that it was in before the panic attack occurred. All settings remain intact.

Operating modes

Neuron distinguishes between two operating modes: sound mode and setup mode. The latter you are probably familiar with – it has the same underlying concept as multimode.

Neuron comes on line in sound mode.

Operating mode: Sound mode

As its name would indicate, in sound mode you can play individual sounds, edit, and store them. You are also free to create new sounds by loading models into the resynators, editing their parameters, and doing other fun stuff like defining envelopes or piling on silver effects. Since this operating mode pertains to a single sound, it is also called single mode.

► How to enter/exit sound mode

Sound mode and setup mode are mutually exclusive. To access sound mode, quit setup mode by pressing the **setup** button. The LED above the button does not light up when Neuron is set to sound mode.

You will find out how to store, load and edit sounds in the section starting on page 50.

Operating mode: Setup mode

In setup mode or multimode, sounds created in sound mode are combined into setups. A setup may contain up to four sounds that can be played simultaneously.

Sound mode and setup mode are mutually exclusive. To access setup mode, quit sound mode by pressing the **setup** button. The LED above the button lights up when Neuron is in setup mode.

Selecting sounds:

Located above the main display you will find four buttons labeled **sound 1** to **sound 4**. Every button represents a sound stored in the current setup. You can assign sounds to buttons in setup mode. For more on this, see page 65.

When you press a button repeatedly, the assigned sound is activated (LED lights up), deactivated (LED extinguishes), or primed (LED flashes).

At the risk of belaboring the obvious, an activated sound is played with the setup while a deactivated sound is muted. But what does a primed sound do? A sound has to primed before you can edit it. It can be manipulated by means of the module's control features while the current setup is performed. For example, you can edit a primed sound's model parameters in real-time using the sticks.

Further setup parameters

A setup consists of more than merely four sounds. It contains many other parameters, for example, the balance of levels between individual sounds, surround settings, and so forth. Though these parameters have a bearing on the sounds contained in a setup, they are only meaningful in the context of a setup.

All parameters that are stored along with a setup are listed in table 5 on page 61.

Handling setups

The section "Programmer: Programming setups" starting on page 58 provides detailed insight into how to program setups.

Hierarchies: The Neuron memory model

Like the food chain in the real world, Neuron is ordered in hierarchies. We distinguish between four levels that are stored separately.

The **basic settings** (see page 36) define the device's basic properties. All global parameters that you will use to tweak Neuron to suit your taste and needs are stored here.

All models that you will load into the resynators and use as the source material for sounds are stored at the **model level**.

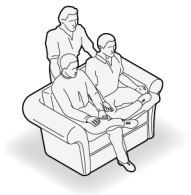
Trust us: The factory model database contains plenty of models. Courtesy of Neuron's system architecture, every model harbors the potential for thousands of tone-shaping options, which is why the actual number of models does not say much about Neuron's phenomenal range of tonal possibilities.

A model of understatement, a notable British automaker likes to call the performance capacity of his lavishly appointed limousines' muscular engines "sufficient." Sounds good to us: Neuron ships with a "sufficient" range of interesting models. In fact, you will find it impossible to plumb the full depths of its powers of expression. In the unlikely event that you find yourself hitting any boundaries, you will be delighted to learn that the model level on its internal

hard disk offers plenty of room to house many more models.

The model files containing all *sphere* and *scape* parameters come in different sizes depending on complexity. But there is no reason to fret about hard disk real estate – there is plenty of acreage reserved for files.

In the section "The idea behind Neuron models" starting on page 70 you will find out everything worth knowing about models.



Note that when editing sounds via resynator, the actual model data stored in the model database is not edited. A model is loaded into the resynator as a reference – in other words, another instance of the original model is generated - and the settings that you dial for its parameters are stored at the sound level rather than the model level.

This explains why the **sound level** is the third stage of our hierarchy. Every sound is the sum of wildly diverse information, including everything from the employed models to silver effect settings. When you load a sound, all settings pertaining to this sound are loaded from the sound database into the appropriate modules. Every new sound that you store wanders into the sound database accompanied by all this data.

Unlike many other synthesizers, Neuron has no sound banks because the 1,000 potential sounds are stored sequentially. For purposes of MIDI addressing, consider sounds 0 to 99 to be a "virtual" first bank, sounds 100 to 199 a second bank, and so forth.

So, what kind of information is stored at the sound level?

- The name and number of the sound.
- References (or links) to the employed model numbers of both resynators.
- The settings of all scape and sphere parameters of both resynators (see page 77).
- Blender settings (see page 94).
- Envelope settings (see page 108).
- Mod settings (see page 116).
- Slicer settings (see page 122).
- Silver settings (see page 138), with the exception of the surround settings - these belong to the setup!
- Controller settings (see page 165).
- Sound-related pan values (page 49).
- Master effect settings are stored at the sound level and at the setup level.

Back in the section "Operating modes" starting on page 32 you learned that up to four sounds can be combined into a setup.

This brings us to the very top of our hierarchy: Multimode-specific data is stored at the **setup level**. Each of the up to 512 setups that the setup database can hold contains the following information:

- Name and number of the setup.
- Numbers of the four sounds.
- Volume level for every sound.
- Transpose setting for every sound.
- Detune setting for every sound.
- MIDI channel for every sound.
- Local on/off setting for every sound.
- The selected audio output for every sound.
- Pan setting for every sound.
- Key low and key high for every sound.
- Low and high velocity for every sound.
- Silver mix value for every sound.
- Delay send for every sound.
- Reverb send for every sound.
- Surround settings for every sound.

The four sounds contained in the setup are not copied into the setup; they are referenced by their numbers. The actual sound remains in the sound database. Its data is copied from there when a setup is loaded. Consequently, every change made to a sound is automatically audible in the setup without having to be stored anew.

You will find in-depth information on these settings in the parameter table on page 61.

Master volume

Adjust the overall volume of your Neuron using the red master volume knob located below shaper 1.

The master volume knob controls the levels of all analog audio outputs (stereo/surround and headphones) as well as the digital output (S/PDIF).

The current setting is not stored with a sound or setup! Instead, when Neuron comes on line, it automatically dials in the volume level set when you last played the synth.

When you twist the master volume knob, the current volume appears in the main display (the value range is 0 to 127).

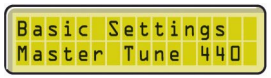
At peak volume, Neuron delivers maximum dynamic range with minimum converter noise. Back off the volume on connected equipment and crank up Neuron's level. That said, though, you don't want to max out Neuron's master volume; leave a little reserve and, depending on sound, keep an eye (or ear) on levels. You do not want any spikes to hurt your ears or gear.

Fundamentals: Basic settings

Neuron offers global parameters called basic settings that let you set the device up to suit your wishes and preferences. Basic settings have a bearing on the device as a whole rather than a single sound or setup.

► **Defining basic settings:**

- Press the **basic settings** button located below the main display. The display should read as follows:



- **Stick.down** and **stick.up** to scroll through the available global parameters (see table 1 on page 37).
- Use the knob to edit the currently selected parameter.

The device automatically quits the basic settings menu when you edit a parameter in any module. When you quit the basic settings menu by pressing the **basic settings** button again, Neuron jumps to the most recently edited menu. In both cases, the device recalls the most recently edited basic settings parameter and displays it when you call the menu back up again.

Table 1 explains all basic settings parameters.

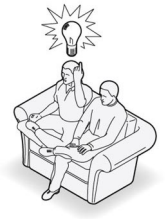
A look at basic settings

Master tune	Determines Neuron's overall tuning by adjusting the reference frequency A3 (440 Hz). The value indicated for this parameter is an absolute value (that is, it is not offset). Value ranges from 400 to 480 Hz.
Stick mode	Determines the operating mode of stick controllers in the resynators and silver module. A bit of background on this menu option: Neuron is not equipped with motorized sticks that retrieve the current parameter values when you switch to another parameter level or load another sound/model and move to positions corresponding to these values. After you switch over, the four cross-x displays indicate the currently stored values, but it is an unlikely coincidence if the stick position actually tallies with these parameter values. Three modes determine how the indicated parameter values respond to stick movements: • *Jump*: When a stick is toggled, every parameter immediately takes over the value of the current stick position, that is, the value jumps. • *Snap*: The parameter values remain unchanged when a stick is toggled until the stick moves to about 10 value increments within the range of the stored value. Then the value zeros in on the value determined by the stick's position and can be edited again. In essence, this mode simulates a motorized stick, with the difference that the stick must be set manually to the correct position. • *Reltv* (relative): The stick movement is relative to the stored value: The physical distance from the current position to the furthest point of travel is superimposed on the range of values **yet** to be covered and the scale is adjusted accordingly. Once the stick arrives at the maximum / minimum value, the stick position and the range of values are identical again. We recommend that you select a preferred mode and stick (ha, ha) with it.

Table 1: Basic settings

ResyParReset	Determines if default values are loaded into a resynator or the current values are retained when a model is loaded. Options: • *Yes*: Models are always loaded into the resynator with the default parameter values stored in the model database. • *No*: No models are loaded into the resynator with the default values. The currently defined values are retained in the newly loaded model. • *Ask*: When loading a model, the device asks if you want to take over the parameter values or load the default values. The display reads: **`Use Defaults?`** Use the knob to select *yes* or *no* before you load the model via **enter**. The option of loading existing parameter values into another model can come in handy. Case in point: You can load a similar model into the resynator and use the existing values as a starting point for your sound-sculpting efforts.

Table 1: Basic settings (cont.)



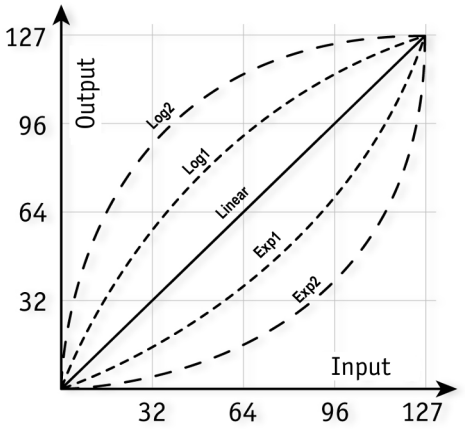
VeloCurve	Determines the dynamic response of the keyboard. Attack dynamics vary according to the selected velocity curve. Your options are: • *Log2, Log1*: Various types of logarithmic curves. • *Linear* (default setting): Linear curve, that is, the pressure you apply to the key dictates dynamic response. • *Exp1, Exp2*: Various types of exponential curves. • *Fix32, Fix64, Fix96* and *Fix127*: No attack dynamics; instead response is fixed. The higher the fixed value, the higher the output volume. The velocity value is computed for every voice. In other words, every note you play is rendered at its original velocity! Neuron treats velocity like an internal controller. The modulation destinations for velocity are determined at the destination via the *depth* parameter.  Example: Resynator volume is modulated via velocity when the menu option *volume velo depth* in the resynator menu is set to a value other than 0. For more on this, read the section "Velocity as an additional controller" starting on page 168.

Table 1: Basic settings (cont.)

Aftertouch scale	Defines a factor (threshold value) for the aftertouch scale. As the name would imply, "aftertouch" is the pressure applied to a key once it has been pressed. The keyboard determines how much force is applied, converts this value into an aftertouch command, and sends it to predefined *destinations*. This data may be employed to shape tone, for example, to generate vibrato or modulate the filter frequency (see below). The harder you bear down on a key after striking it, the higher the aftertouch value and the more intense its influence on the given sound. In Neuron (and via MIDI), aftertouch is monaural, meaning that the aftertouch modulation affects the entire sound rather than individual voices. Value range: 0 to 127. 0 deactivates the function. At low values, aftertouch is less responsive; a value of 127 gives you the full dynamic range. Neuron treats aftertouch like an internal controller for which you can define up to four simultaneous *destinations*. Go to the controller menu to do this. While you are there, you can also define the *depth* for every destination. In addition to the "global" *scale* value, you can adjust aftertouch depth individually for each destination. For more on this, pore over page 165. Note also in this context the menu option for calibrating aftertouch (see page 28).
MIDI Glb Ch	Determines the global send and receive channel for MIDI data (MIDI global channel) for **sound mode**. In sound mode, Neuron responds to incoming MIDI data only when the defined MIDI global channel and send channel numbers are identical. Value range: 0 to 16. 0 denotes omni, meaning that Neuron processes incoming messages on all MIDI channels. For more on this, pore over page 178. In **setup mode**, the individual sound-related MIDI channel settings in the setup menu apply - see page 61.

Table 1: Basic settings (cont.)

Local	Deactivates/activates Neuron's synthesis engine via the keyboard as well as via controls 1 to 4, the footswitch, the sustain pedal and aftertouch. *Local* = Off: Neuron's keyboard is disabled. It cannot address the internal synthesis engine; all controls are deactivated. Neuron can play incoming MIDI data or serve as a MIDI master keyboard. *Local* = On: The internal synthesis engine can be controlled using Neuron's keyboard and as well as via incoming MIDI data. All controls (see above) are enabled. Note in this context the function of the *local* setup parameter, which serves the same purpose for every sound within a setup (see page 61). If the global *local* parameter is set to *off*, the setup parameters of the same name are overruled, meaning that all four sounds are *off* regardless of the respective *local* parameter setting.
SysXDeviceID	Defines the device identification for system exclusive MIDI messages. Hexadecimal values range from 00 to 7F. To learn more about this, read the section "SysEx commands (System exclusive data)" starting on page 179.
Dspl Contrast	Controls the brightness of the displays. Values range from 1 (dark) to 4 (bright).
StkRec start	Determines the trigger that starts stick recording. After you press a module's **record stick** button, the recording function is set to standby and the button's LED flashes. To actually start recording, you must activate the defined trigger, that is, either move the appropriate stick or press any key on the keyboard. You will find further details on this starting on page 89. Options: *Key* or *Stick*.
Srnd Sub Hz	Defines the cutoff frequency for the subwoofer channel in surround mode. Frequencies below the defined sub cutoff frequency are sent to the subwoofer. Options: 13 Hz to 20.2 KHz (in semitone steps). Surround mode is described on page 169.

Table 1: Basic settings (cont.)

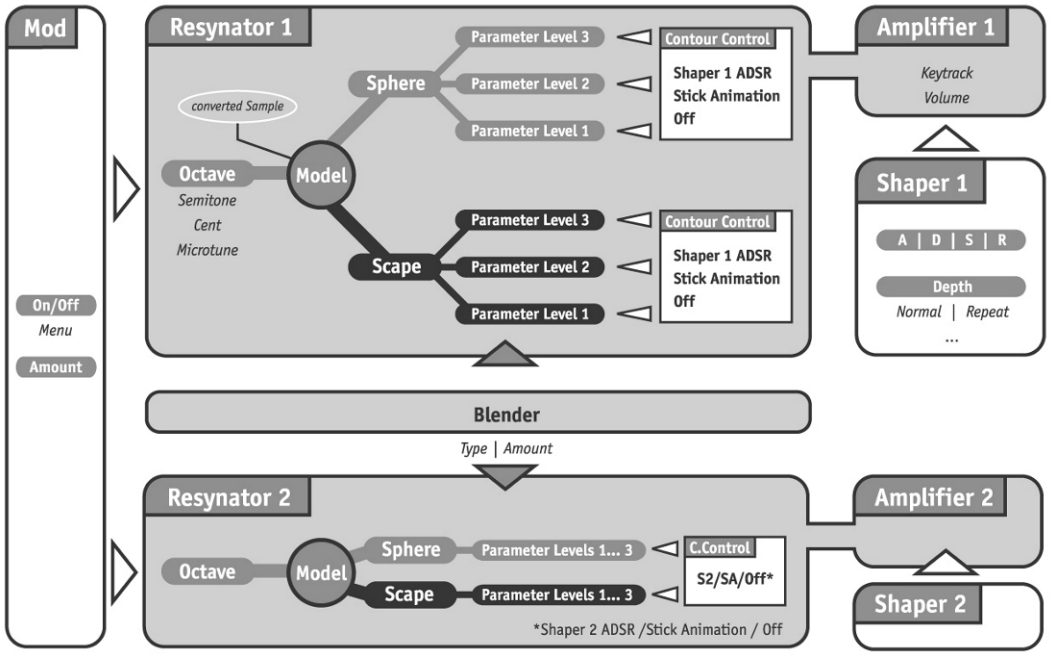
Footswitch	Defines the type of footswitch connected to the **pedal/switch** port (see page 11). Normally, Neuron identifies the connected switch on its own. If it fails to do this, you can enter the type using this parameter. Your options are *open* and *close*. MIDI controller number: 66.
SustainPed	Defines the type of footswitch connected to the **pedal/sustain** port (see page 11). Normally, Neuron identifies the connected switch on its own. If it fails to do this, you can enter the type using this parameter. Your options are *open* and *close*. MIDI controller number: 64.
Switch Off	Determines how Neuron powers down. Options: *Ask* (Neuron's query must be confirmed with **enter**; **exit** cancels the operation) or *quick* (no query). We recommend that you stick with the default setting, *ask*! To learn more about this, read the section "Switching off" starting on page 15.
Software: Version	Indicates the software version that Neuron is currently running. Compare version numbers to find out if an update for your Neuron is ready and waiting on the Hartmann home page (www.hartmann-music.com)!
Calibration?	Serves to calibrate all stick controllers and keyboard aftertouch. After you have pressed **enter**, another prompt appears - *Calib: Move sticks or press aftertouch* – that lets you start calibrating. Good-to-know background stuff: The sticks can be calibrated to compensate for mechanical manufacturing tolerances. The process of calibration adjusts the stick's range of travel to match the value range it is designed to cover. To learn how to calibrate sticks and aftertouch, refer to page 26.

Table 1: Basic settings (cont.)

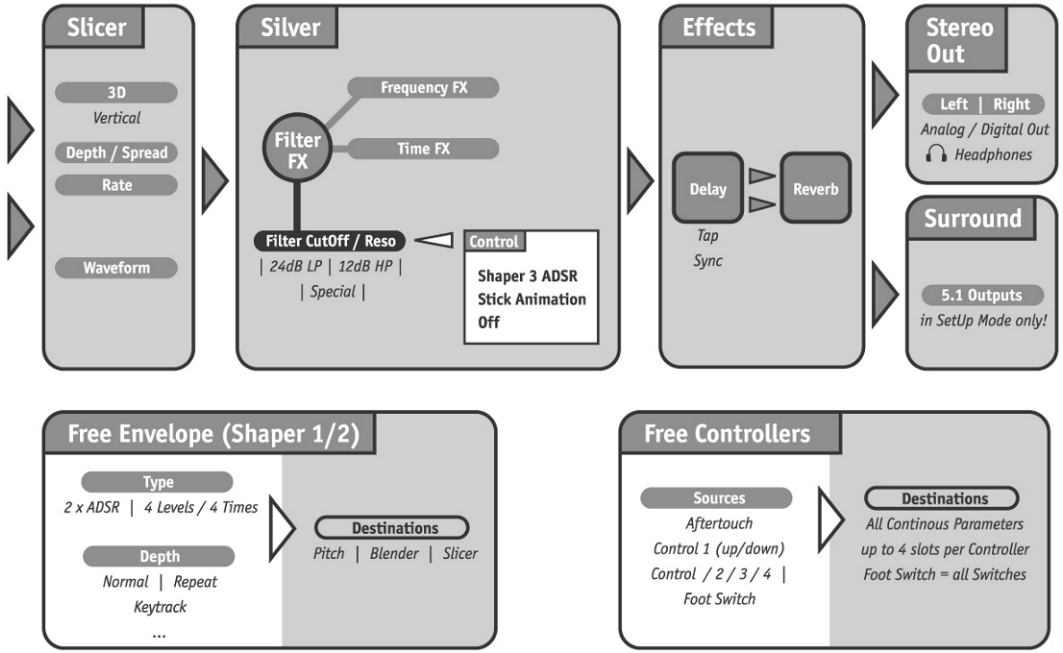
Neuron's modules

Signal Flow

The following two charts depict the Neuron's signal. The gray arrows signify audio data; control data is white.



Signal flow (part I)



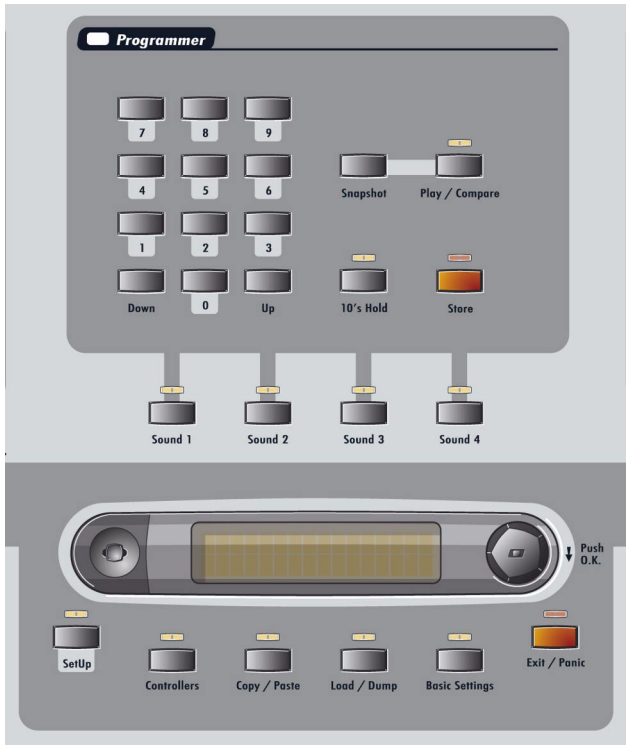
Signal flow (part II)

Module: Programmer

Programmer is Neuron's command and control center. It is your tool for managing sounds and setups. Use the numeric keypad with the **up** and **down** button to select setup and sound numbers and the **store** button to save sounds and setups. Programmer also offers extremely versatile snapshot and play/compare functions, which are described in detail on page 52.

Located below programmer is the main display with its navigation stick and rotary knob, which you are sure to be familiar with by now!

Let us take a closer look at its control features.



Programmer: Control features

Programmer

Numeric keypad	Keypad for loading the desired sound (in sound mode) or setup (in setup mode). When you type in the three-digit number (where appropriate, preceded by zeros), all modules are set to the stored values. When loading a model into a resynator (see page 86), you can also type in the model number on the numeric keypad.
Down and **Up** buttons	Use the **down** button to scroll through stored sounds (in sound mode) or setups (in setup mode) in descending order. Press the **up** button to load the next higher sound or setup. All stored data is loaded into Neuron's modules just as if you type in a sound/setup number on the numeric keypad.
10's hold button	Activate this button (LED lights up) to freeze the tens numeral of the currently selected number. The idea is to make it easier to enter a sound/setup number directly. Example: Say sound 082 is loaded. Press **10's hold**. The 08- is held in place (until you deactivate the function by pressing the button again). Then you can press, say, **9** to switch to 089.
Store button	Stores the current sound (see page 51) and setup (see page 67).
Snapshot and **Play/compare** buttons	The **snapshot** function stores a snapshot of all modules' current settings. In combination with the **play/compare** button, you can audition your snapshots and A/B or compare the edited sound to the original. You will find detailed information and a description of how to proceed on page 52.

Table 2: Programmer control features

Sound 1 to **Sound 4** buttons	Buttons for switching a sound on and priming it within a setup. The LED for the given sound button indicates its status. You can change the status by pressing the buttons repeatedly. LED lights up steadily: The sound is played with the current setup. LED off: The sound is muted in the current setup. LED flashes: The sound is primed, meaning that it can be edited in real-time using the control features on Neuron's modules (for example, the shaper wheels or sticks). You will find out how to load a sound into a setup on page 65. If you want to mute an activated sound without priming it first, press and hold the appropriate **sound** button for several seconds until the LED extinguishes (one second should do).

Table 2: Programmer control features (cont.)

Control unit

Setup button	Switches back and forth between sound and setup modes. The LED above the button lights up when Neuron is in setup mode. You will find basic info on the two operating modes starting on page 32. For a detailed explanation of the programming process, read the section starting on page 67.
Controllers button	Calls up the controller menu in which you can assign specific modules and functions to the free controllers. To learn more about this, read the section "Free controllers" starting on page 162.
Copy/paste button	Serves to copy parameter sets from one sound to another. To learn more about this, read the section "Neuron's copy/paste function" starting on page 54.
Load/dump button	Starts the function that writes (or dumps) and loads models, sounds, setups, and Neuron software via the USB interface to and from a connected PC/MAC. It also serves to transfer system exclusive data. To learn more about this, read the section "Updates and Backups" starting on page 185.

Table 3: Control unit control features

Basic settings button	Calls up the menu offering basic settings that let you set up the device according to your wishes and preferences. Basic settings have a bearing on the device as a whole rather than a single sound or setup. You will find a list of basic settings as well as instructions on how to define them on page 36.
Exit/panic button	This button has two functions: • The **exit** function facilitates navigation in the menus. In sound mode, pressing **exit** briefly returns you to the top level of the sound menu, sound loader. In setup mode, pressing **exit** either jumps to the most recently edited menu option of the setup menu or, if you are already working in the setup menu, to setup loader. In some cases, **exit** also serves to cancel the operation that is currently underway, for example, when storing a sound/setup or when Neuron asks you if you really want to switch it off. • If you press and hold the button until the LED extinguishes (three seconds should do), you will activate the **panic** function. This generates an *all notes off* command, and that spells immediate silence, say, in the event of a hung note. It tells both Neuron's internal workings as well as the MIDI setup to shut up. After rebooting, Neuron comes back on line in the same mode that it was in before the panic attack occurred. All settings remain intact.
Navigation stick and rotary knob	After you retrieve the menu of a given module, you can edit using the navigation stick and knob (located to the left and right of the main display, respectively): **Stick.down** and **stick.up** to scroll through the main menu options. **Stick.right** and **stick.left** to jump to and scroll through submenus if on hand. The **rotary knob** edits the current parameter. Depending on the parameter, you can either select among predefined settings or adjust a numeric value. For certain menu options, pressing the knob is tantamount to pressing the **enter** button (see page 31).

Table 3: Control unit control features (cont.)

Programmer: Programming sounds

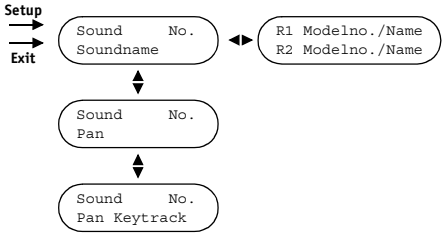
This section discusses all procedures required to program sounds in sound mode. Be sure also to read about the topic "Operating mode: Sound mode" starting on page 32. We will get into setup mode on page 58.

First, though, let us look at a short description of the sound menu.

Sound menu

We call the top level of the sound menu sound loader.

- If setup mode is active, you can access it by starting sound mode (by pressing the **setup** button).
- If sound mode is already active, press **exit**.



Sound parameters

Sound	Number and name of the current sound. (sound loader)
Used models	This menu option shows the currently employed models of both resynators. (For info purposes only, you cannot select models here!)
Pan	Positions the sound in the stereo panorama. Note that the sounds within a setup are assigned individual or dedicated pan settings (see page 62). Value range: -64 to +63 (from the far left to the far right).
Pan Keytrack	Assigns pan settings to the keyboard. This parameter lets you place the sound at different positions within the stereo panorama in accordance with the pitch of the note you play. Value ranges from -64 to +63. 0 = no pan key tracking. Positive values: Lower notes are panned to the left, higher notes to the right. Negative values: Lower notes are panned to the right, higher notes to the left. And on that note, be sure to check out the picture on page 85.

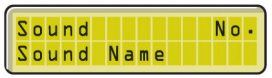
Table 4: Sound parameters

► How to start sound mode

All the procedures described in the following section mandate that Neuron runs in sound mode. To this end, you may have to quit setup mode by pressing the **setup** button below the main display. The LED above the button does not light up when Neuron is set to sound mode.

► How to load a stored sound

Start sound mode (see above).
Sound loader appears in the main display along with the name and the number of the currently loaded sound:



If you are already working in sound mode, call sound loader by briefly pressing the **exit** button.

You have three options for loading sounds:

- In order to step through all sounds successively, press the **up** or **down** button in programmer. In each step, the next sound is loaded and indicated in the main display. (You can only do this when sound loader is displayed.)
- Type in the three-digit sound number using the numeric keypad (whenever necessary, preceded by zeros, e.g. 003). The sound loads immediately after typing the third digit. (You can only do this when sound loader is displayed.)
- Dial in the sound number by twisting the knob next to the display and confirm with **enter** (by pressing the knob). The number continues to flash until the selected sound is loaded.

When you load a sound, all modules are set to the stored values. A tremendous amount of model- and sound-related information has to be loaded with every sound, so the process may take a while.

► How to edit a sound

The technology that powers Neuron offers an unprecedented spectrum of tonal variety. Consider just the possibilities afforded by dynamic parameter assignment and you can appreciate that there simply is not enough room in this manual to explore all the sound-shaping variants. The following list can give you no more than a general idea. Follow the cross-references to learn more about each sound processing operation! The signal flow in Neuron is depicted on page 43.

- If you want to use an existing sound as the starting point for creating a new sound, then load it as described above.

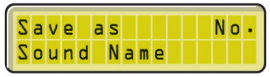
- Then load other models into the resynators (see page 86) and change their parameters (page 87).
- Use the blender (page 93)!
- Use envelopes (page 110).
- Shape the sound using the mod module (page 117), the slicer (page 119), or the effects in the silver unit (page 123).
- Vary the sound's pan settings or define the *pan keytrack* parameter in the sound menu (see page 49).

► How to store a sound

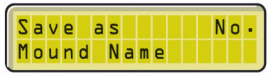
If you like your new creation, store it. (There is plenty of room: Neuron sleeps 1,000 sounds comfortably!) All parameters pertaining to a sound are stored with the sound as properties. To find out which parameters and settings are stored at the sound level, read the section "Hierarchies: The Neuron memory model" starting on page 33.

The store function in sound mode works like the save as... command commonly used on computers. You can either store the sound under the current number or put it to some other place within the sound database.

- Press the red programmer **store** button. The button's LED lights up; the sound number flashes and the current sound name appears in the main display.

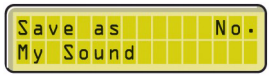


- Twist the knob to select the number under which you want to store the sound. The name of the sound currently stored under this number appears. Note that this sound will be overwritten!
- Name the new sound: **Stick.right** to access the first character in the display's second line. As soon as the name of the currently stored sound appears in the display, you can overwrite it. Twist the knob to select the desired character.



Tip: **Stick.up**/**stick.down** to select uppercase and lowercase.

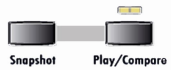
Use the navigation stick and the knob as described above to change each character in the name line.



- After you have named your baby, confirm the storage process by pressing the rotary knob.
  The display reads **`Saving...`** for a moment and returns to the most recently active menu at the end of the storage process.

You can cancel the store operation at any time with the **exit** button before you send the sound off to its new address! This returns the display to the most recently edited menu option.

Snapshots and the play/compare function



As you may have already discovered, you can search for the ultimate sound in Neuron with the delicate touch of a neurosurgeon or the harsh hand of a butcher.

The reason for this is that the resynators – in combination with the fantastic control features – are so versatile. And they invite you to discover the joys of experimentation. Occasionally you may go too far, perhaps attempting to give an almost perfect sound a final polish only to rub off its sonic sheen.

Use the snapshot function –it can fix that problem. It lets you take pictures of every stop along your auditory journey so that you can safely revisit the current sound setting.

In combination with the **play/compare** button, you can audition your snapshots and A/B or compare the edited sound to the original. If desired, you can use a snapshot as the template for renewed experimentation.

This lets you backtrack and find your way home if you lose your way in the sonic jungle.

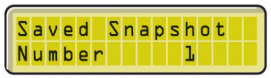
Up to 50 snapshots can be saved in a temporary buffer. Snapshots vanish into the digital ether when you switch sounds, store the sound, or switch Neuron off! If you take more than 50 snapshots, stored snapshots are overwritten automatically starting with number 1.

The snapshot function is available **in sound mode only**!

► How to shoot snapshots

When you have arrived at a sound that you deem worthy of a snapshot, press the **snapshot** button.

The current sound settings are stored as a snapshot. A message appears briefly in the display (in our example, this is the first shot):



You can capture and temporarily save up to 50 settings using this method. Every subsequent shot is automatically assigned the number following the most recently saved number.

Use the play/compare function to audition a saved snapshot.

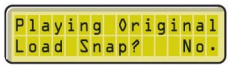
► How to use the play/compare function

Press the **play/compare** button to switch back and forth between two modes.

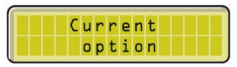
- Play mode applies to the current sound settings,
- compare mode, in turn, renders the original sound, as it is stored in the sound database.

An LED indicating the current mode is located above the button. If this LED lights up, you are working in compare mode, otherwise play mode (which offers the current sound and settings) is active. The main display also indicates compare mode:

Compare mode



Play mode



Press the button repeatedly to conveniently A/B two sound settings – that is, switch back and forth between them.

You cannot edit any sound parameters when in compare mode. To do this, you must play the current settings.

Beyond that, you can select any snapshot in compare mode and compare the initial sound with any of the edited sounds that you have saved temporarily.

To do this, first activate compare mode (LED lights up), then twist the knob to step through the

snapshots and load the desired shot by pressing the knob. Neuron exits compare mode automatically (LED extinguishes) and the current sound setting data is overwritten by the stored snapshot data.

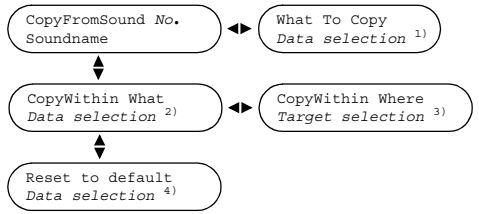
Make a habit of shooting an up-to-date snapshot before loading an earlier snapshot to avoid losing the fruits of your labors!

If while comparing sounds you decide to cancel all changes and continue working with the initial sound, simply load this sound again from the sound database (see page 50). All snapshots are erased when you do this.

Neuron's copy/paste function

Copy and paste lets you copy data to other sounds or other modules within the current sound.

Press the programmer **copy/paste** button to enable the copy function. Here is its menu structure:



1) Selection list: data to be copied (from one sound to another)
2) Selection list: "What" = data to be copied (within a sound).
3) Selection list: "Where" = destination (within a sound).
4) Selection list: data to be reset to default values.

Select options by twisting the knob. **Enter** starts the copy/reset operation.

Copy/paste mode is ended automatically when you change a parameter in any module. If you exit the copy/paste menu by pressing the **copy/paste** button again, Neuron jumps to the most recently edited menu. In both cases, the device recalls the most recently edited copy/paste menu option and displays it immediately when you access the copy/paste menu again.

Copying from one sound to another

When copying from one sound to another, data is always copied from the selected source sound to the currently loaded sound.

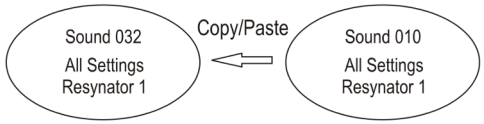
If the source and destination numbers are identical, Neuron loads data stored in the sound database, overwriting the current settings. This lets you cancel changes that have not been stored.

The selection list offers data/parameter sets from all modules whose settings are stored at the sound level. This includes:

- Resynators' model parameter values or the complete resynator configuration,
- envelope parameters of all shapers,
- mod, blender, and slicer settings,
- the silver module's effect parameters,
- master effects settings,
- aftertouch settings,
- free controller assignments,
- the resynators' and the silver module's stick recordings.

▶ Example: How to copy parameter values from one sound to another

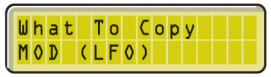
In the following example, we will copy the resynator 1 settings of sound 010 to sound 032.



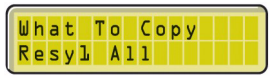
- Prerequisite: Sound 010 is programmed and stored. The current sound is sound 032.
- Press **copy/paste** in programmer. The copy/paste menu's most recently edited option appears in the display.

- Twist the knob to dial in number 10 because that sound is where we want to copy data from.

- **Stick.right** to access the list of data that can be copied:



- Twist the knob to select the desired source data:



- Press **enter**. All resynator 1 source data is copied from sound 010 into resynator 1 of the current sound.

  Then you can immediately copy another data record using the knob or **stick.left** to select another source sound.

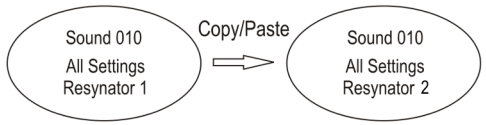
Copying within a sound

You have two selection lists offering options for copying within a sound. The "What" list (see menu diagram) offers resynator data, shaper and controller settings, etc. It is followed by the "Where" list, which lets you select the destination. "Where" offers only those destinations that are meaningful in connection with the previously selected data.

Current settings are always copied when copying data within a sound irrespective of whether or not the settings have been stored.

▶ **Example: How to copy data in the current sound from resynator 1 to resynator 2**

In the following example, we will copy resynator 1's current settings to resynator 2 within sound 010.



- Press **copy/paste** in programmer. The copy/paste menu's most recently edited option appears in the display. If necessary, scroll to the *copy within* menu option.
  Twist the knob to select data to be copied from the „What" list.

- **Stick.right** to access the "Where" selection list. Select the destination within the current sound via knob; in our example this is resynator 2.

- Press **enter**. All data is copied from resynator 1 to resynator 2 within the current sound.

  Then you can copy the same source data to another destination (if possible) using the knob or **stick.left** to return to the "What" selection list.

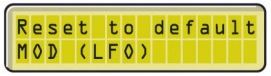
Back to the roots: The reset function

The copy/paste menu boasts a special feature called reset (see page 54). It lets you set selected data records back to their default settings.

The reset selection list offers the same data records as the copy selection list.

- Press **copy/paste** in programmer. The copy/paste menu's most recently edited option appears in the display.

- **Stick.down** to access the reset function. The selection list appears in line 2. Select the desired data record using the knob.



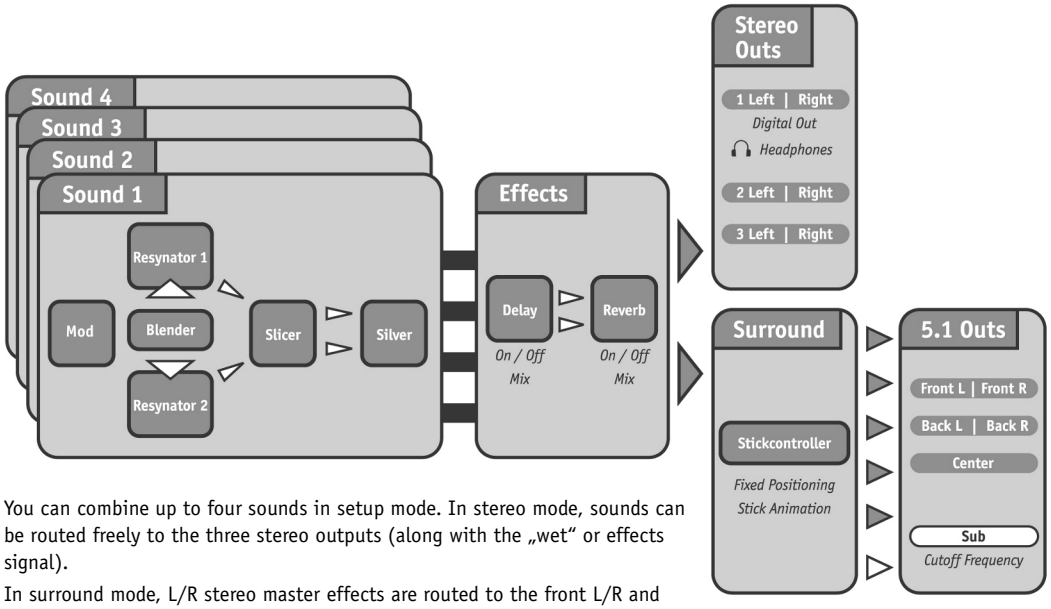
- Press **enter**. The values of the selected data record are reset. In the case of stick recordings, all corresponding tracks are erased.

  Then you can reset another data record immediately using the knob or **stick.up** to go to the copy function.

You can also use the **enter** button to reset just the current parameter rather than entire parameter sets to the default setting.

Programmer: Programming setups

Before we dive right into programming, look at the following chart. It recaps basic information on the topic of "Operating mode: Setup mode" starting on page 32.



You can combine up to four sounds in setup mode. In stereo mode, sounds can be routed freely to the three stereo outputs (along with the „wet“ or effects signal).

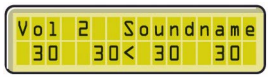
In surround mode, L/R stereo master effects are routed to the front L/R and back L/R outs, while the center channel and sub remain "dry." Sounds can be positioned freely in the surround field via stick controller or on the fly in the soundscape via stick animation.

Setup menu

Stick.down and **stick.up** in the usual fashion to scroll through the various menu options.

The four sounds in the setup are displayed side by side for every menu option (with the exception of the surround parameters). The cursor **<** indicates which sound you are currently editing with the knob. The name of this sound also appears in the first line of the display.

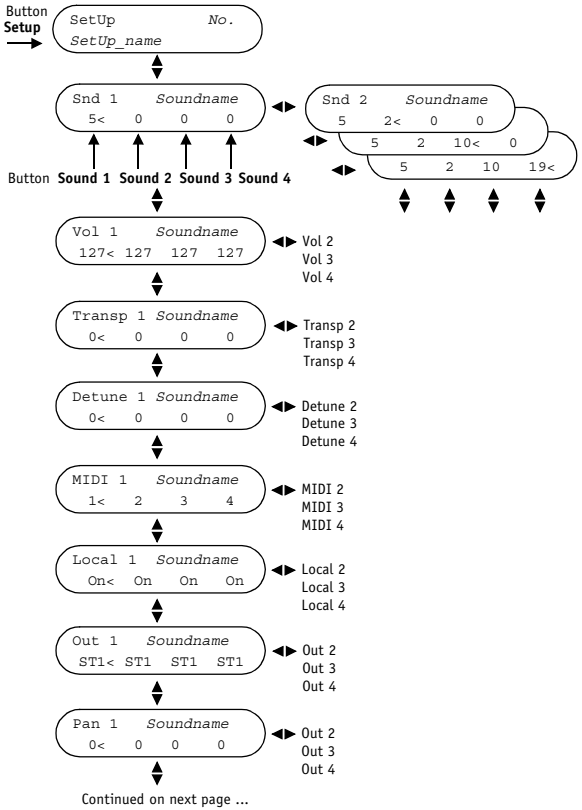
Example: Volume settings for the four sounds in the setup. The same level (30) is set for each sound. The cursor points to sound 2.

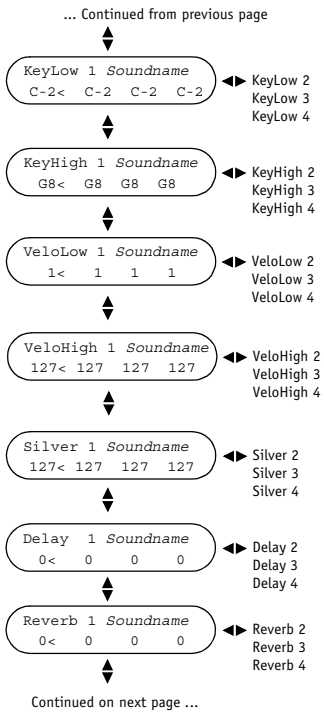


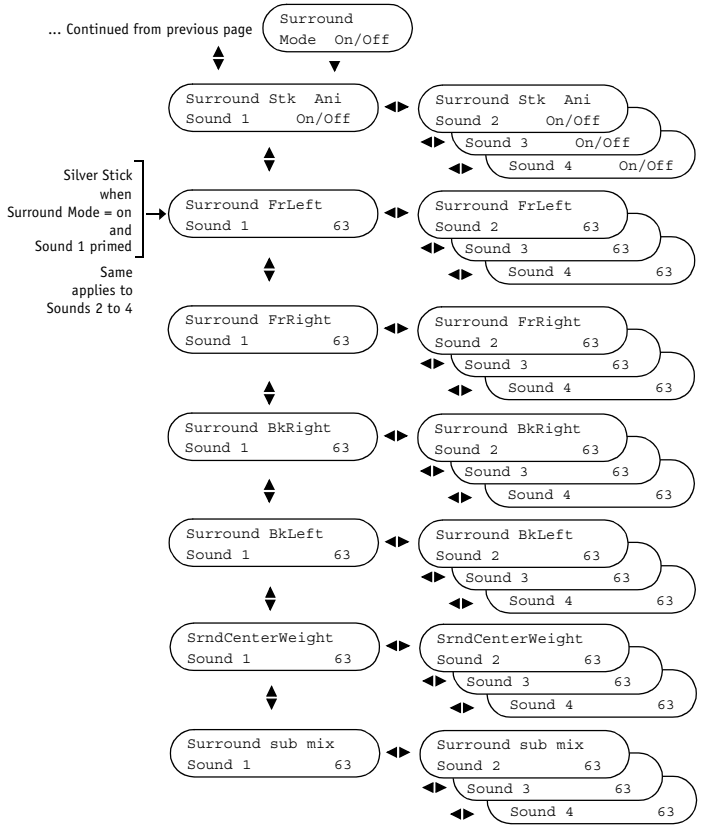
Stick.left and **stick.right** to scroll among the sounds within a menu option.

The setup menu is a **matrix**: If, for example, the cursor points to sound 2 and you **stick.up/down** to scroll to the next/previous menu option, the cursor remains in place; that is, it continues to point to sound 2.

The menu diagrams on the following pages show the default settings of the individual setup parameters. All parameters are described in table 5 on page 61.




... Continued from previous page
KeyLow 1 Soundname
C-2< C-2 C-2 C-2
KeyLow 2
KeyLow 3
KeyLow 4
KeyHigh 1 Soundname
G8< G8 G8 G8
KeyHigh 2
KeyHigh 3
KeyHigh 4
VeloLow 1 Soundname
1< 1 1 1
VeloLow 2
VeloLow 3
VeloLow 4
VeloHigh 1 Soundname
127< 127 127 127
VeloHigh 2
VeloHigh 3
VeloHigh 4
Silver 1 Soundname
127< 127 127 127
Silver 2
Silver 3
Silver 4
Delay 1 Soundname
0< 0 0 0
Delay 2
Delay 3
Delay 4
Reverb 1 Soundname
0< 0 0 0
Reverb 2
Reverb 3
Reverb 4
Continued on next page ...


... Continued from previous page
Surround Mode On/Off
Surround Stk Ani Sound 1 On/Off
Surround Stk Ani Sound 2 On/Off
Sound 3 On/Off
Sound 4 On/Off
Silver Stick when Surround Mode = on and Sound 1 primed
Same applies to Sounds 2 to 4
Surround FrLeft Sound 1 63
Surround FrLeft Sound 2 63
Sound 3 63
Sound 4 63
Surround FrRight Sound 1 63
Surround FrRight Sound 2 63
Sound 3 63
Sound 4 63
Surround BkRight Sound 1 63
Surround BkRight Sound 2 63
Sound 3 63
Sound 4 63
Surround BkLeft Sound 1 63
Surround BkLeft Sound 2 63
Sound 3 63
Sound 4 63
SrndCenterWeight Sound 1 63
SrndCenterWeight Sound 2 63
Sound 3 63
Sound 4 63
Surround sub mix Sound 1 63
Surround sub mix Sound 2 63
Sound 3 63
Sound 4 63

Setup parameters

Snd	Numbers of the sounds contained in the current setup.
Vol	Sets the volume levels for the individual sounds within the setup. Value range: 0 to 127.
Transp	Transposes the individual sounds within the setup in semitone steps. Value range: -48 to +48.
Detune	Detunes individual sounds within the setup in cent increments. Value range: -99 to +99.
MIDI	Determines MIDI data send and receive channel for sounds in setup mode. A sound responds to incoming MIDI data only when the defined MIDI channel and send channel numbers are identical. Value range: 0 to 16. 0 denotes omni, meaning that the sound responds to incoming messages on all MIDI channels (see page 178). In **sound mode**, the global MIDI channel settings defined in the basic settings apply (see page 40).

Table 5: Setup parameters

Local	Deactivates/activates Neuron's synthesis engine via the keyboard as well as via controls 1 to 4, the footswitch, the sustain pedal and aftertouch. *Local* = Off: Neuron's keyboard is disabled for this sound so that it cannot control the internal synthesis engine; the controls are deactivated. However, the sound can be played via incoming MIDI data and send MIDI data. *Local* = On: The internal synthesis engine can be controlled for this sound via Neuron's keyboard as well as via incoming MIDI data. All controls are enabled. Note in this context the function of the *local* basic settings parameter (see page 41): If this global parameter *local* is set to *off*, the settings of the four setup parameters of the same name are overruled.
Out	Defines the audio output for every sound in stereo mode. Your options are ST1 (stereo output 1), ST2 and ST3. The headphones output receives the same signal as ST1. See also the illustration on page 10.

Table 5: Setup parameters (cont.)

Pan	Positions the sound in the stereo panorama. Value range: -64 to +63. The setup menu lists special surround parameters for defining the surround panorama (see page 63). For more on the pan parameter, see the explanation given for sound mode panorama settings starting on page 49.
Key Low *Key High*	Limits the keyboard range for every sound. *Key low* defines the lower limit, *key high* the upper limit. The parameters represent note numbers. A sound is triggered only when notes higher than or equal to the *key low* value (default: C-2) **and** lower than or equal to the *key high* value (default: G8) are played. Value range: C-2 to G8 (0 bis 127). Default MIDI assignment: C3 = 60.
Velo Low *Velo High*	Defines a velocity window for each sound. A sound is audible only if the velocity (key pressure) lies within the boundaries defined here. The default for each sound is 1 for *velo low* and 127 for *velo high*. Value ranges: 1 to 127.

Table 5: Setup parameters (cont.)

Silver	Defines the silver mix amount for the individual sounds. This is best explained by an example: Say individual silver settings are stored for each of the four sounds within a setup. Say also that you are satisfied with each sound when you hear it in isolation, but in the context of the entire setup, you find a given effect too puny or too mighty. The setup menu offers these mix parameters so you can determine the level of silver effects separately for each sound and adjust the desired balance between them. Value range: 0 to 127. 0 = silver effects are switched off. 127 = silver effects are rendered at the level determined in the sound (meaning they are not amplified!)
Delay	Determines the delay send amount for the individual sounds. The master effects module processes the composite signal of all four sounds, meaning that the delay settings apply to all sounds within a setup. This parameter lets you determine the send amount for each sound individually.

Table 5: Setup parameters (cont.)

Reverb	Determines the reverb send amount for the individual sounds. The master effects module processes the composite signal of all four sounds, meaning that the reverb settings apply to all sounds within a setup. This parameter lets you determine the send amount for each sound individually.
Surround Stk Ani	Defines the playback mode for stick recordings in surround mode (stick playback) **for each** sound. • *Off*: Stick animation is disabled for the given sound. • *1Shot*: The first note you play triggers the recorded stick movement for the given sound (single trigger) and the animation continues to shape the sound regardless of how many notes you play thereafter. Once the animation has run its course it is not re-triggered. • *Repeat*: The first note you play triggers the animation and then – unlike when the *1shot* setting is enabled – it is repeated in cycles for as long as you continue playing notes. To learn how to record stick controller movements, read the topic "Stick recording and animation" starting on page 89.

Table 5: Setup parameters (cont.)

Surround FrLeft	Determines the amount or level of each sound in the left front surround channel. Value range: 0 to 127. 0 means that the given sound is not audible in the left front speaker. 127 means the sound is routed in the maximum amount (or level) to the left front surround channel. Note that this parameter is the inverse of the parameter for the right rear channel: For more on this, see the comments following the table!
Surround FrRight	Determines the amount or level of each sound in the right front surround channel. Value range: see above Note that this parameter is the inverse of the parameter for the left rear channel: *Surround FrRight* + *Surround BkLeft* = 127. For more on this, see the comments following the table!

Table 5: Setup parameters (cont.)

Surround BkRight	Determines the amount or level of each sound in the right rear surround channel. Value range: see above Note that this parameter is the inverse of the parameter for the left front channel: *Surround BkRight* + *Surround FrLeft* = 127. For more on this, see the comments following the table!
Surround BkLeft	Determines the amount or level of each sound in the left rear surround channel. Value range: see above Note that this parameter is the inverse of the parameter for the right front channel: *Surround BkLeft* + *Surround FrRight* = 127. For more on this, see the comments following the table!
Srnd Center Weight	Boosts or cuts the center channel for each sound. Note that the effect of this value is relative to the value determined by stick. Value range: 0 to 127. Default 63. Values < 63: Cuts the center channel's level. Values > 63: Boost.

Table 5: Setup parameters (cont.)

Surround sub mix	Boosts or cuts the subwoofer channel for each sound. Value range: 0 to 127. Default 63. Values < 63: Cuts the subwoofer channel's level. Values > 63: Boost.

Table 5: Setup parameters (cont.)

The values of the surround pan parameters *FrLeft* to *BkLeft* (and implicit Center) can be adjusted via silver stick controller **when** surround mode is active and the given sound is primed within the setup. Please note that *SrndCenterWeight* is a separate parameter in addition to the implicit center value.

Surround mode is described in detail starting on page 169.

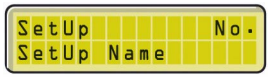
► How to start setup mode

All the procedures described in the following section require that Neuron is running in setup mode.

To start this mode, press the **setup** button located below the main display. The LED above the button lights up when Neuron is in setup mode.

► How to load a setup

Start setup mode as described above. Setup loader appears in the main display along with the number and name of the currently loaded setup.



If you are already working in setup mode, call setup loader by briefly pressing **exit** once or twice (depending on the currently active menu).

You have three options for loading a setup:

- In order to step through all stored setups successively, press the **up** or **down** button in programmer. In each step, the next setup is loaded and indicated in the main display. (You can only do this when setup loader is displayed.)
- Enter the three-digit setup number using programmer's numeric keypad (whenever necessary, preceded by zeros, e.g. 003). The setup is loaded immediately after the third digit is entered. (You can only do this when setup loader is displayed.)
- Dial in the setup number by twisting the knob next to the display and confirm with **enter** (by pressing the knob). The setup number continues to flash until the selected setup is loaded.

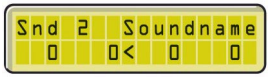
When you load a setup, all modules are set to the stored values.

► How to load a sound into a setup

Located above the main display you will find four buttons labeled **sound 1** to **sound 4**. Every button represents a sound stored in the current setup.

If you press one of these buttons when the device is in setup mode, the display jumps right to the menu option that lets you load sounds and the cursor points to the desired position.

Example: Press **sound 2**.



Dial in the desired sound number using the knob and confirm with **enter** (press the knob).

Stick.left and **stick.right** to move the cursor so that you can load sounds to the other positions in the setup.

► How to prime a sound for editing within a setup

The aforementioned **sound 1 to 4** buttons also serve to do this.

When you press a button repeatedly, the assigned sound is activated (LED lights up), primed (LED flashes), or deactivated (LED extinguishes).

If you want to mute an activated sound without priming it first, press and hold the appropriate **sound** button until the LED extinguishes (one second should do).

An activated sound is played with the setup while a deactivated sound is muted. A primed sound can be edited by means of the module's control features while the current setup is being performed.

All changes - for example, parameters edited via stick in the resynators, or in slicer or silver - always apply to the primed sound and are audible in the setup **without** having to first store the edited sound or load the edited sound into the setup.

► How to store edited sounds in a setup

Sounds are reference by (or linked into) a setup. If you edit a sound's parameters within a setup because you want it to sound a bit different in the setup than it does in sound mode, you must store these changes specifically. Simply storing the setup will not save these changes.

Setup mode offers an enhanced store function for this very purpose.

- Press the red **store** button.

  You can now select in the display what you want to store:

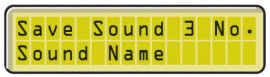
  Use the knob to select the setup-specific parameters or one of the four sounds to be stored.

For example, say you have edited sound 3 and want to store sound 3 under another name and number.

- Select sound 3 using the knob.

- Confirm your selection via **enter**.

  The rest of the procedure is the same as the procedure for storing a sound in sound mode.
- If necessary, dial in a new number with the knob and assign a new name to the sound.



  For details on how this is done, please read the description on page 51.
- Confirm the storage process by pressing **enter** (the rotary knob). The display reads `Saving...` for a moment and then returns to the most recently edited menu option.

After you have stored the sound under another number and with a new name, the new sound automatically takes the place of the old sound in the setup.

► How to program a setup

You have two options for programming a setup: either load a previously programmed setup and change the settings as desired or generate a new setup by loading a "fresh" number and begin assigning the sounds.

After you have loaded the desired sounds, toggle the navigation stick to scroll through the setup menu (see page 59) and define the various parameters for each sound. All parameters are described in the table starting on page 61.

► How to store a setup

The store function in setup mode works like the save as... command commonly used on computers. You can either store the setup under the current number or put the setup some other place within the setup database.

- Press the red programmer **store** button while in setup mode. Now you can select what you want to store:

  Press **enter** to select the `setup`.

- The current setup number or name appears in the main display.

```
Save StUp as No.
SetUp Name
```

- Twist the knob to select the number under which you want to store the setup. The name of the setup currently stored under this number appears. Note that this setup will be overwritten!
- Name the new setup: **Stick.right** the navigation stick to access the first character in the display's second line. The name of the currently stored setup appears in the display and you can now **overwrite** it (see the example display). Twist the knob to select the desired character.

```
Save StUp as No.
MetUp Name
```

Tip: **Stick.up**/**stick.down** to select uppercase and lowercase.

Use the navigation stick and the knob as described above to change each character in the name line.

```
Save StUp as No.
My SetUp
```

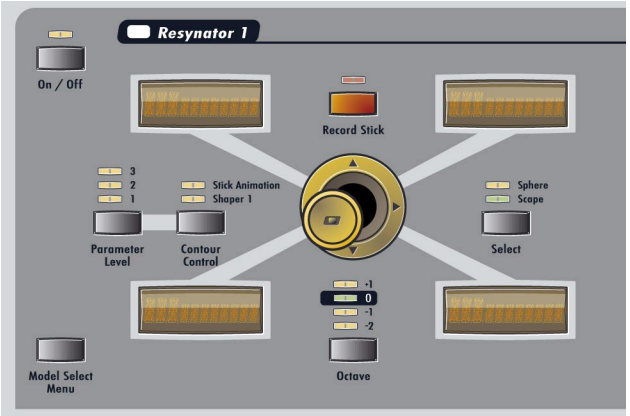
- After you have named the setup, confirm the storage process by pressing the rotary knob. The display reads **`Saving...`** for a moment and returns to the most recently active menu at the end of the storage process.

You can cancel the store operation at any time with the **exit** button before you send the setup off to its new address! This returns the display to the most recently edited menu option.

Module: Resynator

The philosophy behind resynators

You are sure to be familiar with the term "resynthesis". It has certainly been on musicians' and sound designers' minds for many years. For good reason: This brand of synthesis harbors tremendous sound design potential. The problem to date has been that no one had found a feasible solution to the interface problem: How can all this sonic potential be handled intuitively?



The solution to this problem is intelligence, a quality that conventional sound generating machines lack. But Neuron is a breed apart: its synthesis engine's nerve system is endowed with artificial intelligence. Happily for users, it handles very much like a classic synth, though the approach to shaping sound is completely different.

Whereas it takes all kinds of complicated connections between the various modules to generate interesting sounds on a classic synth, Neuron holds a treasure-trove of great-sounding source material right there in the heart of its synthesis engine. You can tailor this material to suit your taste with ease - some might even say in style.

The dynamo that drives classic subtractive synthesizers, the oscillator, inspired the resynator. Its name expresses that kinship: The term "resynator" is an amalgam of "resynthesis" and "oscillator." A resynator also performs similar functions. Like an oscillator, it provides the basic material for sound generation.

The idea behind Neuron models

While the classic analog synthesizer offers just a few basic waveforms for purposes of sound generation, the resynator features a sophisticated sound model at this bottom-line level of sound shaping. The underlying principle is comparable to that of many modern-day PCM synthesizers that use samples rather than basic waveforms. However, Neuron's models are far more advanced and versatile than the fixed sound bite that is a sample, which does not allow invasive sound sculpting.

Neuron sound models are created via adaptive sound analysis and linked to individual parameter sets. And as parameter names like *small*, *warm*, *cold*, and *torsion* would attest, every parameter addresses some kind of tonal property.

Model parameters

A model's parameters are a combination of musically meaningful values. As discussed above, accessing the key musical attributes of a sound poses tremendous obstacles. Courtesy of adaptable algorithms, resynthesis has the power to blast through this performance barrier:

Following a basic classification, the neural synthesis engine detects the formative parameters of a sound, categorizes them in groups, and assigns them to one of two parameter levels that we call *scape* and *sphere* (more on this later). How "freely" or "abstractly" the neural synthesis engine defines the parameters of a sound is determined during the process of model generation.

This analysis yields parameter sets that are loaded into the resynator along with the sound (which in the process of model generation is transformed into a model) and placed at your fingertips. The stick controller lets you modify these parameters in real-time. That is tantamount to performing open-heart surgery on the very essence of what makes a sound sound like it does.

And that makes Neuron the first synthesizer to parameterize audio source material on the fly. Because this base material can be any conceivable audio event, you have an inexhaustible supply of sonic goods at your disposal at this early stage of sound generation.

Scape and sphere

Every model is subdivided into two parameter regions called *scape* and *sphere*.

A *scape* puts all parameters associated with the formative qualities of a sound at your disposal, for example, the vibrations of vocal cords, or a string. A *scape* serves to determine inherent attributes, for example, whether the sound is the product of a chaotic, disharmonic or harmonic oscillating system.

By *sphere*, we mean extrinsic sound-shaping factors, that is, the environmental conditions – a piano case, a guitar body - in which the sonic event occurs. Spectral processes, formants, resonance, absorption factors, and the like are determined here.

Each of the two regions contains three parameter levels. At every level, the parameters are positioned crosswise as polar opposites as depicted in the picture on page 69.

The Neuron library contains models of classical instruments; after all, bending the commonplace sounds of instruments such as the piano, strings, oboe, or even a Minimoog bass promises truckloads of fun. However, if you restrict yourself to merely manipulating these oft-encountered sounds, you will not tap into the true potential of the awesome powers of neural synthesis.

The first time you fire up the synthesis engine, it will dawn on you what astonishing sound-shaping possibilities the stick controllers in the resynators offer!

Manipulating scape and sphere

The actual editing of a model – that is, invasive sound sculpting – is performed in real-time using the stick controller. The stick morphs between two opposite sonic attributes, and it does this selectively by *scape* or *sphere* and parameter level. (In this context, the verb "morph" means to change over seamlessly from parameter to another.)

This process is best explained using an **example**: Say resynator 1 contains a model called "flute". The neural process assigned the following *sphere* parameter sets (among others) to this sound: "metal / wood" and "large / small". The woodiness and size of the flute can be varied on the fly by moving the stick. For its *scape* parameters, our flute is assigned at one of the three levels "wide / narrow" and "clear / rough". This means that you can edit the breadth and roughness of the flute's sound on the fly.

The two resynators in Neuron...

Neuron features two resynators of identical design. Models may be selected freely for each resynator.

Envelopes and stick recording/animation

Editing within the *scape* and *sphere* parameter levels can be performed at each level via a "hard-wired" ADSR envelope. The envelope defined in shaper 1 modulates resynator 1, likewise shaper 2 serves as the envelope generator and resynator 2.

In addition, the two shapers offer freely routable envelopes (either two ADSR envelopes or one 4 levels 4 times curve) for controlling resynator pitch. The curve parameters are defined in the respective shaper, the *depth* or intensity of the curve (and therefore its routing) is determined in the menu of the given resynator (*FreeEnv Pitch*, see page 83).

To learn how to handle the shaper, read the section "Module: Shaper 1/2" starting on page 99.

As an alternative, stick movements can be recorded in real-time and applied selectively to control the parameters of each *scape/sphere* level.

We call this process **stick animation** and have dedicated a separate section to it starting on page 89.

Pitch, volume and parameter modulation

The volume of every resynator output as well as pitch and every *scape* and *sphere* level's opposite parameter pairs can be modulated via the mod module's LFO.

The form and frequency of the modulating LFO oscillation are determined in the mod menu, which also lets you define the basic *depth* as well as delay time. You will find more on this on page 116.

After you have defined the LFO oscillation in the mod module, go to the resynator menu to assign the modulation to the resynator (if desired) and determine modulation intensity.

To this end, the *LFO depth* menu offers the options pitch, volume, and L1 scape 1/3 to L3 sphere 2/4. These parameters are in described in table 7 starting on page 82.

Resynator: Control features

On/Off buttons	On/off switch for the resynator. Pressing this button can mute each resynator.
Stick-controller	Neuron is a synthesis instrument designed specifically to let you get fast results. That is why it affords swift, efficient and intuitive access to parameters. This is particularly evident in the resynator. The stick controller lets you tweak up to four parameters simultaneously. Though gamers will love its joystick-like vibe, it is nevertheless a very subtle sound-sculpting tool. And it is phenomenally powerful. Though you may start with the sound of a conventional instrument, in no time at all you will be exploring totally uncharted (synthetic) sonic territory. **Tip**: After you manipulate the stick to get a coarse parameter setting, the main display shows the current parameters. To fine-tune that setting, toggle the navigation stick to scroll (**stick.right**/**left**) through the four parameters of the current level and use the knob to set the desired value. Note also the basic settings parameter *stick mode* (see page 37).

Table 6: Resynator control features

Displays	The nature of these parameters varies considerably depending on the type of model and its attributes. For better orientation, they are shown along with the respective values in the displays surrounding the stick controller.
Model select/ menu button	When you are not working in the resynator menu, you can press this button to access the most recently edited resynator parameter. To use model loader to load a model into the resynator (see page 86), press the button in the resynator menu. You will find a description of the menu on page 75.
Select (scape/ sphere) button	The parameters of every model are subdivided into *scape* and *sphere* parameters (see page 71). This button lets you select a parameter region for editing via the **level** button and stick. The current parameter values of a region are automatically retained when you switch to the other region.

Table 6: Resynator control features (cont.)

Parameter Level (1 / 2 / 3) button	*Scape* and *sphere* parameters are ordered in three levels each. After you have chosen a region using the **select** button, this menu is where you determine the level to be processed via stick. Again, Neuron "memorizes" the current settings when you switch to another level.
Record stick button	The movements of the stick controller can be recorded and stored for every *scape* and *sphere* parameter level. By activating stick animation, you can play the recorded movement back (see the next line in the table). This lets you program extremely vigorous modulations as an integral component of a sound. To learn how to record stick controller movements, read page 89.

Table 6: Resynator control features (cont.)

Contour control button	An ADSR envelope or previously recorded movement of the stick controller can influence every *scape* and *sphere* parameter level. The contour settings can be determined separately for every parameter level, so you have six contour controls available for each resynator. By pressing this button several times, you can select between: • *Off* (no LED lights up): An envelope or stick recording does not manipulate the selected parameter level. • *Shaper*: The *par. level* ADSR envelope in the given shaper is assigned to the current *scape* or *sphere* parameter level. Note that the par. levels LED in the shaper must light up before you can define the envelope. Continued on next page...

Table 6: Resynator control features (cont.)

	... Continued from previous page The amplifier envelope defined in the shaper is always active for the entire resynator, regardless of the contour control setting in the resynator. To find out how to define an envelope, please read the section starting on page 110. • *Stick Animation*: The stick movement previously recorded via **record stick** is played back as a *1shot* or in *repeat* mode, depending on the stick animation setting in the resynator menu (see page 80). Manual stick movements have no effect on the current parameter level while stick animation is activated!
Octave button	The pitch for the given model can be edited in octaves. Note also in this context the *pitch* menu options *semi* and *cent* in the resynator menu (see page 82).

Table 6: Resynator control features (cont.)

Resynator: Menu

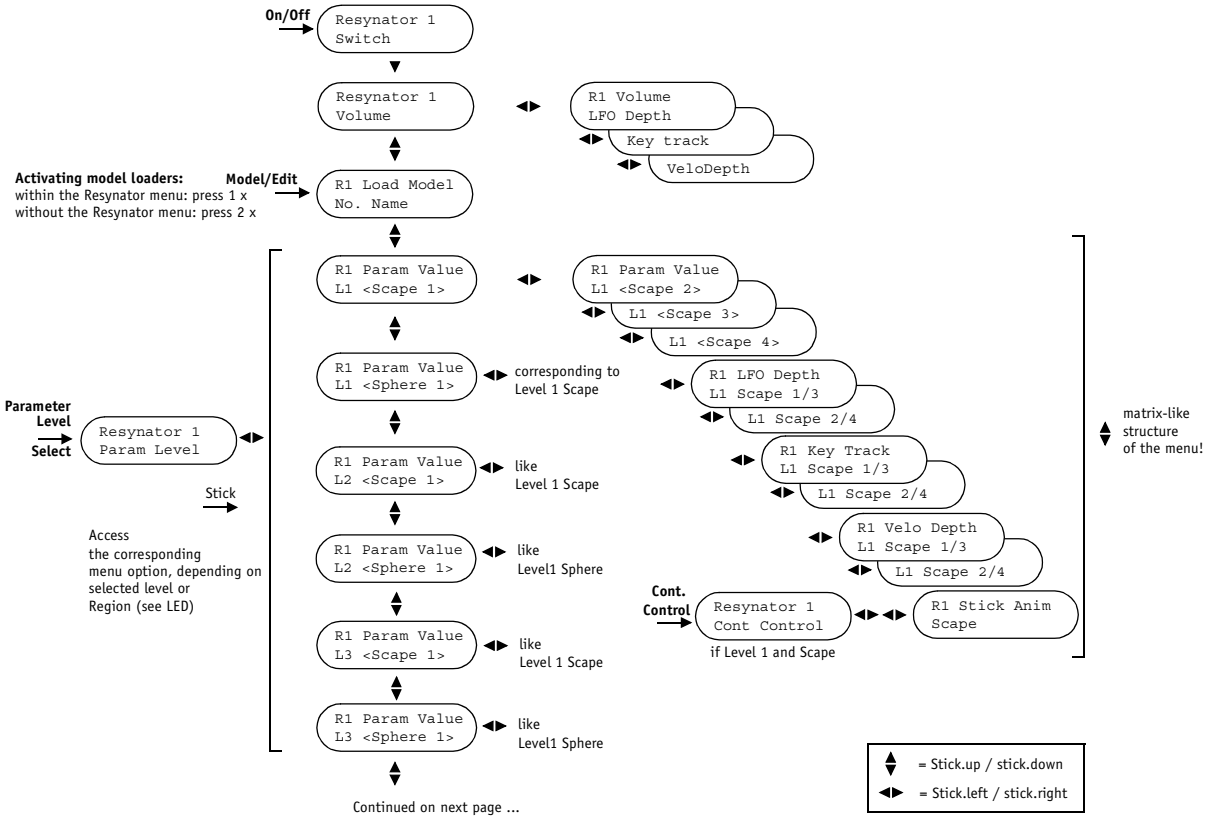
Press the **model select/menu** button to access the resynator menu. The most recently edited resynator menu option appears in the main display. Press this button again to access model loader.

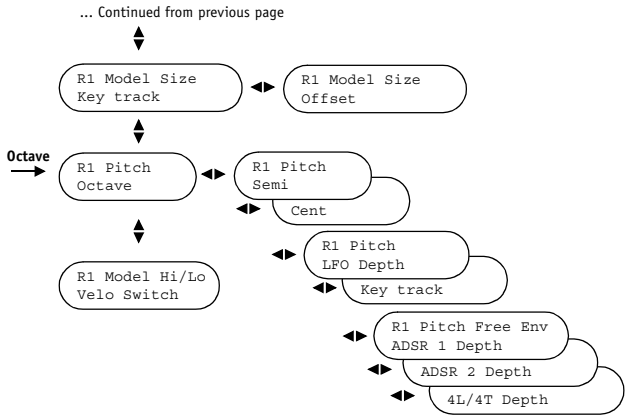
The resynator menu is a **matrix**. **Stick.up/down** to scroll through the main menu options as well as through related options in a submenu.
Example: **Stick.down** takes you from <L3 scape 4> directly to <L3 sphere 4> and **Stick.up** leads to <L2 sphere 4>.

The **rotary knob** adjusts numeric values or scrolls through predefined settings.

The **model select/menu** button takes you to this menu, as do diverse other resynator control features. For example, when you move the stick controller the values of the currently edited model parameter appear directly in the display and can be edited via knob.

Though the following diagrams show resynator 1's menu (the display indicates `R1` in line 1) only, these illustrations serve as an example for both resynators. Note also that the device shows the actual parameter names in line 2 rather than the dummies `<scape>/<sphere>` shown here.


On/Off
Resynator 1 Switch
Resynator 1 Volume
R1 Volume
LFO Depth
Key track
VeloDepth
Activating model loaders:
within the Resynator menu: press 1 x
without the Resynator menu: press 2 x
Model/Edit
R1 Load Model No. Name
R1 Param Value L1 <Scape 1>
R1 Param Value L1 <Scape 2>
L1 <Scape 3>
L1 <Sape 4>
R1 Param Value L1 <Sphere 1>
corresponding to Level 1 Scape
R1 LFO Depth L1 Scape 1/3
L1 Scape 2/4
Parameter Level Select
Resynator 1 Param Level
R1 Param Value L2 <Scape 1>
like Level 1 Scape
R1 Key Track L1 Scape 1/3
L1 Scape 2/4
Stick
Access the corresponding menu option, depending on selected level or Region (see LED)
R1 Param Value L2 <Sphere 1>
like Level1 Sphere
R1 Velo Depth L1 Scape 1/3
L1 Scape 2/4
Cont. Control
Resynator 1 Cont Control
R1 Stick Anim Scape
if Level 1 and Scape
R1 Param Value L3 <Scape 1>
like Level 1 Scape
matrix-like structure of the menu!
R1 Param Value L3 <Sphere 1>
like Level1 Sphere
= Stick.up / stick.down
= Stick.left / stick.right
Continued on next page ...



Resynator: Parameters

Volume	Determines the volume of the resynators. This lets you adjust and balance the relative levels of the two resynators. Value range: 0 to 127.
Volume LFO Depth	Determines the modulation depth of the mod-generated LFO oscillation and thus the intensity of its effect on resynator volume. Value range: -64 to +63. *Depth* = 0: No mod-generated volume modulation. *Depth* > 0: Starting at the current level, the volume increases in accordance with the LFO oscillation (up to a max value of 127). *Depth* < 0: Volume decreases in accordance with the LFO oscillation. Note in this context the *global LFO depth*, which is defined directly in the mod module (page 116). Global *LFO depth* is offset against this modulation destination's *depth* value.

Table 7: Resynator parameters

Volume *Key track*	Also called key follow, key track is a form of keyboard control data. When key tracking is activated, the keyboard serves as a modulation source, generating key track values in accordance with the position or pitch of the notes played on the keyboard. This parameter determines the relative or weighted volume of the various keyboard zones. The notes of certain predefined keyboard zones sound louder or softer depending on the key track value. Value range: -64 to +63. 0 = No weighting. Positive values: Notes above the center key's pitch (C3) are played louder than notes below C3. The higher the value, the further this weighting is shifted to the right of the keyboard. Negative values: Notes below the center key (C3) are played louder than notes above C3. The lower the value, the further this weighting is shifted to the left. See also the illustration on page 85.

Table 7: Resynator parameters (cont.)

Volume *VeloDepth*	Determines velocity modulation depth and thus the intensity of the effect on the resynator's volume. Value range: -64 to +63. *VeloDepth* = 0: Velocity does not modulate the volume level. *VeloDepth* >0: The harder you bear down on a key, the louder the output level. *VeloDepth* <0: The harder you bear down on a key, the softer the output level.
Param Value *L1 <Scape>* to *L3 <Sphere>*	Model parameter values. Value ranges: 0 to 127. Model parameters can be set using the resynator's **stick** or the **rotary knob** located next to the main display. The latter lets you dial in settings more precisely. We recommend that you set coarse values using the sticks and fine-tune them in the menu.

Table 7: Resynator parameters (cont.)

LFO Depth *L1 Scape 1/3* *to* *L3 Sphere 2/4*	Determines the modulation depth of the mod-generated LFO oscillation and thus the intensity of its effect on the opposite cross-x *scape* and *sphere* parameter pairs (1/3 and 2/4). Value range: -64 to +63 *LFO depth* = 0: Parameters are not modulated. *LFO depth* > 0: Starting at the current value, the parameter value increases in accordance with the LFO oscillation (up to a max value of 127). *LFO depth* < 0: The value decreases in accordance with the LFO oscillation. Note in this context the *global LFO depth*, which is defined directly in the mod module (page 116). Global *LFO depth* is offset against this modulation destination's *depth* value.

Table 7: Resynator parameters (cont.)

KeyTrack *L1 Scape 1/3* to *L3 Sphere 2/4*	Weights model parameters for different keyboard zones. The higher the parameter's weight, the greater is its influence and the more intense the effect of parameter value changes. Key tracking is defined separately for each *scape* and *sphere* parameter level. Note that you can differentiate between the two cross-x parameter pairs within a level. Example: `Keytrack L3 sphere 2/4` weights the third sphere level's second and fourth parameter. Value range: -64 to +63. 0 = No weighting Positive values: Notes above the center key (C3) are weighted higher than notes below C3. The higher the value, the further this weighting is shifted to the right of the keyboard. Negative values: Notes below the center key (C3) are weighted higher than notes above C3. The lower the value, the further this weighting is shifted to the left. See also the illustration on page 85.

Table 7: Resynator parameters (cont.)

VeloDepth *L1 Scape 1/3* to *L3 Sphere 2/4*	Determines velocity modulation depth and thus the intensity of its influence on individual cross-x *scape* and *sphere* parameter pairs. Value range: -64 to +63 *VeloDepth* = 0: Parameters are not modulated. *VeloDepth* >0: Starting at the current value, the parameter value increases in accordance with velocity (up to a max value of 127): current parameter value **+** *velo depth* **x** velocity value *VeloDepth* <0: The value decreases in accordance with velocity.
Stick animation *L1 scape to L3 sphere*	Defines the playback mode for stick recordings (stick playback). Your options are: • *1Shot*: The first note you play triggers the recorded stick movement for the given sound (single trigger) and the animation continues to shape the sound regardless of how many notes you play thereafter. Continued on next page...

Table 7: Resynator parameters (cont.)

	Once the animation has run its course it is not re-triggered until you release all keys and then press a new key. Tip: You can opt to use envelopes for this purpose. The shaper offers multi-trigger functionality, meaning that - unlike stick animation - the envelope is triggered every time you press a key. This starts the envelope separately for every note you play. • *Repeat*: The first note you play triggers the animation and then – unlike when the *1shot* setting is enabled – it is repeated in cycles for as long as you continue playing notes. To learn how to record stick controller movements, read the explanation starting on page 89.

Table 7: Resynator parameters (cont.)

Model Size Key track	*Model Size Key track* determines how keyboard transposition affects the size of the model. Value range: -64 to +63. 0 = the size of the model remains the same across the entire keyboard. Positive values: Notes above the root key reduce the size of the model, notes below the root key enlarge it. Negative values: Notes below the root key reduce the size of the model, notes above the root key enlarge it. **Good-to-know background stuff:** Neuron's approach to transposing models differs from that of a sampler or ROMpler (a synthesizer featuring sample playback or sample ROM). While in a sampler not only the pitch but also the apparent sample size changes in accordance with the played note, the size of a Neuron model remains largely unchanged when it is transposed. This yields a more natural, organic sound. Continued on next page...

Table 7: Resynator parameters (cont.)

	When working with multi-models (models derived from a multisample and consisting of several *scape/sphere* pairs), an audible jump or gap in the soundscape may occur because virtually every zone brings its own model size to the sonic equation. You can counter this effect by taking advantage of the *model size key tracking* parameter and, if necessary, the *model size offset* parameter (see the next line of the table). When you enter a suitable setting, Neuron transposes much like a sampler. The model size can even be inverted in relation to pitch if you enter negative values, which makes for interesting effects. *Model size key track* and *offset* cannot be modulated! In order to change the size of the model on the fly, you must modulate the given model parameter directly (usually this will be *sphere level 1*). All modulation sources and controllers may be used for this purpose.

Table 7: Resynator parameters (cont.)

Model Size Offset	Determines the extent of the offset between the size of a model and the root key. Value range: -64 to +63. 0 = the model size remains constant, meaning that it corresponds to the size of the original sample on the root key. Values other than zero increase or decrease the size. This means that you can play a model so that it behaves like a sample (key track = +63, see above) and retains the pitch of the original sample even though it is smaller than the original sample.
Pitch	Tunes the resynators. The submenu contains the following menu options: • *Octave*. Value ranges from -2 to +1. Adjustable only via the **octave** button. • *Semi*. Value ranges from -24 to +24. The knob detunes in semitones. • *Cent*. Value ranges from -99 to +99. The knob detunes in cent steps.

Table 7: Resynator parameters (cont.)

Pitch LFO Depth	Determines the modulation depth of the mod-generated LFO oscillation and thus the intensity of its effect on resynator pitch. Value range: -64 to +63. *LFO depth* = 0: Mod does not modulate pitch. *LFO depth* > 0: Starting at the current value, pitch is modulated upwards in accordance with the LFO oscillation. *LFO depth* < 0: Pitch is modulated downwards in accordance with the LFO oscillation. Note in this context the *global LFO depth*, which is defined directly in the mod module (page 116). Global *LFO depth* is offset against this modulation destination's *depth* value.

Table 7: Resynator parameters (cont.)

Pitch Key track	Determines the key tracking for the resynator's pitch. Value range: -64 to +63. Default: 63 0 = Pitch remains constant over the entire keyboard (C3). Positive values: The pitch of notes above the center key (C3) rises. +63 pitch = standard keyboard assignment. Negative values: The pitch of notes above the center key (C3) drops. -64 = inversion of the standard keyboard assignment. See also the illustration on page 85.
Pitch FreeEnv ADSR 1 Depth and *ADSR 2 Depth*	Determines the modulation depth of the free ADSR envelope generated by shaper 1 (or shaper 2) and thus the intensity of its effect on resynator pitch. Value range: -64 to +63. *Depth* = 0: The free envelope does not modulate pitch. *Depth* > 0: Starting at the current value, pitch rises in accordance with the ADSR envelope. *Depth* < 0: Pitch drops in accordance with the envelope. Continued on next page...

Table 7: Resynator parameters (cont.)

	Note in this context the *global depth* of the envelope, which is defined directly in the shaper (page 108). This global *depth* is offset against the *Free Env Depth* value determined at this modulation destination.
Pitch FreeEnv 4L/4T Depth	Determines the modulation depth of the free 4 levels 4 times envelope generated by shaper 1/2 and thus the intensity of its effect on resynator pitch. Value range: 0 to 127. *Depth* = 0: The free envelope does not modulate pitch. *Depth* > 0: : Starting at the current value, the pitch rises in accordance with the 4L/4T curve. Unlike *ADSR depth*, *4 L/4 T depth* does not allow negative values because the envelope itself can accept negative levels. Note in this context the *global depth* of the envelope, which is defined directly in the shaper (page 108). This global *depth* is offset against the *Free Env Depth* value determined at this modulation destination.

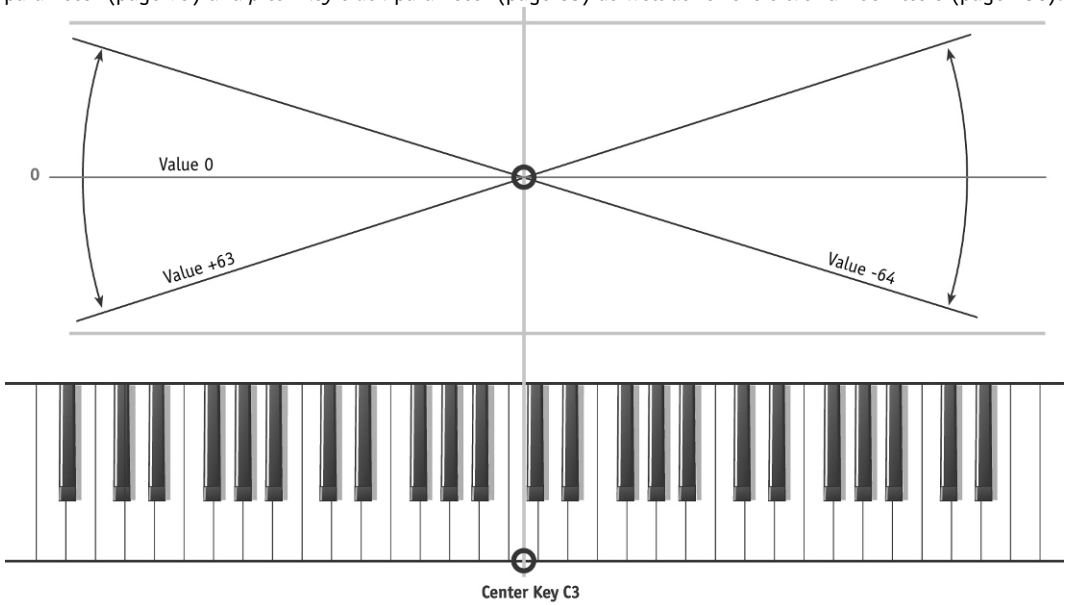
Table 7: Resynator parameters (cont.)

Model Hi/Lo Velo Switch	**Heads up**: This parameter is enabled only when the model loaded in the resynator distinguishes between low and high velocity zones. This property is determined when the model is created in ModelMaker. The parameter defines a velocity threshold value. If the pressure applied to the key exceeds the threshold value, the high velocity zone plays. If the force of your key attack falls short of the defined threshold value, the model's low velocity zone sounds. That way you can address two sound components within a model by simply varying key pressure. Value range: 1 to 127.

Table 7: Resynator parameters (cont.)

Key tracking

You can define key tracking performance for every resynator (*volume key track* parameter (page 78), *key track* parameter (page 79) and *pitch key track* parameter (page 83) as well as for the silver unit's filters (page 138).



Starting from the center key, this parameter weights a module or a parameter with reference to pitch. An analogy may explain this better: Picture a set of scales. The center key is the lever holding the two pans. Key tracking is the weight placed in a pan. Negative values = weighted to the left side of the keyboard; positive values = weighted to the right of the keyboard.

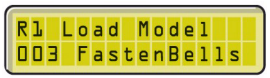
Resynator and silver unit key tracking

Resynator: Handling

If you are working in setup mode, you must first prime the sound that you want to edit (see page 66) or switch to sound mode!

► **How to load a model into a resynator:**

- Activate the given resynator (**on/off** button).
- Press **model select**. Model loader appears in the main display. Here's an example using resynator 1:



- Twist the knob to scroll through the model database until you find the desired model. The model number flashes until the selected model is loaded. Load the model via **enter** (press the knob).

  Alternative:

  Type in the three-digit model number on the numeric keypad. The model loads immediately after entering the third digit. You do not have to press enter.

- The display reads:

Note in this context the basic settings parameter *ResyParReset*. Use it to determine whether the model is loaded into the resynator with the default values stored in the database or if the current settings are retained. A prompt may appear depending on parameter setting. The basic settings parameter is described on page 38.

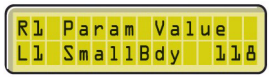
Picture the following: The *ResyParReset* parameter is set to *yes/ask*. You have run into a sonic dead-end while editing the model, but you do not want to or cannot use the snapshot function (see page 52) to recall the initial parameter values. In this case, simply load the default model values back into the resynator and start over!

► **How to edit models in the resynator:**

You have a function called **snapshot** at your disposal when editing. It lets you save the current sound settings at any time. In combination with the **play/compare** button, you can audition your snapshots and A/B or compare the edited sound to the original.
Snapshots are described on page 52.

- To edit a model's parameter values, first select the parameter region (**select** button), then the desired level (**parameter level** button).
- Edit the current level's parameters using the stick controller. The four displays surrounding the stick indicate the current values:

- Once you have "touched" a parameter level with the stick, the first parameter also appears in the main display and can be fine-tuned there using the knob:



- **Stick.right** and **stick.left** to access and edit the other parameters at the same level. **Stick.up**/**stick.down** takes you to the model's other parameter levels.
- Tune the resynator up or down using the **octave** button. Go to the menu option *pitch* and scroll to the right to detune the model in semitone or cent steps (see the menu diagrams starting on page 75).
- **Velocity**: If you want to modulate resynator volume or individual cross-x parameter values via key pressure, define the given *velo depth* parameter in the resynator menu (see page 78).
- **Key tracking**: If desired, define volume key tracking for the entire resynator (see page 78) or key tracking for individual model parameters (page 79).

- **LFO**: If you want to modulate the model via an LFO oscillation, first define the oscillation in the mod module (page 117), then define the modulation depth for pitch, volume or individual parameter values in the resynator (see parameter descriptions starting on page 77).
- **Contour control**: Use the **contour contr.** button to activate *stick animation* for the resynator or to modulate model parameters via envelope (*shaper 1* LED lights up).

  You must activate stick animation or the shaper envelope specifically for every *scape* and *sphere* parameter level. This means that in order to modulate all levels, you must the select the parameter levels via **select** and **parameter level** and define the modulation source using **contour contr.**

Stick animation is only available if a recording of the stick movement (or track) has been made for the given level. For more on this, read the section starting on page 89.

If you want to use an envelope to modulate the model parameters at a given level, you must define the ADSR envelope in the appropriate shaper and determine the desired *depth* (see page 110).

The setting **contour control** = *shaper 1* applies to the parameter envelope only! The amp envelope, which modulates resynator volume, remains unaffected by this setting!

Copying parameter sets or reloading stored parameter values

You have the option of copying parameter value settings or an entire resynator configuration from a stored sound into the current sound or from one resynator to another within the current sound. It is also possible to reload the values stored in the sound database into the respective resynator and cancel all the previous changes made during editing.

You will find the copy function in the copy/paste menu. As well as copying resynator settings and parameter values, it serves to copy many other data records, for example, effect settings or controller assignments

The copy function is described in the section "Copy/paste" on page 54. There you will find an example demonstrating how to copy the complete set of resynator settings from one sound to another.

Resetting model parameter/resynator settings

In the copy/paste menu, you will also find a reset option. It resets resynator and other data to default values. This function is described on page 57.

Stick recording and animation

When you move the stick controller to edit parameter values, you can record these movements and play them back to manipulate parameter values on the fly. We call this process "stick animation."

In addition to envelopes, stick animation is your other option for manipulating parameter values as a function of time.

Let us look at the rules for stick recording and animation:

- You can record one track for every parameter level. This m+63eans that you can record six tracks per resynator – one each for the three *scape* and three *sphere* parameter levels.

  You can record three tracks in the silver module: one track each for the selected filter, time FX and freq FX.
- You can play back a stored track at the parameter level at which it was recorded. You must press the **contour contr.** button to specifically select an animation and play it back for each level (see page 74).
- The resynator menu's *stick animation* option lets you determine if a track is played once or (*1shot*) or it is cycled (*repeat*).

  Playing a note triggers the animation. In *1shot* mode, the animation runs through once while

in *repeat* mode it is re-triggered from the top for as long as you hold the note.

- The first note that you play triggers every stick animation. While the animation is running, any notes played thereafter have no effect on the animation. Unlike multi-triggering in envelopes, stick animation is limited to a single trigger.
- If *stick animation* is activated for a parameter level (**contour contr.**), then this level responds exclusively to the animation. No other type of manipulation – say, moving the stick controller manually, or starting a previously defined parameter envelope - has an effect on this level.

If a stick animation is activated for a specific level, the parameters of all levels for which *no* animation has been activated can be manipulated in real-time by moving the stick even if the respective shaper is activated for purposes of contour control.

- The *stick record start* parameter in the basic settings menu (see page 41) defines the trigger conditions for starting a recording (the options being move the stick or press a key).
- The maximum duration of a recording is contingent upon the number of recorded tracks and the intensity of stick movements. No worries, though: under normal conditions, you are unlikely to hit any boundaries!
- Stick recordings are stored at the sound level.

  Surround tracks are an exception. Surround data is generally stored in connection with a setup!

  If you exit a sound without storing it, any newly recorded tracks evaporate into the digital ether!

► **How to record a stick movement:**

A new recording on the same track (at the same parameter level) overwrites a previously recording without warning!

- In the given module, use **select** (in the resynator only) and **parameter level** to determine the parameter level at which you want to create an animation.
- Press the **record stick** button to set the recording function to standby. The LED above the button flashes.
- Start the actual recording by satisfying the trigger condition defined for the basic settings parameter *stick record start*; in other words, move the stick or press any key on the keyboard.

  The LED lights up continuously during the recording process.

  Every movement of the stick controller is recorded.

- Stop recording by pressing the **record stick** button again.

  The track is stored along with the other sound-specific data in the sound database when the sound is stored.

  If you do not store the sound, the recording is lost when you change the sound/setup or switch Neuron off!

► **How to start a stick animation:**

- In the given module, use **select** (in the resynator only) and **parameter level** to determine the parameter level at which you want to play back an animation.

  Press the **contour contr.** button for this level repeatedly so that the *stick animation* LED lights up.

  Repeat this step for every desired parameter level.

- Go to the resynator menu and define stick animation mode for every *scape* and *sphere* parameter level - *1shot* or *repeat* (see the parameter table on page 80*)*.

The exception in surround mode:
The silver module's **contour contr.** is reserved for the filter and effects. The surround menu offers an added option called *off* for the menu option *stick animation* that serves this purpose. Activate a surround stick animation by selecting *1shot* or *repeat* in the surround menu.

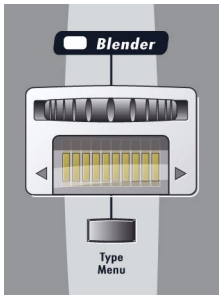
For more on this, be sure to check out the chapter "Surround mode" starting on page 177.

► How to delete a track

A new recording made at the same parameter level overwrites a track without warning! In order to delete a track without overwriting it with a new recording, proceed as follows:

- Select the parameter level at which you want to delete a track in the given module using **select** (in the resynator only) and **parameter level**.
- Press and hold the **record stick** button until the LED above the button extinguishes (three seconds should do).

Module: Blender



Neuron features another breed of newfangled control unit that sweeps between resynators called blender. We had originally intended to equip Neuron with just one resynator.

However, as we were developing Neuron it came to us that the capability of blending or mixing two models could offer tremendous creative potential. And that notion prompted us to build the blender module.

It enables dynamic cross fading between two resynators and lets you manipulate one resynator using another.

Say resynator 1 contains the model of a flute. Resynator 2 provides a piano-like model. Neural synthesis allows specific parameters of one model to influence the other model. In this configuration it would be entirely feasible to impose the sound generating properties of the piano model (that is, the elements of the sound that we classify as *scape* parameters - the vibration of strings, the dimensions or the material the strings are made of) on the sound-shaping environment of the flute model - for example the material or size of the flute body. These, in turn, are represented by the flute model's *sphere* parameters.

What does a strings pad sound like when chopped up rhythmically by a drum loop? This could generate freakish, alien-sounding rhythm clusters. How about a choir made to "sing" through the body of a grand piano or a snare striking the strings of a guitar – what would that sound like?

Practically the only boundary is your zeal for experimentation, especially when you consider the complex intra-resynator routing options that various blender types (see page 96) put at your disposal. The more abstract models in particular offer wholly unprecedented approaches to synthesizing sound.

But there is more good news: The blender is such a versatile feature that it offers options for shaping the blender *amount* (or level) on the fly. You can modulate the *amount* via the mod module's freely definable LFO oscillations and/or via the shaper's free envelopes. The latter option gives you a choice of two ADSR envelopes or one 4 levels 4 times envelope.

Both modulation methods are defined via the given *depth* parameters in the blender menu (see page 95).

Blender: Control features

Type button	Selector button for the blender type. Press it to access the blender menu in the main display (see below).
Blender wheel	The blender wheel controls the relative *amount*s of the two resynator outputs or determines the times for dynamic cross-fades. How this amount or duration is defined depends on the selected blender type (see the section "Blender: Types" starting on page 96). The *amount* can be modulated via mod's LFO oscillation or the free envelopes of shaper 1 and 2. The menu offers *depth* parameters used for this purpose (see page 95).

Table 8: Control features of the blender

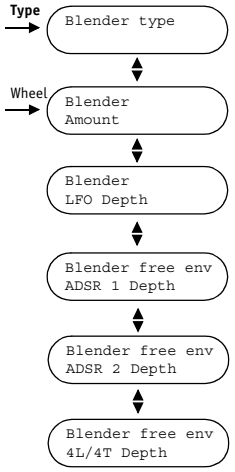
Blender: Menu

The blender menu appears in the main display when you press the **type** button.

Turn the blender wheel to dial in the **`amount`** menu option.

Scroll with the navigation stick and choose the desired parameter setting using the knob.

All parameters are described in detail in the following table.



Blender: Parameters

Blender Type	Defines the blender type and thus how the two resynators influence each other. The available blender types are described and illustrated on page 96.
Amount	Determines the weighting of the resynator output levels. The value can be defined via the blender wheel. The significance of the *amount* varies according to the blender type.

Table 9: Blender parameters

LFO Depth	Determines the modulation depth of the mod-generated LFO oscillation and thus the intensity of its influence on the blender *amount*. Value range: -64 to +63. *Depth* = 0: The blender is not modulated. *Depth* > 0: Starting from the current *amount*, the value increases in accordance with the LFO oscillation (up to a max value of 127). *Depth* < 0: *Amount* decreases in accordance with the LFO oscillation. Note in this context the *global LFO depth*, which is defined directly in the mod module (page 116). Global *LFO depth* is offset against this modulation destination's *depth* value.
Free Env ADSR 1 depth and *ADSR 2 depth*	Determines the modulation depth of the free ADSR envelope generated by shaper 1 (or shaper 2) and thus the intensity of its effect on the blender *amount*. Value range: -64 to +63. *Depth* = 0: *Amount* is not modulated. *Depth* > 0: Starting at the current value, the *amount* increases in accordance with the envelope (up to a max value of 127). ... Continued in next column

Table 9: Blender parameters (cont.)

	Depth < 0: *Amount* decreases in accordance with the envelope. Note in this context the *global depth* of the envelope, which is defined directly in the shaper (page 108). This global *depth* is offset against the *Free Env Depth* value determined at the modulation destination.
Free Env 4L/4T Depth	Determines the modulation depth of the free 4 levels 4 times envelope generated by shaper 1 **and** shaper 2 and thus the intensity of its influence on the blender *amount*. Value range: 0 to 127. *Depth* = 0: *Amount* is not modulated. *Depth* > 0: Starting at the current value, the *amount* increases in accordance with the envelope up to the maximum value: Unlike *ADSR depth*, *4 L/4 T depth* does not allow negative values because the envelope itself can accept negative levels. Note in this context the *global depth* of the envelope, which is defined directly in the shaper (page 108). This global *depth* is offset against the *Free Env Depth* value determined at the modulation destination.

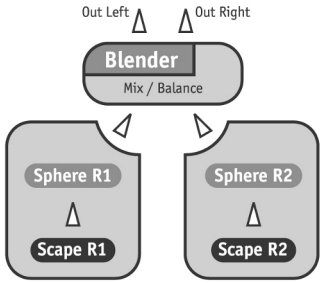
Table 9: Blender parameters (cont.)

Blender: Types

The following blender types can be selected via the *type* parameter.

Mix

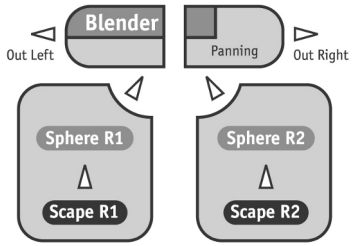
Scape 1 plays through sphere 1, scape 2 plays through sphere 2. The results are mixed in the blender and sent to the output. *Amount* controls the balance between the two results.



Blender type: Mix

Stereo

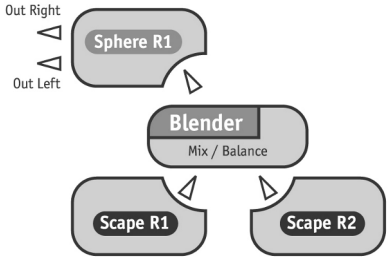
Scape 1 plays through sphere 1, scape 2 plays through sphere 2. Each result is sent to a separate output channel. *Amount* determines the panorama position.



Blender type: Stereo

Mix singlesphere

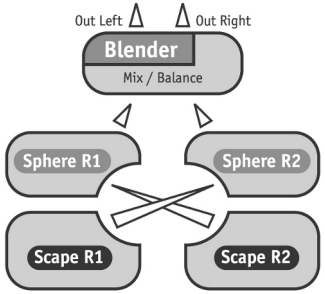
Scape 1 and scape 2 play and are mixed in the blender. The composite signal is routed through sphere 1 to the output. *Amount* controls the balance between scape 1 and scape 2.



Blender type: Mix singlesphere

Chromophonic

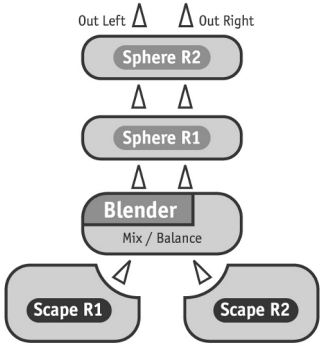
Scape 1 plays through sphere 2, scape 2 plays through sphere 1. The results are mixed in the blender and sent to the output. *Amount* controls the balance between the results.



Blender type: Chromophonic / Velo chrome

Dual sphered

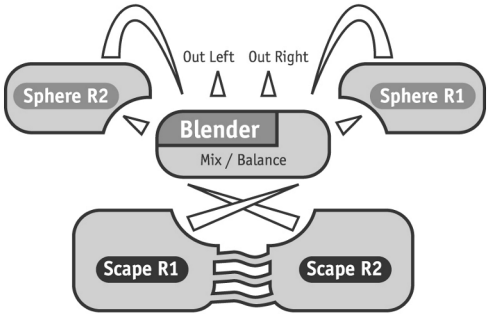
Scape 1 and scape 2 are mixed proportionally in the blender, sent through sphere 1 and sphere 2 consecutively, and then routed to the output. *Amount* controls the balance between scape 1 and scape 2.



Blender type: Dual sphered

Intermorph

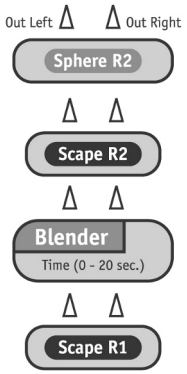
Scape 1 and scape 2 are split up into complementary (or opposite) frequency bands (for example, one frequency band contains low frequencies, the other high frequencies). Then the bands are mixed cross-x and proportionally in the blender and the signal is patched to the other sphere. The result is sent proportionally to the output. *Amount* controls the balance between scape 1 and scape 2.



Blender type: Intermorph

Dynamic transsphere

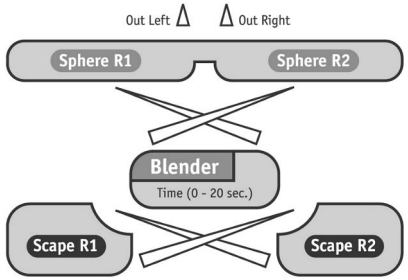
Scape 1 cross-fades over to scape 2 within a definable time. The resulting signal is patched through sphere 2 and then to the output. *Amount* controls the cross-fade time (up to 20 seconds).



Blender type: Dyn. transsphere

Dynamic crossmorph

Scape 1 and scape 2 are cross-faded or morphed reciprocally within a definable time and assigned to the other sphere. The result is mixed to create a composite signal, which is then routed to the output. *Amount* controls the cross-fade time (up to 20 seconds).



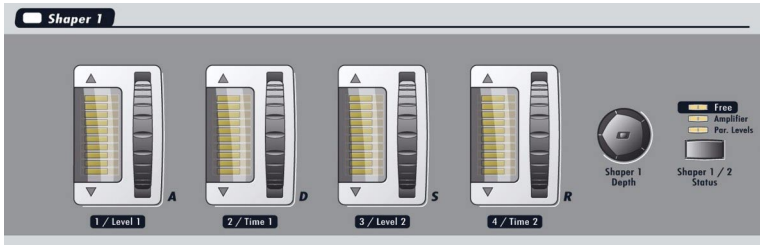
Blender type: Dyn. crossmorph / Velo crossmorph

Velo crossmorph und Velo chrome

Velo crossmorph is similar to the dynamic crossmorph type, velo chrome is similar to chromophonic. However, the balance between the resynators is here controlled by velocity. *Amount* = 127 and weakest key attack: 100% resynator 1. Strongest key attack: 100% resynator 2. *Amount* = 64 and strongest key attack: sounds exactly "between" resynator 1 and 2.

Module: Shaper 1/2

Each shaper is an extremely versatile envelope generator. What makes it so flexible is that the envelope can influence different parameters and modulation destinations. Beyond that, it lets you choose between two types of envelopes (in *free* mode).



Refresher course: Envelope basics

An envelope is a time-based process. Defined by several envelope parameters, it modulates certain sonic properties, for example, volume or - in the case of Neuron - model parameters.

Playing any note triggers an audio signal modulation, which means that the envelope influences each note separately and explains why the process is called multi-triggering.

A modulation driven by stick animation is, in contrast, a single trigger function. This means that after pressing the first key starts it, it runs through once only (*normal*) or it is cycled (*repeat*). For more on this, read page 103.

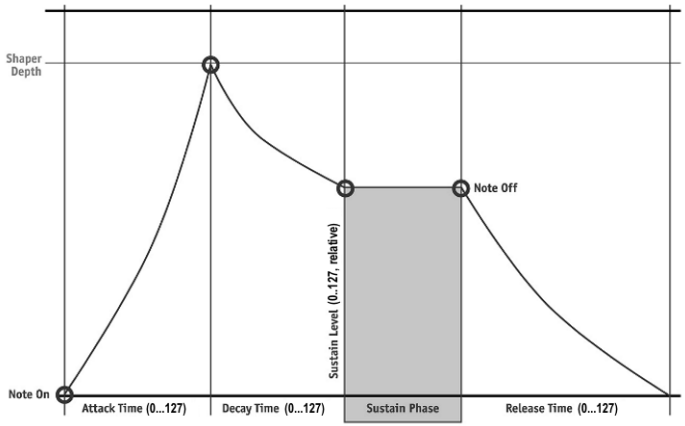
ADSR envelope

Like many classic synthesizers, every Neuron shaper offers a handy four-part **ADSR envelope**.

The envelope is defined by four parameters; three are functions of time and one of level:

After a note is played, the envelope rises to its peak value within the defined ***a**ttack* time. The ***d**ecay* parameter determines the amount of time it takes for the curve to drop to the ***s**ustain* level after the attack phase ends (decay = fade). However, *sustain* does not actually determine the period, it defines the level at which the curve remains until the key is released. The last phase of the curve is defined by the ***r**elease* parameter. This is the time the curve

takes to return from the defined sustain level to a value of zero after the key is released.

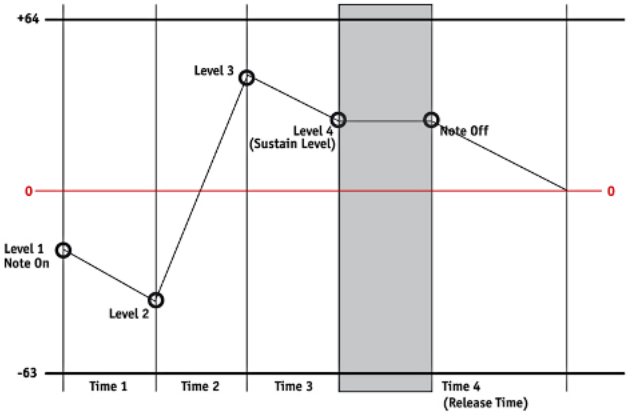


ADSR envelope in normal mode

In shaper modes *amplifier* and *par. levels* always an ADSR envelope is used.

4 levels 4 times envelope (4L4T)

This is the second type of envelope available in addition to the ADSR curve. It is defined by four paired values. Every paired value consists of a level and a time. You can determine at which level the envelope starts and how long it takes to achieve the next level.



4 levels 4 times envelope in normal mode

The phase indicated in gray (level 4) in the illustration is comparable to an ADSR curve's sustain phase.

As you can gather from the picture, the 4L4T curve can also accept negative levels.

To add delay at the beginning of the curve, set level 1 and level 2 to 0. The delay time is determined by the time 1 setting.

The 4L4T envelope makes it very easy to define how the modulated parameter responds.

In Neuron, the 4 levels 4 times curve is available in shaper status *free* only.

Modulating volume via an ADSR envelope

Say you opt to use the aforementioned ADSR envelope to modulate the amplitude of a sound. In Neuron, the shaper's *amplifier* mode serves this purpose. It elicits the following amplitude response: You press a key, the attack phase begins. The note swells to its peak volume in the defined attack time. The lower the attack parameter, the faster the note responds to your key pressure. After attaining maximum volume, the note drops to sustain level within the defined decay time. This means that the sustain parameter determines the level at which the note is held. The release phase begins as soon as you release the key. The note fades during this phase until it is no longer audible at the end of the phase.

In Neuron, this modulation is available in two versions: The ADSR curve defined in shaper 1 influences resynator 1. Shaper 2 is routed to resynator 2.

The **contour control** of the respective resynator has no influence on the *amplifier* envelope. *Amplifier* envelopes are always active.

Modulating pitch via an ADSR or 4 levels 4 times envelope

In the shapers, you can define free ADSR envelopes to modulate either of the two resynators' pitches.

The free ADSR curve's modulation depth is defined via an "overall" depth (which is adjusted in the respective shaper) **and** via the menu option *free env pitch ADSR1/ADSR2 depth* in the respective resynator menu (see page 83).

The same applies to a 4 levels 4 times envelope used for modulating a resynator's pitch. The resynator menu option *freeEnv pitch 4 L/4 T Depth* defines the modulation depth.

Modulating model parameters

An envelope can modulate not only the amplitude and frequency (pitch) of a signal but also other parameters.

Neuron's two resynators and the sound models loaded into them offer infinite sound-shaping without adding envelopes to the equation, so imagine what mind-boggling possibilities envelopes give you for modulating the model's parameters.

Hard to envisage? Then call to mind the aforementioned amplitude modulation and try to picture what this kind of process could do to a model parameter. Perhaps this will make the possibilities more tangible: Take, for example, *metallicity*. The note gains a metallic edge in the defined attack time, dropping to sustain level during the decay phase that defines how metallic the timbre will remain for as long as you hold the key down. After you release the key, the metallic sheen fades during the release phase.

The parameter value defined in the resynator determines the limits of the envelope's influence on the model parameter. The minimum value is the currently selected parameter value, the peak value is the maximum possible parameter value (127). In our example, this means that at a *metallicity* value of 70 the envelope modulates the parameter within the value range of 70 and 127.

So how is this modulation configured in Neuron? The envelope defined in shaper 1 (shaper status = *par.level*)modulates the resynator 1's model parameters, shaper 2 influences resynator 2's parameters. As a prerequisite for the modulation, the given resynator's **contour contr.** button must be set to *shaper*. The envelope's *depth* can be determined separately for every parameter level.

Velocity-driven envelope effects

Have you ever wished that you could define an envelope just once and have it modulate at different intensities in accordance with how hard you strike the keys? Wish no more: Neuron makes it happen:

The envelope's *depth* parameter is modulated via your key pressure when you enter a value other than zero for the *velo depth* parameter (see the parameter description on page 109).

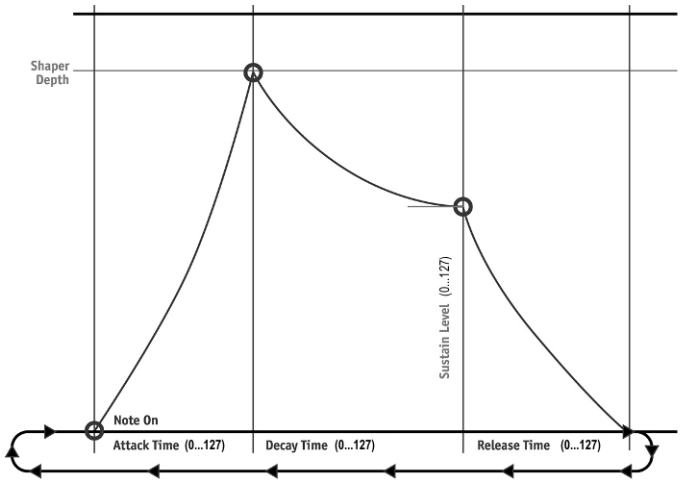
Normal or repeat?

You have already learned that pressing a key triggers an envelope. Let us look at it from another perspective: pressing any key launches the time-based process that is an envelope. But what happens next? Neuron distinguishes between two modes:

In *normal* mode, the envelope runs through once. After the release time (or time 4) elapses, the envelope is not triggered again until a new note is played.

In *repeat* mode, the envelope is repeated in cycles, though the envelope does not run its full course. The sustain phase falls by the wayside, and the release phase is launched at the sustain level right after the decay phase ends. Then the attack phase of the next cycle begins. This cycle continues for as long as the key is held down. Releasing the key stops the envelope immediately. In *repeat* mode, a 4L/4T envelope goes from level 4 to level 1during the release phase (time 4).

The *repeat* option lets you create LFO-like effects, among others.



ADSR envelope in repeat mode

Shaper 1/2 routing: Modulation destinations

Now you know that you can use envelopes to influence the most diverse sound parameters. To do this, you must assign a destination parameter to the envelope. In Neuron, some of these routing options are predefined while others can be defined freely.

Shaper 1's *amplifier* envelope is "hard-wired" to resynator 1's amplifier and therefore modulates the signal's amplitude or volume. The same applies to shaper 2 and resynator 2. In this mode, you will always define an ADSR envelope in the shaper.

The *parameter level* envelope of a shaper is "hard-wired" to its resynator's model parameters. Again, you will always be dealing with an ADSR envelope whose *depth* is determined separately for each of the resynator's three *scape* and *sphere* parameter levels. This means that the modulation intensity can be varied selectively for every cross-x parameter pair at the six parameter levels, even though the same curve is used for all parameters.

Free envelopes: flexible routing

Unlike *amplifier* and *par. level* envelopes, *free envelopes* can be assigned to several modulation destinations (for example, to a resynator's pitch).

You can also select the more complex 4 levels 4 times envelope instead of the two classic ADSR envelopes.

If you opt for the two ADSR envelopes (one curve per shaper), you can assign dedicated modulation destinations to each envelope.

The two shapers are combined for defining a 4L/4T curve.

Use the *depth* parameter of the desired modulation destination to **route** free envelopes: Every potential modulation destination offers the menu options `ADSR1 depth`, `ADSR2 depth` and `4 L/4 T depth`; they let you define the desired modulation intensity. If a modulation destination's *depth* = 0, the given envelope will not modulate it.

You can assign the following modulation destinations to free envelopes:

- Resynator pitch (page 83).
- Blender amount (page 95).

Shaper 1/2: Control features

Wheels **A/ D / S / R or L/T 1-4**	Input wheels for the envelope parameters. The LED bar display indicates the parameter value. The more LEDs light up, the longer the defined time or, in the case of a level, the higher the level. The LEDs reveal the status of an envelope at a glance. When you move a wheel, the current parameter also appears in numeric form in the main display and can be edited using the knob. Every shaper defines a complete curve for **ADSR envelopes**. The curve for the free **4 levels 4 times envelope** (available only in shaper status *free*) is entered using the eight wheels of the two shapers.
Depth knob	**Shaper in *par. level* status**: Determines the intensity of the envelope's influence on the current parameter. The knob affects the currently selected parameter level. The defined *depth* value is retained when you select another level or another region (*scape/ sphere*) in the resynator. *Depth* is also adjustable via menu. ...Continued on next page

Table 10: Control features of Shaper 1/2

	Shaper in *amp* status: In this mode, the envelope does not have a *depth* parameter. However, to make programming easier, we have assigned the given resynator's volume to the knob. **Shaper in *free* status**: Determines the "overall depth" of the free envelope. When using free envelopes, please bear in mind the relevance of the *depth* value determined at the modulation destination! You will find further information about this topic on page 104.
Shaper 1/2 status button	Determines the type of envelope that is adjusted via the Wheels: • *Par. Levels*: The adjusted parameters define the ADSR envelope that modulates the currently selected *scape* or *sphere* parameter level of the given resynator (shaper 1 > resynator 1, shaper 2 > resynator 2). The defined values are retained when you switch to another level or region. ... Continued on next page

Table 10: Control features of Shaper 1/2 (cont.)

... Continued from previous page

- *Amplifier*: The wheels define the ADSR envelope that modulates the amplitude of the given resynator (here too the shaper > resynator routing is "hard-wired").
- *Free*: In *free* mode you can (a) select between the envelope types **ADSR** and **4 levels 4 times** and (b) define different modulation destinations. You will find further information on page 104.

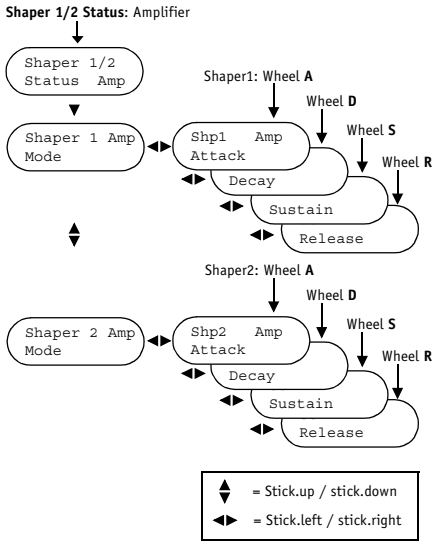
An appropriate shaper menu appears in the main display for the selected shaper status (and thus the envelope type).

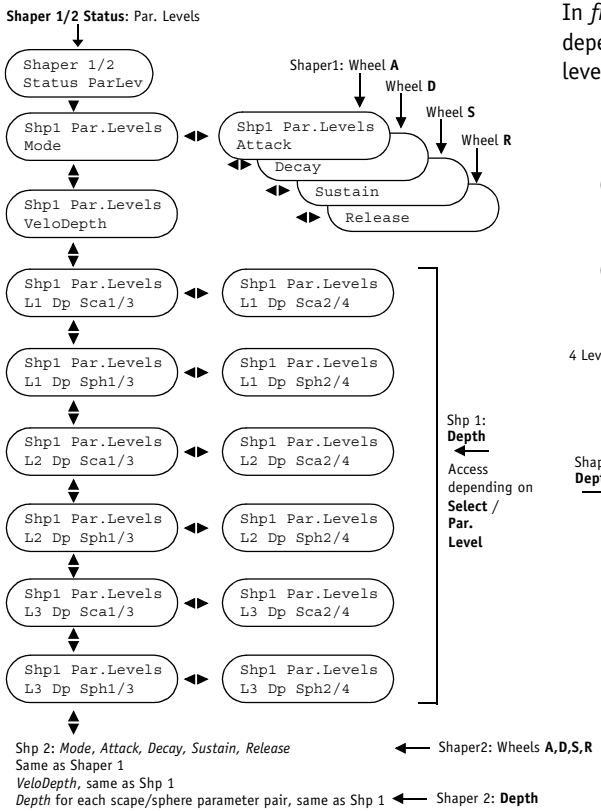
Good-to-know stuff: The **shaper 1/2 status** button does not activate or deactivate an envelope. It serves solely to select the envelope level (par. level, amplifier, free) addressed by the wheels or **depth** knobs. The *par. levels* envelope is activated via the resynator's **contour control** button, the *amplifier* envelope is always active and the *free* envelope is activated via the respective **depth** knob.

Table 10: Control features of Shaper 1/2 (cont.)

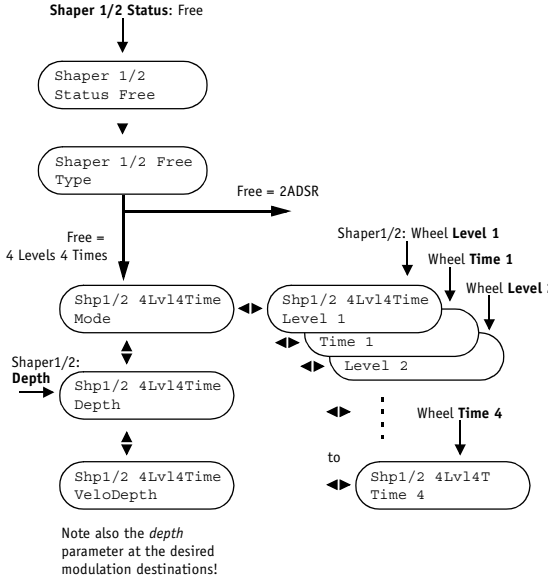
Shaper 1/2: Menu

The shaper menu's options vary in accordance with the selected shaper status (**shaper 1/2 status** button). The following illustrations depict the menus for every status. The parameters of these menus are summarized in table 11 on page 108.

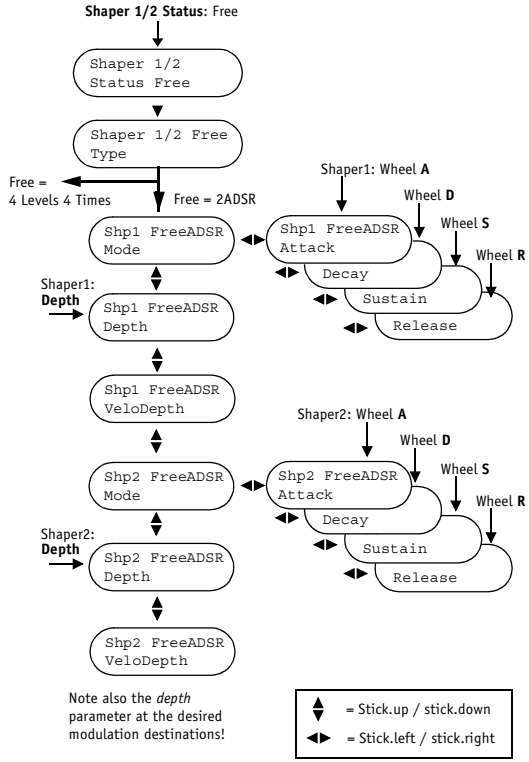




In *free* status, the menu offers different parameters depending on whether two ADSR envelopes or one 4 levels 4 times curve has been selected.



Note also the *depth* parameter at the desired modulation destinations!



Shaper 1/2: Parameters

The following table describes all shaper parameters regardless of shaper status.

A/D/S/R	The parameters of an ADSR envelope are described on page 99. The influence of the *sustain* level setting is - like the *depth* setting - relative to the defined target parameter value.
Depth	Defines the intensity of the envelope's effect on the parameter that you want to modulate. The greater the depth, the more intense the influence on the parameter. The **amplifier envelope** does not have a *depth* parameter. The amplifier ADSR envelope is always active.

...Continued on next page

Table 11: Shaper 1/2 parameters

	The **parameter envelope** (*par levels* shaper status) can be defined selectively for every *scape* and *sphere* parameter level. See also page 104. Value range: -64 to +63. *Depth* = 0: No modulation. *Depth* > 0: Modulation adds to target parameter values. *Depth* < 0: Modulation subtracts from target parameter values. *Depth* is variable for each shaper when you use two **free ADSR envelopes** (*free* > *2ADSR*). If you opt for one **4 levels 4 times** curve, there is of course just one *depth* parameter (adjustable via both **depth** knobs). **Good-to-know stuff**: The *depth* at the modulation destination is of relevance when using free envelopes! The two *depth* values are offset against each other. You will find further information about this topic on page 104. You can also control *depth* via velocity: see the following parameter *velo depth*.

Table 11: Shaper 1/2 parameters (cont.)

Velo Depth	The *depth* parameter (page 108) defines the intensity of the envelope's effect on other Neuron modules. The *velo depth* parameter lets you manipulate *depth* manually by varying key pressure. There you have it - a modulation of a modulation... Value range: -64 to +63. *VeloDepth* = 0: *Depth* is not modulated. *VeloDepth* >0: *Depth* increases in accordance with velocity (up to a max value of 127): current parameter value **+** *velo depth* **x** velocity value The harder you strike the keys, the greater the depth of the envelope. *VeloDepth* = 63: Maximum effect of velocity on the depth of the envelope. *VeloDepth* <0: *Depth* decreases inversely to velocity. The harder you strike the keys, the weaker the envelope's influence. A value of -64 denotes the maximum inverse effect of velocity on the depth of the envelope. This parameter is not available for the *amplifier* envelope because it does not have a *depth* parameter.

Table 11: Shaper 1/2 parameters (cont.)

Mode	Defines the envelope mode. The *mode* can be selected for every envelope type and in every status. • *Normal*: Playing a note triggers the envelope once only. • *Repeat*: Playing a note triggers the envelope. In the case of ADSR curves, a new cycle's attack phase is launched after the release phase ends. A 4L/4T curve goes from level 4 to level 1 within the time defined for time 4. For more on this, read page 103.
Level / time	The parameters of a 4 levels 4 times envelope are described on page 100.
Type	The *type* parameter is available only in *free* shaper status. It lets you select the desired type of free envelope: • *2ADSR*: An ADSR envelope is defined for each shaper, which can then be routed to different modulation destinations. For more on this, read page 104. • *4L4T*: The two shapers are combined to define a 4 levels 4 times envelope, which can also be assigned to different destinations. For detailed information on the 4L4T curve, check out page 100.

Table 11: Shaper 1/2 parameters (cont.)

Shaper 1/2: Handling

► **How to define an amplifier envelope**

- Press (repeatedly if necessary) the **status** shaper button so that the *amplifier* LED lights up. `Status Amp` appears in the main display.
- **Stick.down** the navigation stick to access the menu option *mode*, which lets you select the envelope mode.
- Adjust ADSR parameter values by turning the wheels. Once you move a wheel, you can also define the given value in the main display using the knob.
  Alternatively, you can navigate via **stick.right/ left** back and forth among individual envelope parameters.

► **How to define a parameter envelope**

- Activate the parameter envelope by pressing the **contour contr.** button (repeatedly if necessary) in the given resynator so that the *shaper* LED lights up.
- Press (repeatedly if necessary) the **status** shaper button until the *par. levels* LED lights up. `Status ParLevel` appears in the main display.

- **Stick.down** the navigation stick to access the menu option *mode*, which lets you select the envelope mode.
- Adjust ADSR parameter values by turning the wheels. Once you move a wheel, you can also define its assigned value in the main display using the knob. Alternatively, you can navigate via **stick.right/left** back and forth among individual envelope parameters.
- If you want to modulate all of the envelope's *depth* parameters via key pressure (velocity), define the *velo depth* parameter (see page 109).
- Now define the intensity of the envelope's effect on every resynator parameter level. To this end, first select the desired *scape* or *sphere* parameter level in the resynator module (using the **parameter level** and **select buttons**). Use the **depth** knob in the shaper to determine the depth for each parameter level.
  (Alternatively, you can enter these settings to the menu's *depth* options; see menu diagram.)

▶ **How to define a free ADSR envelope**

- Press (repeatedly if necessary) the **status** shaper button until the *free* LED lights up. `Status Free` appears in the main display.
- **Stick.down** the navigation stick to access the menu option *type*. Here you can choose between two free ADSR envelopes or one 4 levels 4 times envelope (see also page 100). Twist the knob to select `2ADSR`.
- Define the *mode*, the ADSR parameter values of the envelope as described for the amplifier envelope (page 110).
- If you want to modulate the *depth* of the envelope via velocity, define the parameter *velo depth* (see page 109).
- You are dealing with free envelopes, so you must determine the various modulation destinations.

  You can assign a module as the modulation destination by selecting the corresponding *depth* parameter in the menu of the desired module and defining a value other than zero for it (values range from -64 to +63).

Example: Say you want shaper 1's ADSR envelope to modulate resynator 1's pitch. Press the **menu** button in resynator 1 and use the navigation stick located next to the main display to scroll to the menu option `Pitch FreeEnv, ADSR 1 Depth`. Now adjust the modulation depth in the resynator using the knob located next to the main display.

The same applies to the destinations resynator 2 pitch and blender.

You will find further information on page 104.

► **How to define a free 4 levels 4 times envelope**

- Press (repeatedly if necessary) the **status** shaper button until the *free* LED lights up. `Status Free` appears in the main display.
- **Stick.down** the navigation stick to access the menu option *type*. Here you can choose between two free ADSR envelopes or one 4 levels 4 times envelope (see also page 100). Twist the knob to select `4Level4Time`.
- **Stick.down** the navigation stick to access the menu option *mode*, which lets you select the envelope mode.
- Turn the wheels to dial in four levels and four times. Once you move a wheel, you can also define its assigned value in the main display using the knob.
  Alternatively, you can navigate via **stick.right/left** back and forth among the parameters.
- Define the depth of the envelope by twisting one of the two **depth** knobs (or using the menu option *depth*).
- If you want to modulate the *depth* of the envelope via velocity, define the parameter *velo Depth* (see page 109).
- You are dealing with free envelopes, so you must determine the various modulation destinations.

  You can assign a module as the modulation destination by selecting the corresponding *depth* parameter in the menu of the desired module and defining a value > 0 for it (values range from 0 to 127).

Example: Say you want shaper 1's 4L4T envelope to modulate resynator 1's pitch. Press the **menu** button in resynator 1 and use the navigation stick located next to the main display to scroll to the menu option

`Pitch FreeEnv, 4L/4T Depth`.

Now adjust the modulation depth in the resynator using the knob located next to the main display.

The same applies to the destinations resynator 2 pitch, blender and slicer.

You will find further information on page 104.

Module: Mod

You will find a polyphonic, freely routable low frequency oscillator (LFO) in the mod module located to the left of resynator 1.

It generates a periodic, low-frequency oscillation that you can use as the modulation source for the following destinations: Volume, pitch and model parameters of both resynators, the *amount* of the blender module and the cutoff frequency of the filter currently selected in the silver module.

If you cannot quite recall the meaning of some of these terms, up next is ...

... a primer on LFO basics

The output signal of an LFO (low frequency oscillator) is not audible as such. Instead, this slowly oscillating signal - whose frequency and waveform you can define - is used to shape an audible audio signal. This process is called modulation. The signal can be influenced in various ways depending on the defined modulation destination:

In an **amplitude modulation**, the mod signal shapes the amplitude, which is the volume of the audio signal. The volume envelope of the played note(s) is determined by the mod oscillation. A slow mod oscillation generates a tremolo effect. Can you see the similarity to the shaper and the ADSR envelope? You are right, they are similar but unlike the one-off effect of a *Normal* mode ADSR envelope modulating a sound (see page 101) the mod module's effect is periodic, continuing for as long as the note is played.

In Neuron, you can generate amplitude modulation by routing mod to the resynators' volume.

In addition to amplitude, you can also modulate the frequency of the audio signal. **Frequency modulation** changes pitch rather than varying volume. When this is done slowly by way of a low-frequency modulating oscillation, the result is the ever-popular vibrato effect. Again, there is some similarity to the shaper: In *Normal* mode, the shaper imitates the initial transient response reminiscent of the gradually swelling tone of a wind instrument. However, ultimately it does not generate vibrato because this requires a periodic modulation.

In order to create frequency modulation in Neuron, route mod to the resynators' pitch.

To simplify matters, we will call your third option **sound modulation**. Mod changes (simultaneously if desired):

- the values of model cross-x parameters at any of both resynators' *scape* and *sphere* levels. Every modulated parameter's value changes in accordance with the *LFO depth* (values of 0 to 127) setting in the mod menu **and** the *LFO depth* defined at the modulation destination (-64 to +63), following the LFO oscillation curve. This value can be positive or negative depending on the *depth* setting. What does this sound like? Hear for yourself ...
- the cutoff frequency of a filter setting defined in the silver. The filter sweeps through a certain frequency range depending on the mod signal. So, the sound is shaped on the fly. (For the record, modulating the amplitude of individual overtones creates this effect). The most common example of this type of effect is a wah-wah.
- The blender *amount*. The weighting factor shifts between the resynators, which creates completely different tonal results depending on the selected blender type.

The LFO oscillation's waveform has a significant influence on the modulation effect. You can define it in the mod menu, alongside the depth (intensity) and the frequency of the oscillation generated by mod.

Mod works with voices rather than sounds, meaning that every played note is modulated specifically by the mod-generated LFO oscillation.

Mod: Routing

The routing of a modulation to the desired destinations is determined by the modulation destination's *LFO depth* parameter rather than at the modulation source (in the mod menu). For example, in order to modulate the pitch of resynator 1 via an LFO oscillation, set the pitch parameter *LFO depth* in the resynator menu to the desired value. A setting of *depth* = 0 at a modulation destination of course means "no modulation".

Do not confuse the *LFO depth* parameter at the given modulation destination with the *LFO depth* adjusted in mod (via the **amount** knob). To distinguish between the two, we call the mod module's LFO parameter discussed in the descriptions of the modulated target parameters *global LFO depth*.

Potential modulation destinations for the LFO:

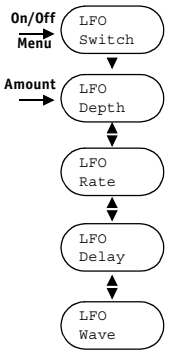
- Resynators: pitch, volume and all cross-x parameter pairs of every *scape* and *sphere* parameter level (described in table starting on page 77).
- Blender: amount (see page 95).
- Silver: cutoff frequency of the current filter. (*LFO depth* parameter, see page 138).

Mod: Menu

After you have pressed **on/off**, the mod menu appears in the main display.

Twist the **amount** knob to access the menu option `depth`.

Scroll with the navigation stick and choose the parameter setting using the knob.



Mod: Control features

On/Off button	Switches the modulator on/off.
Amount knob	Controls the LFO parameter *depth*, that is, the amplitude of the LFO oscillation (see below).

Table 12: Mod control features

Mod: Parameters

Depth	Amplitude of the LFO oscillation. The higher the amplitude, the more pronounced the modulation effect. You can also set the *depth* directly using the **amount** knob. Value range: 0 to 127. **Heads up:** In this context, be sure to keep in mind the parameter *LFO depth* at the respective modulation destination: The "*global*" *LFO depth* defined here in the mod module is offset against the *LFO depth* setting at the modulation destination.
Rate	Frequency of the LFO oscillation. Value range: 0.0 to 20.0 Hz in 0.02 Hz steps.

Table 13: Mod parameters

Delay	Delay time that allows the modulation effect to fade in and out softly. Because mod works with voices, delay is applied to every note you play by pressing a key. Value ranges from -64 to +63. *Delay* = 0: The LFO oscillation attains its peak amplitude in the first period and continues to oscillate at this amplitude. This means that the modulation effect is present from the start and retains this intensity. *Delay* = +63: The amplitude rises slowly with each oscillation. The modulation effect gradually grows stronger until it reaches full intensity at peak amplitude (contingent upon *depth*). *Delay* = -64: The LFO oscillates at peak amplitude right away, meaning that the modulation effect is present from the start. The amplitude decreases over time until the modulation effect is no longer audible.
Wave	Waveform of the modulating oscillation. All waveforms are pictured on page 118.

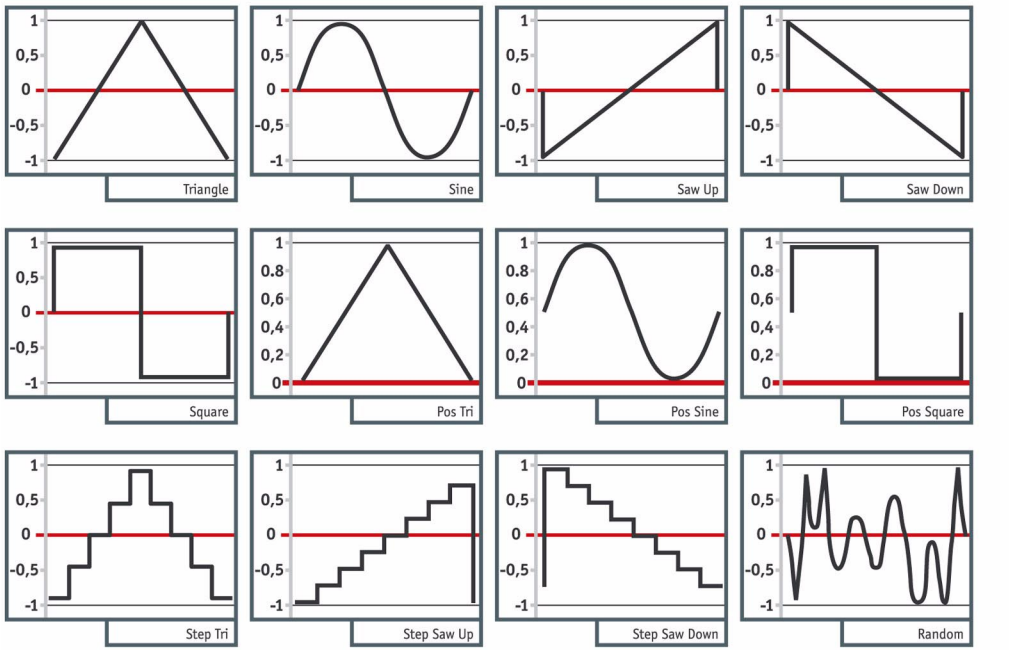
Table 13: Mod parameters (cont.)

Mod: Handling

- Switch on the LFO generator mod (**on/off** button). `LFO Switch On` appears in the main display.
- Route the LFO oscillation to the desired modulation destinations by setting a value other than zero for the *LFO depth* parameter at every desired modulation destination. All potential modulation destinations are listed on page 115. If you determine the routing before defining the LFO parameters *wave*, *rate*, and *depth*, you will be able to hear every change made to the LFO oscillation and its influence on the modulation effect in real-time (provided that the *depth* setting in the mod menu is > 0).
- Select a waveform in the mod menu and define the amplitude (*depth*) and frequency (*rate*) of the LFO oscillation.
- Define an LFO *delay* if you want to shape the oscillation on the fly so that the modulation effect grows stronger or weaker while a note is held.

Mod: Waves - Available LFO waveforms

The **wave** menu option in the mod menu lets you select from the following waveforms:



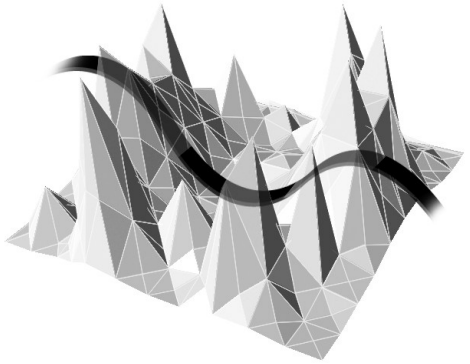
Module: Slicer

... the "cutting machine". If you surmised that slicer is a simple low frequency oscillator (LFO), you would not be far off the mark. And like an LFO, the slicer module generates cyclical, oscillating signals. These low-frequency signals are used to animate sounds.

However, slicer's performance power far exceeds the possibilities of conventional LFOs. We distinguish between two slicer modes:

Slicer in vertical mode

Vertical mode adds an oscillation to the sound; its frequency is adjusted using the **rate** knob and amplitude using the **depth** knob. We call this mode "vertical" because resynators 1's and 2's output signals are modulated via cyclical oscillations as illustrated in the following picture:

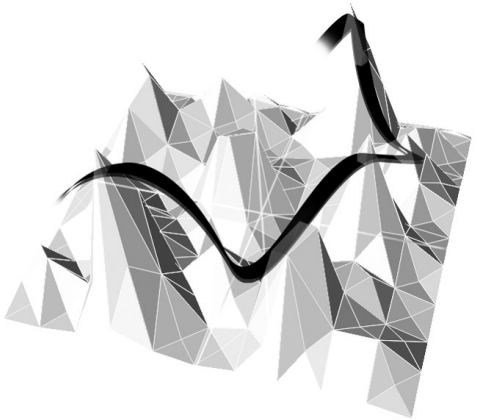


Slicer in vertical mode

Analogy time again: Imagine, as we do, the resynators' output to be a three-dimensional sonic cloud (similar to the image of a spectral model gained in a Fourier analysis). Slicer is an animating force: it generates down/updrafts (by way of the selected oscillation) that change the altitude of this cloud. Alongside frequency and amplitude, you can also select the basic oscillation's waveform using the *wave* parameter in the slicer menu.

Slicer in 3D mode

3D mode is also related to the sonic scenario discussed above. However, in this case the cyclical oscillation is not strictly vertical. Instead, it sweeps the cloud crossways through the soundscape. Words fail; the auditory result is impossible to describe. Fortunately, you have Neuron right there in front of you so you can easily try out this effect. In addition to modulating the sound, this effect animates the stereo image, or, if you are playing the instrument in surround mode, the 5.1 soundscape. *Rate* controls the rate of the effect and *spread* defines the range of the modulation within the soundscape as illustrated in the picture on the right.



Slicer in 3D mode

A brief excursion on the subject of LFOs

Most contemporary synthesizers are equipped with several LFOs that serve as modulation sources and can be routed to the most diverse destinations within the instrument. The drawback is that patching connections between lots of different modules to animate a sound is a time-consuming task requiring lots of brainwork.

Let's be honest: Apologies to the sound designers of this world, but how many people actually create entirely new, extremely complex sounds on the synthesizers available to date by spending hours connecting modules, dialing in values, and tweaking parameters? We hold that the majority of users of synthetic sound generators restrict their efforts to primary functions like determining filter cutoff and resonance, selecting a basic waveform or sample, defining the octave register, and the basics of shaping envelopes and their depth.

This is a pity because contemporary synthesizers particular offer tremendous sound-sculpting possibilities. Even more the pity that their design is an ergonomic nightmare: They're too unwieldy and their sound-shaping options are so intricately linked that it takes a degree in rocket science to understand them.

Here too, Neuron blazes a new trail. The awesome powers of neural synthesis make it possible to explore uncharted sonic frontiers. Right there in the heart of the synthesis engine are sophisticated sounds with a range of tonal properties that can be manipulated directly and immediately. Extremely powerful yet easy to handle, slicer has the tools it takes to enrich and refine this source material.

In combination with the two resynators and the blender, slicer makes complex internal "networking" of modules superfluous. Some old school hardliners actually enjoy connecting modules, so Neuron also offers a modulation matrix with many variable connection options!

Slicer: Control features

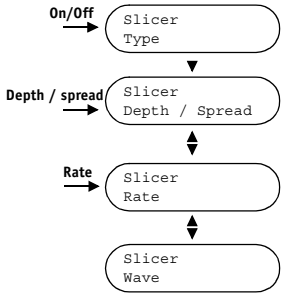
Button **On/Off**	On/off switch and selector button for slicer mode. Select the mode pressing it several times. Slicer is deactivated if both LEDs are extinguished.
Depth / Spread	Adjusts the intensity of slicer's effect on the resynators' output signal in *vertical* mode. In *3D* mode, the *spread* parameter controls the spread of the effect in the "three-dimensional" soundscape.
Rate	Adjusts the frequency of the slicer oscillation. Value range: 0.0 to 20.0 Hz in 0.1 Hz steps.

Table 14: Control features of the slicer

Slicer: Menu

You can access the slicer menu at three points via the control features indicated in the illustration.

Select the slicer type by pressing the **on/off** button repeatedly.



Slicer: Parameters

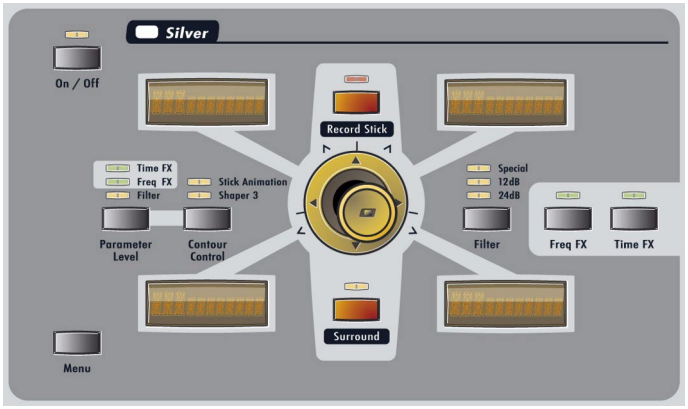
Depth / Spread	In *vertical* mode: *Depth* = intensity of the Slicer's effect on the resynators' output signal. In *3D* Mode: *Spread* = spread of the effect in the 3D soundscape. Value range: 0 to 127.
Rate	Frequency of the slicer oscillation. Value range: 0.0 to 20.0 Hz (in 0.1 Hz steps).
Wave	Waveform of the modulating oscillation. Slicer offers the same waveforms as the mod LFO generator. You will find a list of all available LFO waveforms on page 118.

Table 15: Slicer parameters

Module: Silver

As its name would suggest, Silver lets you put a lustrous shine on sounds. In addition to a high-quality multi-mode filter, it offers two multi-effect processors.

Like the resynators, it can be controlled via stick or silver menu. The stick lets you do things like edit filter cutoff frequency and resonance simultaneously and at the same operating level. You can manipulate the two most important parameters of the selected frequency- or time-based effect using the same method.



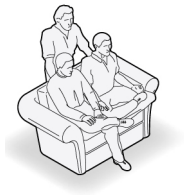
Thus the silver stick allows you to manipulate up to three two-way parameter sets within the filters and frequency- and time-based effects that you have at your disposal.

Surround mode

Neuron is the first and only synthesizer designed from the bottom up for surround mode (5.1) applications. Handling is easy – simply move the silver unit's stick.

A setup contains up to four sounds, and you can pan the sounds in a setup independently and to any position in the surround field. Beyond that, you can record stick movements, creating three-dimensional sweeps, and store these modulations as a component of a sound within a setup.

For more details on surround mode, go to page 169.



Filter basics

Geared toward synthesizer newbies, the following section offers introductory explanations on the basics of filtering. Seasoned keyboardists and sound designers may prefer to continue reading on page 127.

Filters alter sounds by cutting (also called dampening and attenuating) certain ranges of their frequency spectrum. A filter enables infinite variations on the same sound material – anything from subtle changes to total metamorphosis.

Musicians distinguish between two filter types, both of which are found in Neuron. One is called a shelving filter. This type of filter kicks in at a specific frequency and achieves maximum effect at the edge of the audible range. **High-pass** and **low-pass** filters are shelving filters. The other basic filter type is called a peaking filter. The shape of its curve inspired the name. Peaking filters address the frequencies surrounding a specific frequency - as **band-pass filters** and band-stop filters are wont to do.

Neuron currently offers four shelving filters and one peaking filter, which are described in detail on page 125. Further filter types are in the works!

Filter parameters

Every filter, regardless of type, is defined by three parameters. The **cutoff frequency** is the frequency at which the filter starts working. Frequencies are dampened or cut above or below the cutoff frequency depending on the filter type (high-, low- or band-pass page 125). In Neuron, you can vary the cutoff frequency in real-time by moving the stick controller in silver or modulating it via a filter envelope, LFO oscillation or velocity. The cutoff frequency sweeps through a specific frequency range, which is why this process is called a **filter sweep**.

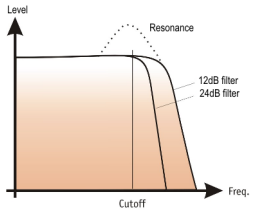
- **Resonance**: One property of filters is that they boost the frequencies in the immediate vicinity of the cutoff frequency. The higher the resonance, the more the frequencies surrounding the cutoff frequency (or the center frequency in the case of band-pass filters) are boosted in relation to other frequencies. This makes the filter's characteristic effect more prominent than at low resonance values.

  If the resonance of a filter is very high, the filter begins oscillating on its own (that is without an input signal) at the cutoff frequency.

The waveform generated at the cutoff frequency is a sine wave, which is excellent for programming lead and electronic drum sounds. This is called self-oscillation.

- **Quality**: Quality has a formative impact on the sound-shaping action of the filter: This parameter determines to which extent frequencies are dampened at a specific distance from the cutoff frequency. In other words, it defines the cutoff steepness or slope of the filter curve. The higher the quality, the greater the filter's effect on the sound. This value is indicated in dB per octave.
  Let us look at an example: Say we have a filter with a quality of 12 dB and a cutoff frequency of 500 Hz. An octave above the cutoff frequency - that is, at 1,000 Hz - the filter dampens by 12 dB and at 2000 Hz by as much as 24 dB.

Low-pass filter

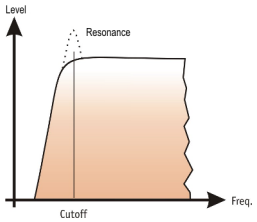


A low-pass filter allows only frequencies below the cutoff frequency to pass. Higher frequencies - that is, the upper-range frequencies responsible for brightness - are cut from the soundscape. The result is a softer sound. Think of the low-pass as the David Hamilton of filters...

Though cutting high frequencies from the spectrum of a sound does not boost low frequencies, it does increase the relative percentage of low frequencies. When a low-pass filter filters a signal, we perceive the sound to be warmer and fuller.

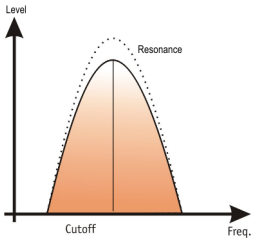
Neuron offers three (count 'em!) low-pass filters: The most commonly used low-pass filters with 12 dB and 24 dB dampening are accessed directly via the silver button labeled **filter**. The *special* LED has multiple assignments so that you can step through all filters by pressing the **filter** button repeatedly and find the remaining 6 dB filter (this filter can also be selected in the menu).

High-pass filter



For the record, the high-pass filter is the inverted twin of the low-pass filter. It allows frequencies above the cutoff frequency to pass. Cutting low frequencies makes the signal sound brighter and thinner - our ear perceives it to be more strident, with greater presence. Neuron features a high-pass filter with a quality of 6 dB. You will find it in the *type* filter menu when the filter option *special* is active. (You can also step through all special filters using the **filter** button.)

Band-pass



A band-pass filter's characteristic curve resembles the shape of a bell. Its working frequency is a center band, meaning that it allows frequencies in a narrow range below and above this frequency to pass, cutting all others outside this frequency band. Though a band-pass filter actually works with a center frequency rather than a cutoff frequency, the term "cutoff" is common usage.

The filtering action of a band-pass with a very high quality - that is, an extremely steep slope - works on specified narrow frequency bands. Just a very narrow spectrum is allowed to pass, and setting a high resonance parameter can boost it. A band-pass's sound-shaping properties are much like that of an acoustic instrument's body (or housing). Typically, the housing emphasizes specific frequencies regardless of the pitch of the played note. This property is decisive in determining the tone of an acoustic instrument. These environmental resonances are called "formants" because they form the characteristic sound of the instrument. A band-pass filter with high quality and high resonance is called a formant filter. It is an outstanding tool for emulating acoustic instruments (for example, strings) and the human voice.

Dynamic filtering via envelope, stick, LFO and velocity

The filters in Neuron are - how could it be otherwise - dynamic. After all, our express goal was to make editing sounds as easy and effective as possible. A filter earns the descriptive modifier "dynamic" if its parameters can steadily accept new values and this modulation of values can also be automated. Neuron offers several dynamic filtering options:

- Cutoff frequency and resonance can be modified in real-time using the stick. You can also use key tracking to sync up the intensity of frequency modulation to different keyboard zones and thus different pitches.
- The movement of the stick can be recorded and used to modulate filter parameters during a performance either in *1shot* or in *repeat* mode (see page 148).
- Shaper 3 lets you define an ADSR envelope. This filter envelope controls the filter's cutoff frequency, creating a time-based filter sweep. For more on this, read page 153.
- You can use the LFO oscillation generated in mod to modulate the filter, which also creates a time-based filter sweep (For more on this, read page 115).
- You can modulate the filter's cutoff frequency via your attack dynamics. Velocity depth is determined via the *velo depth* parameter (see page 139).

Frequency-based effects (Freq FX)

In addition to the filter unit, silver offers a multi-effector for generating frequency-based effects called freq FX for short.

Effects are activated via silver's **freq FX** button. You can edit the selected effect's two most important parameters using the stick controller. To this end, silver's **parameter level** must be set to *freq FX*!

You will find the parameters of freq FX listed in table 18 on page 139.

The following effects are available for each sound:

EQComp

This dual-purpose effect consists of a parametric equalizer and a compressor.

The equalizer: Equalization is the process of selectively boosting or cutting specific frequency ranges. The term has its roots in the effect's initial purpose, which was to achieve linear frequency response (for example, to restore upper range frequencies that are lost when an analog signal is routed through a long cord) rather than color a sound. Today the equalizer ranks among the most important tools for shaping sound and compensating for environmental conditions.
A parametric EQ lets you zero in on specific frequency bands individually by defining the cutoff or center frequency, slope or bandwidth (Q) and gain for each band and filter.

To this end, Neuron offers two shelving filters (*low shelf* and *high shelf*) as well as two peaking filters (*B1* and *B2*). The individual frequency bands can overlap. *Gain* determines the amount of amplification, letting you compensate for volume changes resulting from your sound-shaping efforts.

The compressor: It condenses the dynamic range of an audio signal by cutting high signal levels and boosting low signal levels. You can define the level at which the compressor kicks in via the *threshold* parameter. The response time of a compressor is crucial. When the input level exceeds the *threshold*, a certain amount of attack time elapses before the signal arrives at the output. The same principle applies to release time after the compressor no longer receives an input signal. Neuron offers a parameter called *responsiveness*; it controls response as a function of a combination of program-driven attack and release time.

Distortion

The input signal is boosted to a level exceeding the clip threshold, which generates distortion.

Neuron's distortion effect is based on the principle of soft clipping, a kind of overdrive for the faint-hearted. Instead of cutting all the peaks of the distorted signal beyond the clip point hard and at the same level, it backs these levels off gently. The higher the input level (and the greater the amount of distortion), the more radically the oscillation's peaks are cut. Taken to extremes, this transforms an incoming sine wave oscillation into a square wave.

Located in front of the distortion-generating clipper in the signal chain is a low-pass filter with a user-definable cutoff frequency.

This effect boosts the incoming level. You can adjust the wet outgoing level separately to compensate for this.

The effect adds additional overtones to the input signal.

Ring modulator

This type of modulation is excellent for generating bell-like and noisy sounds as well as for mangling sounds with ruthless efficiency. It can also generate subtle effects like tremolo as soft as the beating of butterfly wings.

In ring modulation, the audio signal is "multiplied" by a carrier wave (whose frequency can be defined via the *mod freq* parameter). If you patch in an input signal that is a single, pure sine-wave oscillation, the frequency spectrum at the modulator's output would be composed of the difference between the original signal and the carrier as well as the sum of the two (the mirror image of the difference, so to speak).
Example: Say we are dealing with a 300-Hz carrier frequency and a 100-Hz audio signal. The ring modulation generates a non-sine signal containing the two frequencies 200 Hz and 400 Hz.

The higher the carrier frequency, the greater the spread between output frequencies and the further apart the outgoing notes will be.

The incoming audio signal (in our example, the 100-Hz sine wave) is lost in the modulation, but you can dial it back in at the effect's output via the mix knob.

But a sound consists of an entire frequency spectrum rather than a single oscillation, so in the real world ring modulation generates two frequency bands called sidebands rather than the sum and difference frequencies. The lower sideband contains all the difference frequencies described above, the upper band contains the sum frequencies. Sidebands can be added to the original signal in any desired mix. This adds largely non-harmonic overtones to the initial sound, which depending on effect intensity, can sound like anything from very weird to very dissonant.

Sound like fun? Certainly, but not half as much fun as with a variable rather than a fixed carrier frequency, which is why the effect offers an LFO designed to animate the soundscape. The low-frequency LFO oscillation (variable via the *speed* and *depth* parameters) modulates the ring modulator's carrier frequency as a function of time.

Note that this shifts the sideband frequencies contingent upon the LFO oscillation. Your best bet is to simply try it out!!!

Decimator

Decimator does what its name would indicate - it decimates the sampling rate. The higher the sampling rate at which a sound was digitized, the richer it is in signal quality but the „poorer“ in character. Also called down sampling, this sampling rate **reduction** degrades the signal to create a grainier, rawer sound.

The sample & hold section of this effect samples a value from the signal and routes it to the output for the amount of time defined by the *S&H factor* parameter, after which a new sample is taken.

A low-pass filter guards the effect's input. It prevents undesirable distortion generated by the S&H circuit's sampling activities. Called aliasing, this distortion is attributable to input signals containing frequencies equal to or greater than half the sampling rate. You can also influence the aforementioned rawness of the signal by changing the cutoff frequency of this input low-pass filter in relation to the sampling rate.

Sp_warp

Sp_warp is an extremely sophisticated stereo modulation effect. It is perfect for generating or refining atmospheric sounds. If you lay this effect over strings or pads, a dense ambient cloud that lends the sound a distinctive “spacey" sci-fi vibe surrounds them. If you use very direct sound material like voices or drum / percussion sounds, SP warp generates interesting but very strange counterpoint melodies. A percussive sound enriched with SP warp makes for a great effect sound for soundtracks or experimental music.

Time-based effects (time FX)

Alongside frequency-modulating effects, Neuron features another effect processor offering various time-based effects (time FX). This effects group is equipped with a dedicated on/off switch: the **time FX** button.

Like for freq FXs, the two most important effect parameters are variable via stick, if you set the parameter level to *time FX*.

Time FX parameters are explained on page 142.

Stereo spread

This effect delays one of the two stereo channels to create a wider stereo image.

LR delay

Delay is a variable time-based parameter used to start an event, in this case a signal, only after a predetermined amount of time. You can vary delay time within the defined limits. Delayed signals are routed back into the effect's input. This is called a feedback circuit or loop. The signal is then routed back to the output with a variable number of repetitions or echoes contingent upon the amount of feedback signal (as determined by the *feedback* parameter).

Phaser

A phaser colors the sound of a signal and modulates it periodically.

Here is a somewhat simplified explanation: The incoming audio signal is doubled and one signal is put out of phase using special filters. Then the out-of-phase signal is delayed ever so slightly and added back to the original signal via a feedback loop. Superimposing one signal over the other generates frequency cancellations. In other words, certain frequencies are wiped out of the sound, which is clearly audible.

The filter frequency determines which frequencies are cancelled out. This special filter causes phase shifting, so if you change its center frequency, the effect changes and you will hear other frequencies being cancelled out.

This is where the aforementioned periodic modulation comes into play: If you modulate the filter's center frequency via an LFO, the phase shifting and frequency cancellation driven by the LFO oscillation changes periodically. The LFO's frequency, amplitude and waveform are variable, creating different filter frequency modulations and thus very different sonic results.

Flanger

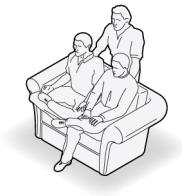
Though flanging is also delay-based, unlike the phaser, it manages without phase shifting. Incidentally, do not confuse this with Neuron's *stereo phase* parameter used to spread the signal in the flanger, phaser and chorus! But back to the issue at hand: The incoming audio signal is delayed in the flanger regardless of its pitch. The delay time remains constant and the wet signal is mixed to the original dry signal at the effect's input via a feedback loop.

Even if you listen very closely to a flanged sound, you will not hear any echoes despite the delay. This is explained by a very short delay time, which usually ranges somewhere around 10 ms. The human ear is said to begin perceiving echoes at delay times of around 70 ms but certainly no lower than that.

So instead of the echoes you might expect to hear when the original and delayed signals are mixed, you get destructive interference causing frequency cancellations and changes in the amplitude of uncancelled frequencies. The greater the flanger's depth (*mix* parameter), the more distinct the cancellations, that is, the more dramatic the changes in the frequency spectrum of the wet signal.

The trademark dynamic flanger sound is produced when delay time is modulated by an LFO oscillation rather than remaining constant. Then the frequency cancellations sweep across the frequency spectrum as determined by the LFO oscillation.

The timbre of this flanged composite signal is colored, resulting in anything from majestic-sounding sweeps to nausea-inducing detuning.



Rumor has is that the flanger was discovered accidentally by the Beatles, no less. The scene of the crime was a studio, the means a tape machine and the motive to create delay. Supposedly, one of the mop-tops inadvertently knocked one of the tape reels, changing the pitch of the delayed signal. Legend has it that the boys fiddled with the reels until they could replicate this random effect and laid it over a few tracks here and there. Thus the typical flanger sound was born. The projecting rim of the tape reel is called a "flange", which gave the newly born effect a name.

Chorus

Imagine two identical instruments playing in unison, but the groove is not quite in the pocket. The timing varies somewhat so that the two instruments are ever so slightly out of tune. This is the effect simulated by the chorus.

Chorus duplicates the input signal (*two instruments* ...), delays it a few milliseconds (...*that are not quite in sync* ...), varies the pitch slightly (... *and minimally detuned*) and adds it back to the original signal at its output.

The chorus section is equipped with an LFO (low frequency oscillator). Its oscillation modulates the input signal according to its frequency, amplitude and waveform. This means that dialing in a chorus effect is tantamount to defining the LFO's waveform.

Mixing the original and duplicate signal creates regularly recurring fluctuations called beats. They make the signal sound bigger or fatter - or like the two instruments in the example above.

Feedback is not essential. However, it can add lovely looped echoes to the signal. The delay line is integrated into the effect, so the choice is all yours.

Silver: Control features

On/Off button	Silver on/off switch. When silver is switched off, all effects including the filter unit are bypassed.
Stick	You read earlier that intuitive handling and fast results were our top priority in designing the resynators. The same can be said of silver. The two most important parameters of the selected silver effects can also be controlled via the stick. For the filters, these are the cutoff and resonance frequencies. You will find more on this in the parameter tables. The **parameter level** button determines which settings (filter, freq FX or time FX parameters) are assigned to the stick. **Tip**: As you manipulate the stick to get a coarse parameter setting, the main display shows the current parameter. Twist the knob to fine-tune the setting.
Displays	The displays surrounding the stick indicate the currently selected parameters and their values. If an effect category is switched off (**freq FX** or **time FX** button), all four displays read `Off`.

Table 16: Silver control features

Menu button	If you are working outside the silver menu, you can access the most recently edited silver menu option by pressing this button. If you press the button while in the silver menu, it jumps to the menu option `filter type`. You will find a description of the menu on page 136.
Parameter Level button	This button determines which parameters are assigned to the stick. Example: If *filter* is the defined parameter level, you can move the stick to edit the selected filter's two most important parameters, which are cutoff frequency and resonance. The button does not activate or deactivate an effect category. Its purpose is to let you edit parameters using the sticks. Once you have defined the values for one category and change over to another category, Neuron remembers the settings. You do not have to store them!

Table 16: Silver control features (cont.)

Record stick button	Stick controller movements can be recorded and stored. By activating stick animation, you can play the recorded movement back (see the next line in the table). Like in the resynators, this creates very lively modulations. To learn how to record stick controller movements, read page 148. Note that in **surround mode**, you will record stick movements controlling the surround channel positions rather than the silver effects!

Table 16: Silver control features (cont.)

Contour control button	The **filter unit** of the silver can be modulated either by an ADSR envelope defined in shaper 3 (filter envelope, not available for freq FX/time FX) or by a previously recorded movement of the stick controller (also available for freq FX/time FX). By pressing this button several times, you can select between: • Off (no LED lights up): Neither an envelope nor a stick recording manipulates the filter or freq FX/timeFX. • Shaper 3: The ADSR envelope in the selected shaper is assigned to the current filter type. Note that the *Silver* LED in the shaper must light up before you can define the envelope. To learn how to define the envelope and adjust the intensity of its effect via the **depth** knob, read page 153. • Stick animation: The stick movement previously recorded via **record stick** (see the previous line in the table) is played back in *1shot* or *repeat* mode, depending on the *stick animation* setting in the silver menu (see page 148).

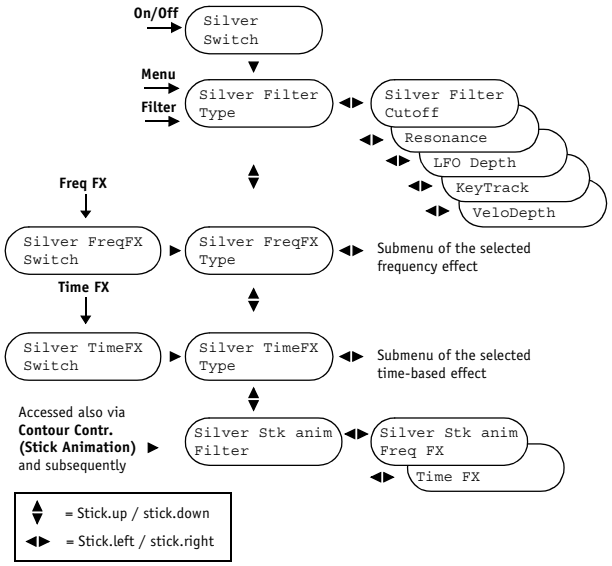
Table 16: Silver control features (cont.)

Filter button	Defines the filter type (press repeatedly). • *12db*: 12 dB low-pass filter • *24dB*: 24 dB low-pass filter. • *Special*: 6 dB low-pass or 6 dB high-pass or band-pass filter (adjustable via menu or by stepping through the special filter). The *special* LED indicates all three settings.
Freq FX button	Switches the frequency effects processor off/on. Select the desired effect in the silver menu (page 136).
Time FX button	Switches the time effects processor off/on. Select the desired effect in the silver menu (page 137).
Surround button	Strictly speaking, surround mode is not a feature of the silver module. However, because the stick controller determines the position of the individual surround channels in the soundscape (the silver stick is a dual-purpose tool) the surround button is located near the stick. Beyond that, surround mode also adds a lustrous sheen to your sonic creations, so it is in a sense a sidekick of the silver... To learn more about this, read the section "Surround mode" starting on page 169.

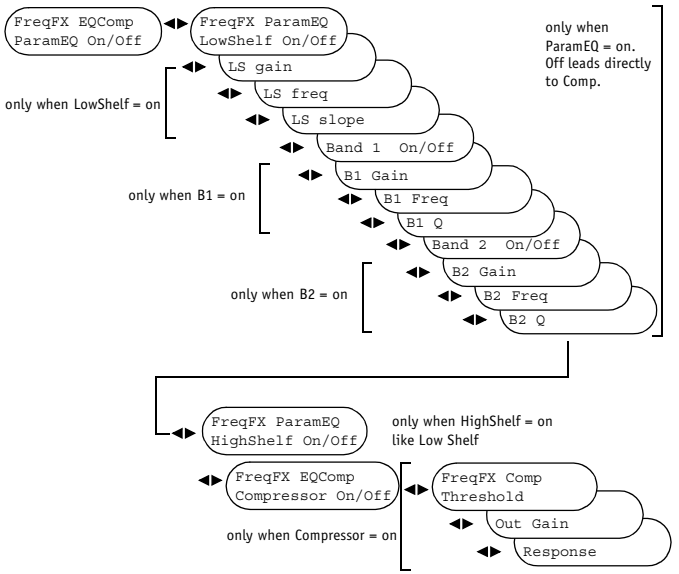
Table 16: Silver control features (cont.)

Silver: Menus

The silver menu is divided into three diagrams. The first diagram depicts the main branch in which you can select the desired filter type and set up one frequency and time-based effect each. You will find the effects submenus in the following two diagrams.

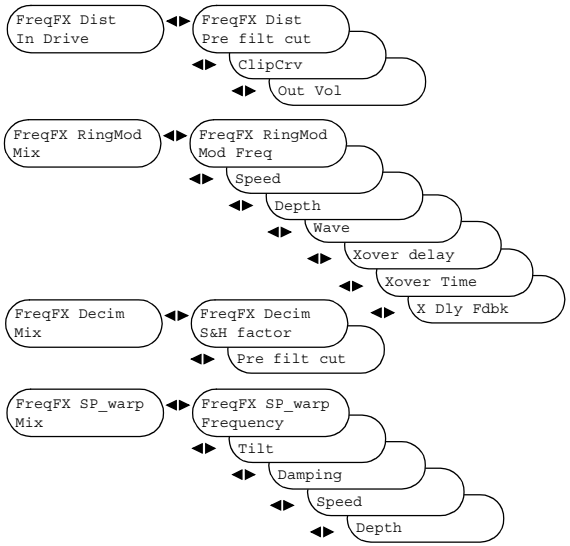


Submenus of the individual frequency effects:

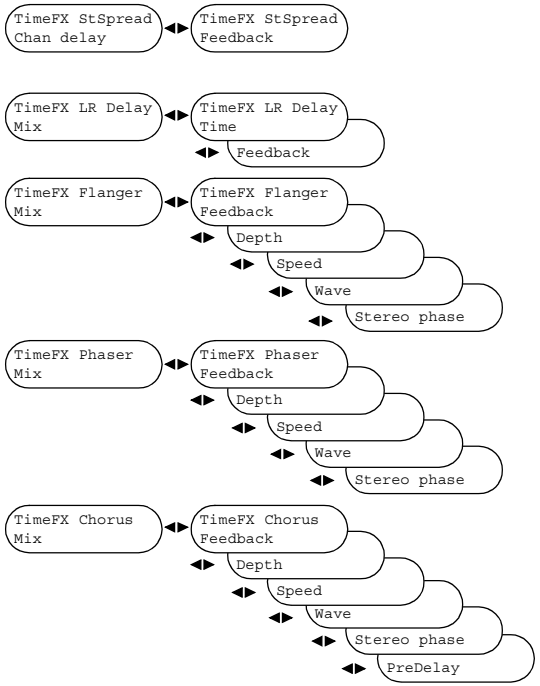


Continued on next page ...

Continued from previous page Frequency effects...



Submenus of time-based effects:



Silver: Parameters

In the following tables, parameters are described separately according to effect category (filter, freq FX and time FX).

The stick icon indicates parameters that can be adjusted using the silver stick (provided that the given level has been selected via **parameter level**).

Filter parameters

Type	Defines the type of filter. Your options are three low-pass filters (24 dB, 12 dB, 6 dB), a 6 dB high-pass filter and a band-pass filter. Filter types are described in the section starting on page 125.
Cutoff	Cutoff frequency of the selected filter. For more on this, read page 124. Value range: 0 to 127 (covers the entire frequency range).
Resonance	Resonance of the selected filter. Value range: 0 to 127.

Table 17: Silver: Filter parameters

LFO Depth	Determines the modulation depth of the mod-generated LFO oscillation and thus the intensity of its effect on the selected filter's cutoff frequency. Value range: -64 to +63. *Depth* = 0: No frequency modulation. *Depth* > 0: Starting at the current level, the frequency increases in accordance with the LFO oscillation (up to a max value of 127). *Depth* < 0: The frequency decreases in accordance with the LFO oscillation. Note in this context the *global LFO depth*, which is defined directly in the mod module (page 116). Global *LFO depth* is offset against this modulation destination's *depth*.
Key track	Also called key follow, key track is a form of keyboard control data. When key tracking is activated, the keyboard serves as a modulation source, generating key track values in accordance with the position or pitch of the notes played on the keyboard. In this context, the parameter determines the effect of the selected filter for the various keyboard zones. Good-to-know background stuff: Many acoustic instruments sound brighter as pitch rises. ...Continued on next page

Table 17: Silver: Filter parameters (cont.)

	Neuron can imitate this phenomenon if filter parameter weighting is modulated by key tracking values: Value range: -64 to +63. *Key Track* = 0: No weighting, meaning that the cutoff frequency is not shifted. *Key Track* > 0: The cutoff frequency increases for notes above the center key (C3). The frequency decreases for notes below C3. *Key Track* < 0: The cutoff frequency decreases for notes above the center key (C3). The frequency increases for notes below C3. See also the illustration on page 85
VeloDepth	Determines velocity modulation depth and thus the intensity of its effect on the selected filter's cutoff frequency. Value range: -64 to +63 *VeloDepth* = 0: No frequency modulation. *VeloDepth* > 0: Starting at the current level, the frequency increases in accordance with velocity (up to a max value of 127): current frequency **+** *velo depth* **x** velocity value *VeloDepth* < 0: The frequency decreases in accordance with velocity.

Table 17: Silver: Filter parameters (cont.)

Freq FX parameters

Type	Defines the effect type. Your options are EQcomp, distortion, ring modulator, decimator and Sp_warp. Effects are described in the section starting on page 127.
LowShelf (EQ Comp)	The parameters are only visible when *ParamEQ* = on and *LowShelf* = on. Frequencies below the *LS freq* setting are boosted or cut in accordance with the *LS gain* setting. *LS slope* defines the steepness of the shelf's slope. Value ranges: *LS Gain*: -24 to +24 dB (0.5 dB steps) *LS Freq*: 13 Hz to 20.2 kHz in semitone steps *LS Slope*: 0.1 to 10 in 0.1 steps

Table 18: Silver: Freq FX parameters

B1 Gain
B1 Freq

Band 1 (EQ Comp)	The parameters are only visible when *Band 1* = on. Frequencies within the band defined by *Q* and surrounding the center frequency determined by *B1 freq* are boosted or cut in accordance with the *B1 gain* setting. *Q* defines the cutoff slope: The steeper the slope, the narrower the band-pass filter's band. Value ranges: *B1 Gain*: -24 to +24 dB (0.5 dB steps) *B1 Freq*: 13 Hz to 20.2 kHz in semitone steps *B1 Q*: 0.1 to 10 in 0.1 steps
Band 2	see Band 1.
HighShelf (EQ Comp)	The parameters are only visible when *HighShelf* = on. frequencies above the *HS freq* setting are boosted or cut in accordance with the *HS gain* setting. *HS slope* defines the steepness of the shelf slope. Value ranges: *HS Gain*: -24 to +24 dB (0.5 dB steps) *HS Freq*: 13 Hz to 20.2 kHz in semitone steps *HS Slope*: 0.1 to 10 in 0.1 steps

Table 18: Silver: Freq FX parameters (cont.)

Compressor (EQ Comp)	The parameters are only visible when *Compressor* = on. Levels above the defined *threshold* are boosted to the *out gain* level. *Response* controls compressor reaction time as a combination of program-driven attack and release value. Value ranges: Threshold: -48 to 0 dB in 1 dB steps Out Gain: 0 to 12 dB in 0.1 dB steps Response: 0 to 127.
In Drive (Distortion)	Determines the input signal's volume. The higher the level, the more distortion. Value range: 0 to 127 Corresponds roughly to *-infinite* to +48 dB.
Pre filt cut (Distortion)	Determines the input low-pass filter's cutoff frequency. Clipper is located right after this filter's output. Value range: 0 to 127. (covers the entire frequency range)
Clip Crv (Distortion)	Determines how the incoming oscillation is cut when the amplitude exceeds the clip point. You have various types of curves to choose from.

Table 18: Silver: Freq FX parameters (cont.)

Out Vol (Distortion)	Determines the distorted signal's output level. This parameter can be used to compensate for the signal level boosted by *In Drive*. Value range: 0 to 127. Corresponds roughly to *-infinite* to 0 dB.
Mix (Ring mod)	Determines the amount of wet or effects signal in the output signal (the mix of the original signal and the ring-modulated signal). Value range: 0 to 127.
Mod Freq (Ring mod)	Determines the ring modulator's carrier frequency. Value range: 0 to 127 Corresponds to 0 Hz to 5 kHz.
Speed (Ring mod)	Determines the LFO oscillation frequency for modulating the carrier frequency (*mod freq*). Value range: 0.0 to 20.0 Hz in 0.1 Hz steps.
Depth (Ring mod)	Determines the modulation depth of the carrier frequency (*mod freq*) via the LFO oscillation. Value range: 0 to 127.

Table 18: Silver: Freq FX parameters (cont.)

Wave (Ring mod)	Determines the LFO oscillation's waveform. The same waveforms are available as in the mod menu. You will find a list of all available waveforms on page 118.
Xover delay (Ring mod)	Determines the amount of delayed signal sent back to the ring modulator's input from its output via feedback loop. Value range: 0 to 127.
Xover Time (Ring mod)	Determines the delay time for the signal sent back to the ring modulator's input from its output via feedback loop. Value range: 0 to 1000 ms.
X Dly Fdbk (Ring mod)	Determines the amount of the signal sent back to the ring modulator's input from its output via feedback loop Value range: -64 to +63.
Mix (Decimator)	Determines the amount of wet signal in the effect's output signal (the mix of the original signal and the down-sampled signal). Value range: 0 to 127.
S&H factor (Decimator)	Determines to which extent the original signal is reduced by the sample&hold circuit. Value range: 0 to 127.

Table 18: Silver: Freq FX parameters (cont.)

Pre filt cut (Decimator)	Determines the cutoff frequency of the low-pass filter located in front of or pre S&H circuit. Serves to attenuate high frequencies to generate more harmonic, less noise-like distortion. Value range: 0 to 127 (covers the entire frequency range)
Mix (Sp_warp)	Determines the amount of wet signal in the effect's output signal (the mix of the original signal and the frequency-inverted signal). Value range: 0 to 127.
Frequency (Sp_warp)	Center frequency at which the spectrum of the incoming audio signal is inverted. Value range: 0 to 127.
Tilt (Sp_warp)	Determines the down-sampling factor. The sampling rate and pitch decreases in accordance with this value. Value range: 0 to 127.
Damping (Sp_warp)	6 dB low-pass filter. Value range: 0 to 127. (covers the entire frequency range)

Table 18: Silver: Freq FX parameters (cont.)

Speed (Sp_warp)	Determines the frequency of the modulating LFO oscillation. Value range: 0.0 to 20.0 Hz in 0.1 Hz steps.
Depth (Sp_warp)	Determines the LFO oscillation's modulation depth. Value range: 0 to 127.

Table 18: Silver: Freq FX parameters (cont.)

Time FX parameters

Type	Defines the effect type. Your options are stereo spread, LR delay, flanger, phaser and chorus. Effects are described in the section starting on page 131.
Chan delay (Stereo spread)	Defines the delay time for the delayed channel. The two channels are spread as a function of time, so that our ears perceive the stereo image to be wider. Value range: -64 to +63. Positive values delay the left channel, negative values delay the right channel.

Table 19: Silver: Time FX parameters

Feedback (Stereo spread)	Defines the level of the delayed signal routed back from the delay line's output to its input, thus determining the number of repetitions. Value range: -64 to +63.

Mix (LR delay)	Determines the amount of wet signal in the effect's output signal (the mix of the original signal and the delayed signal). Value range: 0 to 127.

Time (LR delay)	Determines delay time. The value applies to both stereo channels. Value range: 0 to 1000 (ms).
Feedback (LR delay)	Defines the amount of delayed signal routed back to the effect input via feedback loop. The higher the value, the higher the number of repetitions. Value range: -64 to 63.

Mix (Flanger)	Defines the amount of delayed signal added to the original signal, thus determining the output signal's wet/dry mix. Value range: 0 to 127.

Feedback (Flanger)	Defines the amount of signal routed back to the effect's input via feedback loop. Value range: -64 to 63.

Table 19: Silver: Time FX parameters (cont.)

Depth (Flanger)	Determines the LFO oscillation's modulation depth. The higher the value, the stronger the flanging effect. Value range: 0 to 127.
Speed (Flanger)	Defines the frequency of the modulating LFO oscillation. The higher the LFO frequency, the faster the frequency cancellations are repeated and the faster the effect changes. Value range: 0.0 to 20.0 Hz in 0.1 Hz steps.
Wave (Flanger)	Determines the waveform of the modulating LFO oscillation. The same waveforms are available as in the mod menu. You will find a list of all available waveforms on page 118.

Table 19: Silver: Time FX parameters (cont.)

Stereo phase (Flanger)	Delays the modulation effect in the stereo image for spreading the left and right channels. For example, if the effect attains its highest frequency on the left channel, this value determines the "distance" of the effect's sweep from the left channel to the right channel. Value range: -64 to +63. The maximum values of +63 and -64 shift the phase of the two channels by half of an LFO periodic oscillation. The sign preceding the value determines the direction of shift between the left and right channels.
Mix (Phaser)	Defines the amount of delayed signal added to the original signal, thus determining the output signal's wet/dry mix. Value range: 0 to 127.
Feedback (Phaser)	Defines the amount of signal routed back to the effect's input via feedback loop. Value range: -64 to +63.

Table 19: Silver: Time FX parameters (cont.)

Depth (Phaser)	Determines the LFO oscillation's modulation depth. The higher the value, the stronger the phaser effect. Value range: 0 to 127.
Speed (Phaser)	Defines the frequency of the modulating LFO oscillation. The higher the LFO frequency, the faster the frequency cancellations are repeated and the faster the effect changes. Value range: 0.0 to 20.0 Hz in 0.1 Hz steps.
Wave (Phaser)	Determines the waveform of the modulating LFO oscillation. The same waveforms are available as in the mod menu. You will find a list of all available waveforms on page 118.

Table 19: Silver: Time FX parameters (cont.)

Stereo phase (Phaser)	Delays the modulation effect in the stereo image for spreading the left and right channels. For example, if the effect attains its highest frequency on the left channel, this value determines the "distance" of the effect's sweep from the left channel to the right channel. Value range: -64 to +63. The maximum values of +63 and -64 shift the phase of the two channels by half of an LFO periodic oscillation. The sign preceding the value determines the direction of shift between the left and right channels.
Mix (Chorus)	Defines the amount of delayed signal added to the original signal, thus determining the output signal's wet/dry mix. Value range: 0 to 127.
Feedback (Chorus)	Defines the amount of signal routed back to the effect's input via feedback loop. Value range: -64 to 63.
Depth (Chorus)	Determines the LFO oscillation's modulation depth. The higher the value, the stronger the chorus effect. Value range: 0 to 127.

Table 19: Silver: Time FX parameters (cont.)

Speed (Chorus)	Defines the frequency of the modulating LFO oscillation. The higher the LFO frequency, the faster the effect changes. Value range: 0.0 to 20.0 Hz in 0.1 Hz steps.
Wave (Chorus)	Determines the waveform of the modulating LFO oscillation. The same waveforms are available as in the mod menu. You will find a list of all available waveforms on page 118.
Stereo phase (Chorus)	Delays the modulation effect in the stereo image for spreading the left and right channels. For example, if the effect attains its highest frequency on the left channel, this value determines the "distance" of the effect's sweep from the left channel to the right channel. Value range: -64 to +63. The maximum values of +63 and -64 shift the phase of the two channels by half of an LFO periodic oscillation. The sign preceding the value determines the direction of shift between the left and right channels.

Table 19: Silver: Time FX parameters (cont.)

PreDelay (Chorus)	Defines the delay time of the effect's internal delay line (incl. delay through *depth*). Value range: 0 to 127 Corresponds to roughly 0 to 250 ms

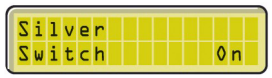
Table 19: Silver: Time FX parameters (cont.)

Silver: Handling

► **How to select/define a filter**

See also the menu diagram on page 136. Filter types and parameters are described on page 124. You will find explanations of the parameters in table 17 on page 138.

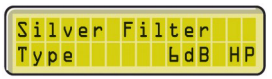
- Switch silver on (**on/off** button).



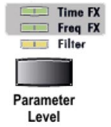
- Select a filter type pressing the **filter** button repeatedly.

The *special* LED has multiple assignments (6dBLP, 6dBHP and band-pass). You can also step through the special filters by pressing the **filter** button repeatedly. (All filters can also be selected in the filter menu.)

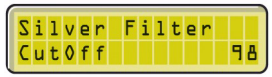
Example:



- Press the silver **parameter level** button repeatedly so that the *filter* LED lights up.
- Move the stick controller to edit the cutoff frequency and resonance.



The two parameters can also be defined in the main display using the knob. The cutoff frequency that you just edited via stick appears in the main display:



- **Stick.right/left** to scroll among the different menu options for resonance, the depths of the modulation options available via LFO oscillation and velocity as well as the key tracking setting.

  Set each parameter to the desired value using the knob. The individual parameters are described on page 138.
- **Stick.left** to return to the filter type selection menu. **Stick.down** from there to access effects.

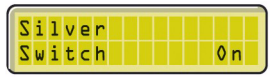
► How to select/define an effect

If you are having problems navigating the menu, check out the diagrams starting on page 136. They will show you the way!

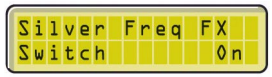
A **frequency effect** serves as the example in the following description. Proceed accordingly for time-based effects. The **`time FX`** menu option is located directly below **`freq FX`**.

Bear in mind that only one frequency effect and one time-based effect can be active at any given time!

- Switch silver on (**on/off** button).

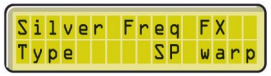


- Switch the freq effect group on so that you can hear the effects of parameter changes immediately while editing (**freq FX** button).

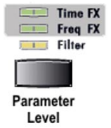


- **Stick.right** (using the navigation stick next to the main display) to scroll to the effects selection list.

- Twist the knob next to the main display to dial in the desired effect. For our example, we will choose "Sp_warp":

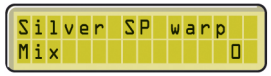


- Press the silver **parameter level** button repeatedly so that the *freq FX* LED lights up.



- You can move the stick to edit the two most important parameters of the selected effect. In our example using "Sp_warp," these are **`mix`** and **`frequency`**.

  You can adjust the two parameters using the knob next to the main display. The first parameter that you just edited via stick appears in the main display:



- To define the remaining effect parameters, **stick.right** to scroll to the effect's remaining menu options, whose values you can adjust via knob (see the menu diagrams starting on page 136).

- **Stick.left** returns you to the freq FX **`type`** selection list. **Stick.up** to go from there to the filter settings and **stick.down** to the time-based effects.

▶ Stick recording and animation in the silver

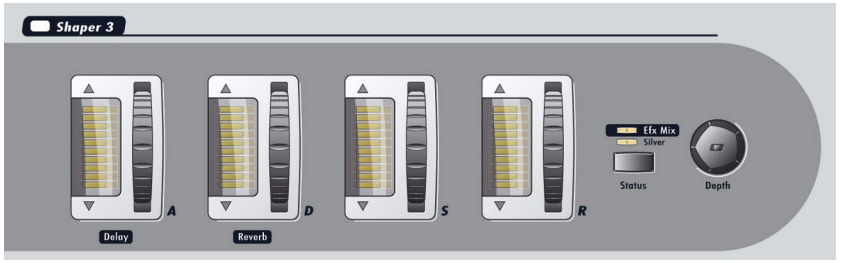
Remember the rules on recording resynator stick movements? The same applies to the silver stick. The procedure for recording and playing animations is also identical.

The only difference is that the silver module's parameter levels do not contain *scape* and *sphere* parameters. Instead, a filter is defined on level 1, level 2 contains a freq effect, and level 3 offers the parameters for the selected time FX. The silver menu gives you the option of playing back (one track per level) stick animations once (*1shot*) or repeatedly (*repeat*).

For details on recording and playing stick animations, please read the section starting on page 89.

Module: Shaper 3

In the section "Dynamic filtering via envelope, stick, LFO and velocity" starting on page 127 you read about how Neuron's filters can be made to sweep dynamically.



A filter earns the descriptive modifier "dynamic" if its parameters can steadily accept new values and this modulation of values can also be automated. For example, say you want all frequencies to initially pass whenever a key is pressed, but a little time later just the low frequencies to be allowed through.

In Neuron, you can do this by modulating the cutoff frequency of the defined filter via shaper 3's envelope generator.

Another dynamic modulation option is to change the filter's cutoff frequency by moving the stick controller or playing back a stick animation (see page 148).

Shaper 3 offers an **ADSR envelope** that is "hard-wired" to the silver's filter unit.

Please note that the status *silver* must be enabled before you can define the envelope in shaper 3. When the shaper status *efx mix* is enabled, the wheels are used to determine the mix values of the master effects reverb and delay.

Shaper 3 must be activated in silver via **contour control** so that the envelope can modulate the selected silver filter (see page 135).

Filter envelope

You will find a basic description of an ADSR envelope's four parameters as well as a picture of its curve on page 99.

A filter envelope shapes the sound far more perceptibly than, for example, an amplifier envelope. This makes it ideal for emulating the response of acoustic instruments. Take a note played on a stringed instrument: It not only grows softer but also loses its brightness as it fades. You can copy this effect using the sustain and release parameters of an ADSR envelope and decreasing the selected filter's cutoff frequency over the time that the note is held. Now take a brass instrument: Some latency in its attack is typical. It takes a moment for the full frequency spectrum of the tone to become audible. The attack parameter of the ADSR envelope is perfect for imitating this property.

The filter envelope changes the sweep of the cutoff frequency, thus shaping the signal's timbre!

Velocity-driven envelope effects

Velocity can be used to shape the *depth* parameter that controls the filter envelope's modulation intensity. To do this, you must enter a value other than zero for shaper 3's *velo depth* parameter (see the parameter description on page 152).

Normal or repeat?

As described for shapers 1 and 2, in *Normal* mode the envelope runs through once only every time a key is pressed. After the release time elapses, it takes a new note to re-trigger the envelope.

The envelope is cycled when you select the *repeat* mode. However, the envelope does not run its full course because the sustain phase is truncated. After the decay time elapses, the envelope jumps directly to the release phase, which in *repeat* mode runs its course even whilst holding the key down issues a note-on command. Then the curve re-enters the attack phase. This cycle continues for as long as the key is held down. Once the key is released the envelope ends after the release phase.

On page 103 you will find an illustration of an ADSR envelope in *repeat* mode.

Shaper 3: Control features

Wheels **A/ D / S / R**	Input wheels for the envelope parameters. The LED bar display indicates the parameter value. The more LEDs light up, the longer the defined time or, in the case of a level, the higher the level. When you move a wheel, the current parameter also appears in numeric form in the main display and can be edited using the knob.
Depth knob	Determines the intensity of the envelope's influence on the filter. *Depth* is also adjustable via menu.
Status button	Determines which parameters are adjusted via wheels: • *Silver*: The displayed parameters define the filter envelope, which in turn determines the sweep of the filter cutoff frequency. • *Efx mix*: The delay and reverb wheels adjust the mix of the two master effects, respectively. **S** and **R** are inactive in this case. ...Continued on next page

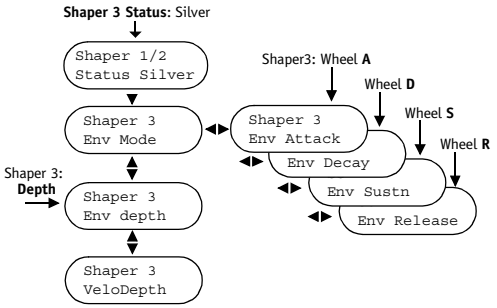
Table 20: Control features: Shaper 3

	Good-to-know stuff: The **shaper status** button has no influence on whether or not parameters are active. It serves only to select the desired parameters so that they can be manipulated using the wheels (or via the **depth** knob in *silver* status). The filter envelope is activated at the silver module's **filter level** via the **contour contr.** button.

Table 20: Control features: Shaper 3 (cont.)

Shaper 3: Menu

The following illustration shows the menu for the shaper status *silver*. The parameters of these menus are summarized in Table 21.



Shaper 3: Parameters in *silver* status

Env Mode	Defines the envelope mode. • *Normal*: Playing a note triggers the envelope once only. • *Repeat*: Like in *Normal* mode, the envelope is triggered by your key attack. A new cycle's attack phase is launched after the release phase ends. For more on this, read page 150.
Env A, D, S, R	The parameters of an ADSR envelope are described on page 99.
Env depth	Defines the intensity of the envelope's effect on the filter cutoff frequency. Value range: -64 to +63. *Depth* = 0: No modulation. *Depth* > 0: Starting at the current frequency, the cutoff frequency increases. *Depth* < 0: The cutoff frequency decreases accordingly. A positive filter modulation is only audible if the cutoff frequency is low! Ditto for negative modulations (vice versa, that is).

Table 21: Shaper 3 parameters

VeloDepth	The *env depth* parameter (see the description on the left) determines the intensity of the envelope's effect on the filter. The *velo depth* parameter lets you manipulate *env depth* manually by varying your attack. There you have it - a modulation of a modulation... Value range: -64 to +63. *VeloDepth* = 0: *Env depth* is not modulated. *VeloDepth* >0: *Env depth* increases in accordance with velocity (up to a max value of 127): current *env depth* + *velo depth* **x** velocity value. The harder you hit the keys, the greater the depth of the envelope. *VeloDepth* = 63: Maximum effect of velocity on the depth of the envelope. *VeloDepth* <0: *Env depth* decreases inversely to velocity. The harder you strike the keys, the weaker the envelope's influence. A positive filter modulation is only audible if the cutoff frequency is low! Ditto for negative modulations (vice versa, that is).

Table 21: Shaper 3 parameters (cont.)

Shaper 3: Handling

► **How to use a filter envelope**

- Shaper 3 must be activated in the silver's filter unit to allow the filter envelope to influence the filter curve.

  Press (repeatedly if necessary) the silver **parameter level** button so that the *filter* LED lights up.

  Then press **contour contr.** until the *shaper 3* LED lights up.
- Press the shaper **status** button until the *silver* LED lights up. `Status Silver` appears in the main display.
- **Stick.down** the navigation stick to access the menu option *env mode*, which lets you select the envelope mode (*normal* or *repeat*).
- Adjust ADSR parameter values by turning the wheels. Once you move a wheel, you can also define the given value in the main display using the knob.
  Alternatively, you can navigate via **stick.right/ left** back and forth among individual envelope parameters.
- Define the intensity of the envelope's effect on the filter by twisting the **depth** knob (alternatively using the menu option *env depth* in the shaper 3 menu).
- If you want to modulate the *depth* of the envelope via velocity, define the parameter *velo depth* (see page 152).

Module: Master effects

Besides silver, Neuron features an effects unit offering delay and reverb in truly excellent quality. A tap function lets you enter delay time intuitively - manually, that is.

The delay precedes the reverb in the signal chain, meaning every generated delay is embedded in the room simulation.

Both effects are available in sound and setup modes. In setup mode, the same delay and reverb settings apply to all four sounds. The wet mix can be controlled for each sound separately, meaning that the send values are stored for each sound at the setup level. For this reason, think of the mix settings for master delay and reverb in setup mode as the return values (see page 161).

Effects are routed out via stereo output 1 (analog or digital), stereo 2 and 3 are dry.

In surround mode, the master effects of the left stereo channel are sent to the left front and left rear surround channels (FrLeft and BkLeft).
The same applies to the right channel. The center and subwoofer channels remain dry.

Before we turn to the master effects parameters and control features, a few words on reverb and delay effects.

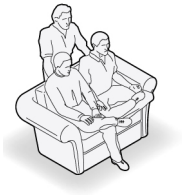
Delay

In simple terms, a delay copies an audio signal and mixes it to the original after a defined delay time has elapsed, thereby creating an echo of the original signal. When the delayed signal is fed back into the effect's input via feedback loop, the echo is repeated until the signal fades. The number of repetitions is determined by the amount of *feedback* and dampening (*Fdbk damp* parameter) in the feedback loop.

Delays are great for "fattening up" instrument sounds. For a rather subtle doubled effect, you can emulate two identical instruments playing in unison by dialing in short delay times (50 to 100 ms). Longer delay times create intriguing rhythmic patterns, which can be especially compelling when synced up to a song's groove.

Neuron features a genuine stereo delay, that is, a dedicated delay line for each channel. This of course means that signals are delayed in true stereo: you

can define delay times separately for the left and right channels. And you can create ping-pong effects by dialing values with a fixed relation to one another (say a ratio of 2:1) for the right and left delay times. The signal then bounces back and forth between the two stereo channels.



Reverb (hall)

Upon reading or hearing the term "reverb", most (electronic instrument playing) musicians picture the knobs and switches on effect devices or amps bearing that label. Many are unaware of the physics of reverb, though a deeper understanding of the phenomenon would certainly be beneficial in handling reverb parameters when creating electronic music.

As sound spreads in a room, it is reflected off many surfaces (walls, ceiling, etc.). Though there is one (!) direct path to the ear of the listener from every sound source, it is not the only path that sound can take. We know that the shortest distance between two points is the direct route and, by extension, that any detour like a reflection takes longer. Consequently, sound waves arrive at the ear of the listener with various delays.

But delay is not the only side effect of reflected sound. The energy of sound waves dissipates slightly with every reflection that bounces off a surface because every reflecting material also has an absorbing effect that dampens the signal. In addition, this attenuation is contingent upon frequency because high frequencies are soaked up more readily than low frequencies (see the *HF damp* parameter).

So, the things that please (or displease) our ears consist of the direct signal and all reflected sound waves. We call the sum of the delayed and dampened signals "reverb". In the real world, the shape, size and physical properties of the room in which sound waves spread determine reverb. In Neuron, we do this via the *type* parameter.

A measurable quality of reverb is **decay time**. This is the time it takes the sound pressure level to drop 60 dB from the original level (*decay* parameter).

So, reverb and delay would seem to be two birds of the same feather. Not so: even if a delay effect is able to generate regularly repeating echoes, it lacks an essential quality of reverb:

Though reverb also consists of echoes, there is a distinction between early and late reflections. Early reflections arrive shortly after the direct sound. In physical terms, these are clearly defined, highly focused waves. Because they have not been diffused by multiple reflections, they provide a more direct and accurate impression of the sound source and shape and size of the room in relation to the position of the listener.

Late reflections arrive much later and in far greater numbers. These late reflections are almost random, so they do not leave you with much of an impression of the physical properties of the room. This is why they are also called **diffuse reflections** (*diffusion* parameter). Diffuse reflections - or the lack thereof - are crucial in determining the acoustics of a room. A good concert hall, for example, absorbs these reflections so well that they decay exponentially.

Another important property of reverb is the incoherence of sound waves when they arrive at our ears. Do not let the terminology baffle you, the explanation is actually quite simple. Our ears are accustomed to hearing sounds first in one ear and then with a slight delay in the other in closed venues. That gives us the impression of space: Picture a concert hall with a very high ceiling. The acoustic waves first reflect off the walls. Because you are not standing equidistant from each wall, the sound waves arrive at your right ear earlier or later than at the left ear. If the venue's ceiling was very low, the sound waves would be reflected off it first and both your ears would hear them simultaneously.

Back to the synthesizer world: The reverb effect simulates the acoustic properties of a room. A dry signal without any reflections sounds unnatural. For reasons of budget, venue and time we do not always have the pleasure of playing in a concert hall or acoustically commensurate room, so we lay the desired type of reverb (*type* parameter, see page 159) over the signal.

Master effects: Control features

On/Off button	Switch the master effects on/off. Note in this context the two mix parameters for delay and reverb (page 159)!
Delay button	Switches the delay effect on/off. Note in this context the *mix* parameter (page 159).
Tap button	Neuron measures the time (in ms) that elapses between the last two taps and uses this value to compute tempo. In other words, press the button repeatedly while locked into the groove of the song and the delay time will be in sync. Whether or not you are locked into the band's groove of course depends entirely on you ... You can then adjust *L time* and *R time* independently via menu.
Reverb button	Switches the reverb effect on/off. Note in this context the *mix* parameter (page 159).
Menu button	Activates the most recently edited menu option or - if you are already working in the master effects menu - the top level of the menu.
Shaper 3: **Delay**, **reverb** wheels	If shaper 3 is in *efx mix* status, you can define both *mix* parameters conveniently using the shaper wheels.

Table 22: Control features of the master effects

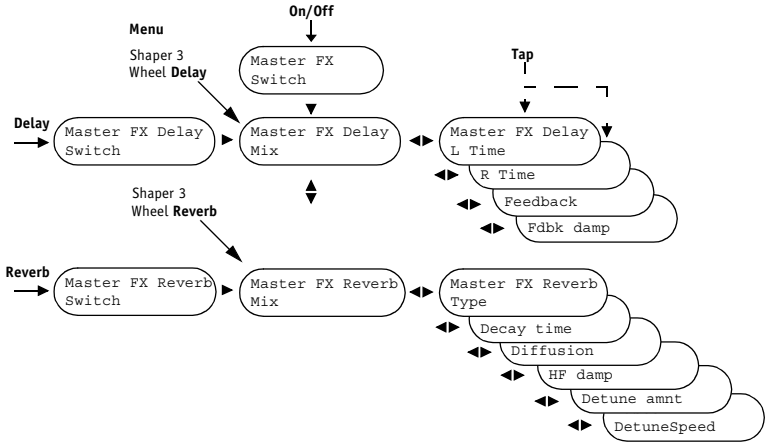
Table 22: Control features of the master effects

Master effects: Menu

The dotted arrow pointing to the menu options **`R time`** and **`L time`** indicates that the two values can be defined via the **tap** button.

After pressing it a second time, *L time* appears in the main display.

The mix values of both effects can also be changed in shaper 3 if *efx mix* status is enabled in it.



Scroll with the navigation stick and select the desired parameter setting with the knob.

The master effects parameters are described in the following table.

Master effects: Parameters

Mix	Defines the amount of processed signal in relation to the original signal (wet / dry mix). Value range: 0 to 127. In **sound mode**, if you switch the master effects module off when *mix* = 127 (100% wet signal), the audio signal will no longer be audible. Why? Because in this setting no dry or unprocessed signal is routed through the effects unit. In **setup mode**, the sounds' effect send values also play a role (*delay* and *reverb*). If the send amount is in each case set to 100% and the master effects mix is set to 100%, the sound of silence is what you will hear when you switch this module off.
L Time *R Time*	Determines delay time for the left and right channels. The value is defined in milliseconds. Time is varied smoothly rather than in audible increments. To avoid the dreaded clicking noise when setting values, the delay time is adjusted gradually. Value range: 0 to 1000 (ms). Press the **tap** button twice or several times to set the delay times of both channels intuitively (see also page 157). Then you can fine-tune the channel settings separately via menu.

Table 23: Master effects: Delay parameters

Feedback	Determines the amount of feedback for the delayed signal. The higher the *feedback* value, the higher the number of repetitions. Value range: 0 to 127.
Fdbk Damp	Determines the amount of dampening in the feedback loop. The higher the attenuation, the weaker the repetitions become over time. Value range: 0 to 127.

Table 23: Master effects: Delay parameters (cont.)

Mix	Defines the amount of processed signal in relation to the original signal (wet / dry mix). Value range: 0 to 127.
Type	Offers different types of reverb simulating different room sizes and properties: SmallRoom, Plate, MedRoom, Hall1, Hall2.
Decay time	Defines the decay time for the reverb effect (see the illustration on page 156). Value range: 0 to 127.

Table 24: Master effects: Reverb parameters

Diffusion	Determines the spread of late reflections. This parameter effects the density of the reverb signal. A high diffusion value evokes a softer, fuller reverb effect. Be aware, though, that overlapping reflections can muddy the soundscape. A low value generates audible echoes. For this reason, strings tend to handle higher *diffusion* settings better than percussive sounds. Value range: 0 to 127.
HF damp	Adjusts high frequency dampening in the decay phase. The amount of attenuation is a factor of time: The longer the decay time, the darker the signal becomes. Value range: 0 to 127.
Detune amnt	Determines the amount of detuning for the reflected signal. Value range: 0 to 127.
Detune speed	Cyclical detuning of the reflected signal. The amount of detuning is defined via *detune amnt*. Value range: 0.0 to 20.0 Hz in 0.1 Hz steps.

Table 24: Master effects: Reverb parameters (cont.)

Master effects: Handling

► **How to load a sound's effect settings into a setup**

In **sound** mode, if you have assigned effects to and stored them with a sound, the effect settings are loaded into a setup when you load the sound from the sound database. These settings are applied to all sounds within the setup **if** master effects are switched off for the setup at the time of loading. This means you can easily configure the effect settings for your setup by simply loading a sound into a setup. Then you are free to edit the settings.

Please bear in mind that you must define the send values for every sound (*delay* and *reverb*) in the setup menu because these settings do not exist in sound mode.

Rather than being referenced or linked, a sound's master effects settings are actually copied from the sound database into the setup. If you edit master effect settings within a setup, these changes are not applied retroactively to the sounds contained in the setup. The data held in the sound database is retained.

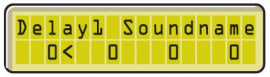
► **FX send and return**

In **sound mode**, you can control the delay and reverb amount via the two mix parameters (either in the master effects menu or via shaper 3 wheels).

In **setup mode**, you also have the option of controlling effect intensity individually for each sound. In this case, the master effects' delay and reverb mix parameters should be viewed as the return values and the sound-related amounts as the send values.

How to set send values in the setup menu:

- Activate setup mode.
- **Stick.down** in the setup menu to scroll to the menu option

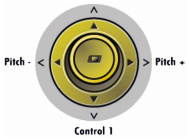


  Define the delay send amount for sound 1 via knob.
- **Stick.down** to scroll to the send parameter *reverb*.
- **Stick.right** and **stick.left** to access the parameters of sounds 2 to 4.

Free controllers

For purposes of performance-based sound shaping, Neuron offers freely definable continuous controllers whose *destinations* can be defined via the controller menu.

Controller settings are stored at the sound level, so they can vary from sound to sound!
When you change or reload a sound, controller values are reset to 0! Stored links are of course retained.



Located at the left next to the keyboard you will find:

- **Control 1**, implemented as the pitch stick controller's Y axis (four destinations each for up and down stick movements).
- **control 2** in the form of a data input wheel with bar display,
- and **control 3**, a rotary encoder,

Connections for external controllers:

- **Control 4** for a continuous pedal,
- and **switch**, for a footswitch of any polarity. Bar a few exceptions, this switch can execute the function of virtually every button on Neuron.

Page 11 offers information on connectable pedals. The potential destinations for all controls are listed from page 165.

Although strictly speaking they are not true hardware controllers, there are two more control signal sources to be found in Neuron's keyboard: **aftertouch and velocity**.

You may recall that "aftertouch" is the pressure applied to a key once it has been pressed. An aftertouch message is generated in response to the force of your post-attack key pressure; its value increases as you bear down harder on keys. Aftertouch data may be used to modulate other sound parameters: You can define up to four *destinations* that can then be controlled simultaneously. You can select these parameters and determine the intensity or *depth* of the aftertouch message's influence on the parameter selected in the controller menu. In Neuron (and via MIDI), aftertouch is monaural, meaning that the aftertouch modulation affects the entire sound rather than individual voices.

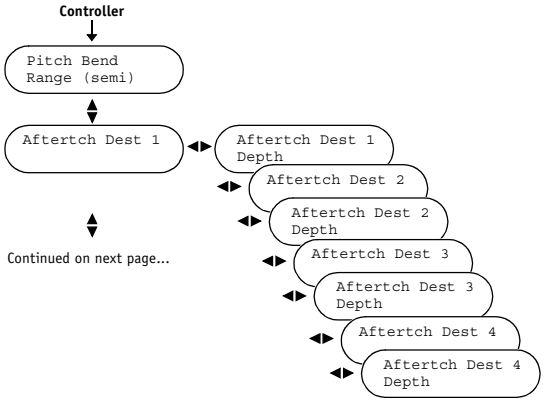
Velocity handles somewhat differently, as described on page 168.

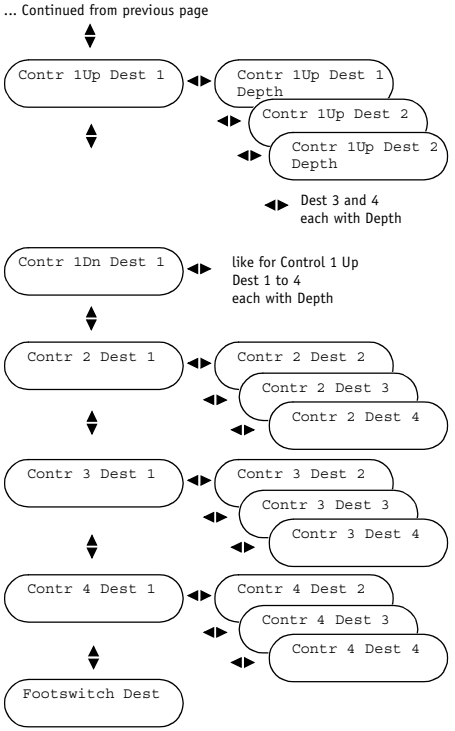
You can **scale** aftertouch and velocity in the basic settings. For more on this, read the descriptions of the *aftertouch scale* parameter on page 40 and *velo curve* parameter on page 39.

Controllers: Menu

To access the controller menu, press the **controller** button located below the main display.

Neuron exits the controller menu automatically when you edit a parameter in another module. If you exit the controller settings by pressing the **controller** button again, Neuron jumps to the most recently edited menu. In both cases, the device remembers the most recently edited controller and displays it immediately when you call the menu up later. This makes it very easy to set up destinations.





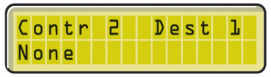
► How to select a destination

The controller menu lists potential destinations in groups (as shown in the following lists). A group is indicated by a '>' symbol following its name.

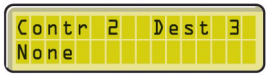
- Use the navigation stick to scroll to the desired controller.
- Twist the knob to select the desired group.
- **Stick.right** to open the group.
- Select the destination using the knob.
- **Stick.left** to exit a group.

Example: Say you want to define slicer rate as destination 3 for control 2:

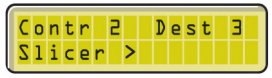
- Press the **controller** button.
- **Stick.down** to scroll to control 2.



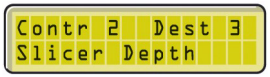
- **Stick.right** to select destination 3.



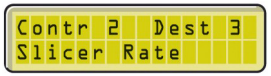
- Twist the knob (to the right) to select the group of *slicer* destinations.



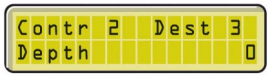
- **Stick.right** to access the first destination (*slicer depth*) in this group.



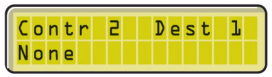
- Select our desired destination *rate* via knob.



- **Stick.right** to access the corresponding *depth* parameter directly and define as usual using the knob.



- **Stick.left** repeatedly to return to the selection list for destination numbers.



Controllers: Route planning

Double *destination* assignments are allowed! And often desirable...

Control 1 to control 4 and aftertouch: Destinations for the modulation matrix

Controls 1 to 4 and aftertouch offer identical destinations. For each control, you can define up to four destinations that are controlled simultaneously.

In the default setting, the pedal connected to control 4 (continuous controller) is routed to the volume of both resynators (destination 1 and 2).

None (= control is not used)

Pan >

- Sound Pan

LFO > (Mod)

- LFO Depth
- LFO Rate
- LFO Delay

Resynator 1 >

- Volume
- L1 Scape 1/3 (*Scape* Parameter 1/3, Level 1)
- L1 Scape 2/4 (*Scape* Parameter 2/4, Level 1)
- L1 Sphere 1/3 (*Sphere* Parameter 1/3, Level 1)
- L1 Sphere 2/4 (*Sphere* Parameter 2/4, Level 1)
- L2 Scape 1/3
- L2 Scape 2/4
- L2 Sphere 1/3
- L2 Sphere 2/4
- L3 Scape 1/3
- L3 Scape 2/4
- L3 Sphere 1/3
- L3 Sphere 2/4

Resynator 2 >

- see Resynator 1.

Blender >

- Amount

Slicer

- Depth
- Rate

Silver Filter >

- Filter Cutoff
- Filter Resonance

Silver Freq FX >

- EQ LowShelf Gain (EQComp)
- EQ LowShelf Freq
- EQ LowShelf Slope
- EQ B1 Gain
- EQ B1 Freq
- EQ B1 Q
- EQ B2 Gain
- EQ B2 Freq
- EQ B2 Q
- EQ HighShelf Gain
- EQ HighShelf Freq
- EQ HighShelf Slope

- Comp Threshold
- Comp Out Gain
- Comp Responsiveness
- Dist. In Drive (Distortion)
- Dist. Prefilter
- Dist. Out Vol
- RingMod Mix (Ringmodulator)
- RingMod Speed
- RingMod Depth
- RingMod ModFreq
- RgMd XoverDelay
- RgMd XoverTime
- RgMd XDlFeedback
- Decim. Mix (Decimator)
- Decim. SH Factor
- Dec.PreFltCutoff
- SpWarp Mix (Sp_warp)
- SpWarp Frequency
- SpWarp Tilt
- SpWarp Damping
- SpWarp Speed
- SpWarp Depth

Silver Time FX >

- StereoSp ChanDly (Stereo Spread)
- StereoSp Feedbk
- L/R Delay Mix (LR Delay)
- L/R Delay Time
- L/R Dly Feedback
- Flanger Mix (Flanger)
- Flanger Depth
- Flanger Speed
- Flanger Feedback
- Flanger StereoPh
- Phaser Mix (Phaser)
- Phaser Depth
- Phaser Speed
- Phaser Feedback
- Phaser StereoPh
- Chorus Mix (Chorus)
- Chorus Depth
- Chorus Speed
- Chorus Feedback
- Chorus StereoPh
- Chorus PreDelay

Shaper 1 >

- S1 Resy Env Att (Attack Shap 1 Status *ParLevel*)
- S1 Resy Env Dec (Decay Shap 1 Status *ParLevel*)
- S1 Resy Env Sust (Sustain Shap 1 Status *ParLevel*)
- S1 Resy Env Rel (Release Shap 1 Status *ParLevel*)
- S1 Amp Env Att (Attack Shap 1 Status *Amp*)
- S1 Amp Env Dec (Decay Shap 1 Status *Amp*)
- S1 Amp Env Sust (Sustain Shap 1 Status *Amp*)
- S1 Amp Env Rel (Release Shap 1 Status *Amp*)
- S1 Free Env Att (Attack Shap 1 Status *Free*)
- S1 Free Env Dec (Decay Shap 1 Status *Free*)
- S1 Free Env Sust (Sustain Shap 1 Status *Free*)
- S1 Free Env Rel (Release Shap 1 Status *Free*)
- S1 Free EnvDepth (*Depth* Free Envelope Shaper 1)

Shaper 2 >

- see Shaper 1.

4Level / 4Time >

- Free Env Level 1 (Free 4L4T Envelope Shp 1+2)
- Free Env Time 1 (Free 4L4T Envelope Shp 1+2)
- Free Env Level 2 (Free 4L4T Envelope Shp 1+2)
- Free Env Time 2 (Free 4L4T Envelope Shp 1+2)
- Free Env Level 3 (Free 4L4T Envelope Shp 1+2)
- Free Env Time 3 (Free 4L4T Envelope Shp 1+2)
- Free Env Level 4 (Free 4L4T Envelope Shp 1+2)
- Free Env Time 4 (Free 4L4T Envelope Shp 1+2)
- LevelTime EnvDpt (4L4T Envelope *Depth*)

Shaper 3:

- Filter Env Att (Attack Filter Envelope Shp3)
- Filter Env Dec (Decay Filter Envelope Shp3)
- Filter Env Sust (Sustain Filter Envelope Shp3)
- Filter Env Rel (Release Filter Envelope Shp3)
- Filter Env Depth

Footswitch (Switch): Destinations

Only one destination is possible for the footswitch.

None (= footswitch is not used)

LFO (Mod)

- LFO Switch (**On/Off**)

Resynator 1

- Switch (**On/Off**)
- Para Level
- Contour (**Contour Contr**)
- Octave
- Scape/Sphere (**Select**)

Resynator 2: like Resynator 1!

Shaper 1/2

- Stat (**Shaper 1/2 Status**)

Slicer

- Switch (**On/Off**)

Programmer

- Up (sound or setup, depending on mode)
- Down (sound or setup, depending on mode)

Silver

- Switch (**On/Off**)
- Par Level
- Contour (**Contour Contr**)
- Surround
- Filter
- Freq FX
- Time FX

Shaper 3

- Status (**Shaper 3 Status**)

Master FX

- Switch (**On/Off**)
- Delay
- Reverb

Velocity as an additional controller

As discussed previously, velocity can also be viewed as an internal controller and used as a modulation source. Unlike aftertouch - whose modulation destinations are defined in the controller menu - velocity modulation destinations are determined via the respective *velo depth* parameter at the destination. Velocity is the modulator when *velo depth* is set to a value other than zero.

You have the following routing options:

- Resynators: Volume (default depth 63, otherwise no response to velocity) and all cross-x parameters (see the section starting on page 78).
- Shaper 1/2 (for *par.level* and *free* envelopes): *Depth* of the envelope (see page 109).
- Silver: Cutoff frequency (*velo depth* parameter, see page 139).
- Shaper 3: *Depth* of the envelope (see page 152).

How does the *depth* value work?

The effect of the *depth* value is explained using aftertouch as an example. The same principle applies to every *depth* value in the modulation matrix.

The following rule applies to every modulation: Maximum modulation is possible only if the destination parameter is set to its minimum value.

All free controller *depth* parameters can also accept negative values. Think of *depth* values as percentages. The indicated value of 63 is equal to 100%, 32 = 50%, and so forth.

The value of a controller is multiplied by the given *depth* value. The result of this multiplication is added to the current value of the defined destination.

On to our aftertouch example: Say we select blender amount as our aftertouch *destination* and set aftertouch *depth* to 63 and the current *blender amount* to 60. A light aftertouch generates a value of 30. At a *depth* of 100%, the *blender amount* comes to 60 + 30 = 90.

If depth is = 32 (50%), 30 x 50% = 15, resulting in a *blender amount* of 60 + 15 = 75.

If you decide to use several controllers for the same destination, all multiplication results are added to the destination. The computed destination value cannot be greater than or less than the actual maximum and minimum values, respectively. In our example, this means the *blender amount* will never exceed 127 no matter how many controllers we use.

Surround mode

Neuron is the first and only synthesizer designed from the bottom up for surround mode (5.1) applications. Handling is easy - simply move the silver unit's stick. You can position sounds within a setup precisely in the soundscape. Beyond that, you can record stick movements to create animated sweeps through the soundscape and store these modulations as a component of a sound within a setup.

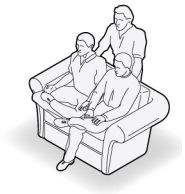
Before we get into the handling of Neuron's surround features, we will clear up potential misunderstandings by discussing a few surround basics.

First, two facts:

- Surround is also a stereo format.
- Surround does not necessarily equate to Dolby Surround®!

If you are aware of (or don't care about) these two facts, feel free to skip to page 174. Otherwise, the following topics may be of interest to you.

Surround basics



The definition of the term "stereophonic" refers to two or more audio channels. This tells us that stereo sound reproduction is not limited to the left and right channels that the casual listener associates with it.

A stickler for accuracy would insist that the audio experience commonly known as stereo be called two-channel stereo. This is unlikely to become idiomatic, so even the professional world has accepted this misinterpretation at face value.

Though four-channel quadraphonic stereo blazed the trail back in the early '70s, it never took off. More recently, the emergence of a multi-channel technology necessitated a new term. "Surround" was chosen because it seemed to capture the vibe of 3D audio. The fact remains, though, that this new aural experience comes courtesy of multi-channel stereo.

The purpose of every multi-channel stereo technology is to render the natural sound field of a given environment, the point usually being to reproduce the natural sound of the room in which the signal was recorded rather than using artificial reverb effects to simulate it.

That certainly makes sense. One cannot help but note the irony in suppressing the sound of the room

when recording only to simulate it again later using reverb effects.

A few definitions of terms

The following definitions are derived from the recommendations of the International Telecommunication Union (ITU). Each of these technical writings is a recommendation geared toward establishing technical standards without undermining audio engineers' creativity and willingness to experiment.

3/2: Main recommendation for discrete multi-channel stereophony with three front speakers (left/center/right) and two rear channels (LS = left surround and RS). Standard according to BS ITU-R 775.

5.1: A variation on the 3/2 recommendation that extends the standard to include a frequency-limited subsonic bass channel (low frequency effect, LFE).

Sweet spot: The best possible listening position. The ITU recommends a specific speaker array for every multi-channel audio type, the goal being to achieve the largest possible listening area with the highest possible fidelity. The array recommended for the 5.1 format is depicted on page 171.

Audio shoptalk revealed: Surround, Dolby Surround, Dolby Digital

Neuron supports **surround format 5.1**, a digital multi-channel format with six discrete channels (see definition).

The 5.1 format is not to be confused with the first commercial multi-channel technology Dolby Surround®. It is based on a matrix comprising two analog transmission channels. A frequency limited center channel and a frequency limited rear surround channel are encoded into a two-channel stereo signal. The rear channel is delayed and sent to two speakers. The center channel is either distributed in equal parts to the left and right front channel or rendered via a dedicated center speaker (depending on decoder).

The 5.1 multi-channel format provides the technical underpinning for the encoding and transmission format Dolby Digital® widely used for DVDs.

Dolby Surround®, Dolby Digital® and Virtual Surround® (which is achieved by phase and frequency shifting without requiring additional speakers) are not multi-channel formats. They are the names of CODECs (the proprietary coding/decoding algorithms of Dolby Labs™) and as such do not necessarily refer to the number of channels.

Subwoofers - bottom end bliss

In 5.1 format, the low bass channel serves to expand the low end and - in (home) movie theater applications - render effects. In the latter case, the bass channel is also called the low frequency effects (LFE) channel.

Low bass frequencies are filtered out of the remaining channels and transmitted exclusively via the frequency limited subwoofer channel. As a result, the volume of the five main speakers (or satellites) can be reduced significantly.

In Neuron, you can determine the subwoofer's upper frequency limit via menu.

Excerpts from recommendation ITU 775...

for studio and home multi-channel audio productions. Note that all parameters relate to a very small sweet spot!

Though the requirements for a studio environment are more demanding, the parameters translate reasonably well to home use.

Requirements for a surround room:

Area ..... > 25 m^2

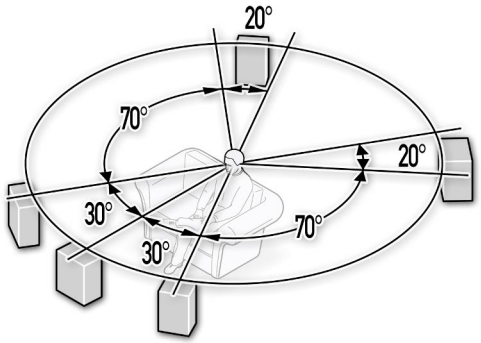
Room volume .....> 300 m^3

Reverberation time ... 0.2-0.4 s (200 Hz - 2.5 kHz)

Early reflections .....-10 dB to the direct sound

Speaker array:

Reference array in accordance with 3/2 recommendation (L/C/R and LS/RS) with five identical speakers.



LFE channel:

The most common extension of the 3/2 recommendation using a subwoofer. Narrow bandwidth. Neuron lets you adjust the subwoofer's upper frequency limit (see page 176). The standard does not mandate a fixed position for the subwoofer because the human ear has trouble pinpointing the source of low frequencies.

The quality of surround sound...

Our perception of sound is a function of personal bias. It is so very subjective that there will never be universal agreement on *the* definitive sound. However, there are some criteria designed to introduce dispassionate standardized parameters for assessing sound quality rather than the emotional yardstick we usually use to gauge sound (my how beautiful; oh, that's just brilliant). These criteria must be met to compete with the best of 'em in the professional sound-sculpting league. The European Broadcasting Union (EBU) - founded in 1950 and based in Geneva - has published its evaluation criteria for multi-channel recordings.

We took some excerpts, adapted them to the Neuron, and came up with the following tips on rating sound quality:

Front image
- Is the panorama narrow or wide?
- Do the signal sources sound realistic or artificial?
- Do the sources appear to be stable or unstable?
- Are signal sources easily localized, that is, pinpointed in the soundscape?

Rear (side) image
- Is the rear soundscape balanced?
- Are signal sources easily localized?
- Is the sound of the rear soundscape homogenous?

Environment
- Does the ambient environment match the audio content?
- Is reverberation audible or is the sound dry?
- Is the size of the room in which the signal was recorded recognizable; does the signal have spatial depth?
- Is the acoustic balance right?

Transparency of the overall sound
- Are audio details easily heard? Are they distinguishable as a function of time?

Distribution of signal sources
- Are signal sources distributed realistically across the room?
- Are individual sources too loud or too soft?
- Are individual sources rendered too directly or too indirectly?
- Are the dynamics of every source appropriate to the signal?

Surround monitoring

We recommend that you monitor surround settings over a good monitor system to achieve the best possible results. A standard stereo set-up certainly will not do the trick (see the section "Monitor matrix"). To learn how to connect Neuron to the surround system, please check out the illustration on page 10. You will find the best monitor speaker positions (according to the ITU 775 recommendation) illustrated on page 171.

Monitor matrix

If you are working in a studio, you will need a suitable mixer as well as a monitor matrix to audition the individual channels in isolation. When you are connecting Neuron to the console, make sure each of its six channels is patched into the corresponding surround bus. In addition, you will only hear the surround panning in all its 3D glory if all channels of the Neuron are set to exactly the same level.

If you want to try out Neuron's surround powers at home, be sure to work with a suitable system equipped with a surround amp or receiver. It must offer a six-channel input of the type used for connecting DVD video or DVD audio players.

If you opt to run Neuron in this kind of stand-alone configuration, note that the sound handling options within a setup serve the same purpose as a monitor matrix. After all, in Neuron surround sound is generated at the setup level. This means that the four sounds of a setup can be positioned individually in the soundscape. For more on this, read the section starting on page 174.

Surround panning

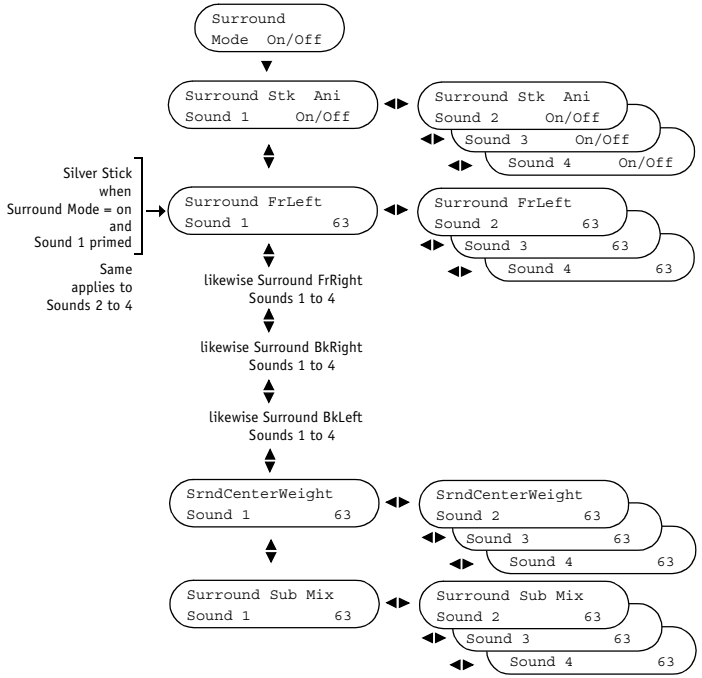
Neuron works with surround sound exclusively in setup mode. A setup comprises four sounds that can be positioned throughout the soundscape. The process of positioning signal sources (referred to here as sounds) in the sonic image is called panning.

In Neuron, panning is done in the most convenient and intuitive way imaginable using the stick controller in the silver module. Alternatively, you can position sounds via the setup menu in the main display. Read page 174 to learn more about this.

The stick recording function lets you define the position of every sound in the sound field on the fly. This is done by recording the movement of the stick controller and playing this animation back during a performance. You will find out the details of how this works in the section starting on page 177.

Surround menu in Neuron

The surround menu is part of the setup menu. To access it, press the **surround** button or move the silver stick while surround mode is active.



Surround handling in Neuron

Surround sound is possible only in setup mode! Surround settings are stored for each sound at the setup level.

In surround mode, the master effects of the left stereo channel are sent to the left front and left rear surround channels (FrLeft and BkLeft).
The same applies to the right channel. The center and subwoofer channels remain dry.

▶ **How to switch surround mode on**

- Activate setup mode.
- Press the red **surround** button in the silver module. The LED above the button lights up. In surround mode, the silver stick controller no longer serves to manipulate filter or effect parameters; instead it is used to position sounds in the surround sound field.

▶ **How to position a sound in the surround sound field via stick controller**

- Activate setup mode and switch on surround mode (see above).

- Prime the sound that you want to position by pressing the appropriate sound button (located above the main display) repeatedly. The LED of the primed sound flashes. If you want to hear

the sound in isolation, you can mute the other three sounds by pressing and holding their buttons for about half a second (until the LED extinguishes).

- Move the stick controller in the silver module to the desired position.
  The four displays surrounding the stick show the current amounts of the primed sound for the two front and the two rear channels:

The *FrLeft* value (front left) also appears in the main display.

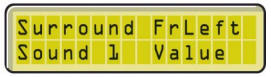
At the same time, positioning the stick determines the amount of the center channel. See note on page 64.

- After making a rough adjustment using the stick controller, you can fine-tune all values. To this end, scroll with the navigation stick (**stick.up/down**) to the given menu options and use the knob to define the values.
- Repeat these steps for the other sounds in the setup.
- Start by priming each sound. In the surround menu, navigate to the parameter *surround sub mix* and boost or cut the subwoofer signal for each sound (value ranges from 0 to 127, values > 63 = boost, values < 63 = cut).

Surround settings are stored for each sound with the setup.

► **How to position a sound via the setup menu in the surround sound field**

- Activate setup mode and switch on surround mode (see above).
- In the setup menu, **stick.down** to scroll to the menu option



- Twist the knob to determine the amount of sound 1 routed to the left front channel.
- **Stick.down** to scroll to the other menu options

  `Surround FrRight`
  `Surround BkRight`
  `Surround BkLeft`

  and define each value using the knob. Note that the response of the cross-x channels is inverted or opposite and that the sum of their parameter values is always 127.
- **Stick.down** to scroll to the other menu options

  `SrndCenterWeight`
  `Surround sub mix`

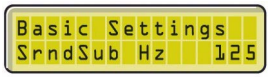
  and define each value using the knob. The following applies to both parameters: values < 63 dampen the center/sub for the current sound, values > 63 boost it.
- **Stick.right** and **stick.left** to adjust the same channel for sounds 2, 3 and 4 of the current setup.

The surround settings are stored with the setup.

► **How to change the subwoofer's limiting frequency**

The limiting frequency for the subwoofer channel is defined in the basic settings, which means it is a global rather than a local setup parameter.

- Press the **basic settings** button located below the main display.
- **Stick.down** to scroll through the global Neuron parameters to the menu option



  Values range from 13 Hz to 20.2 kHz. The default setting for the limiting frequency is 125 Hz.
- Define the desired frequency using the knob.
- Exit the basic settings menu. The value is stored automatically and is valid for every setup.

Note also in this context the surround sub mix parameter, which you can use to boost (values > 63) or cut (values < 63) the subwoofer channel for every sound. See page 64.

► How to record a stick movement

A new recording overwrites a previous track without warning!

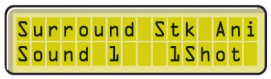
- In the silver module, press the **record stick** button in order to switch the recording function to standby. The LED above the button flashes.
- After the device starts recording a track (as defined by the basic settings parameter *stick record start*) the LED lights up continuously. Every movement of the stick controller is then recorded.
- Stop recording by pressing the **record stick** button again. The recorded track is stored along with the other setup-specific data when the setup is stored.

In order to delete a recording without overwriting it with a new track, press and hold the **record stick** button until the LED extinguishes (three seconds should do).

► How to start a stick animation

A stick animation within a setup is determined individually for each sound. To this end, the surround menu offers a parameter called *surround stk ani* for each sound.

- Press the **surround** or **setup** button to access the menu. (The surround menu is part of the setup menu - see page 174).
- If necessary, **stick.down** to scroll to



- Twist the knob to choose one of the options, *off*, *1shot* or *repeat* (see page 63).
- **Stick.right** the navigation stick to access the animation settings for sounds 2, 3 and 4.

Surround settings are stored for each sound with the setup.

MIDI control

The illustration on page 12 shows how to use Neuron's MIDI connections to configure a MIDI set-up.

Unlike many other synthesizers, Neuron has no sound banks because the 1,000 potential sounds are archived sequentially. For purposes of MIDI addressing, consider sounds 0 to 99 to be a "virtual" first bank, sounds 100 to 199 a second bank, and so forth.

MIDI-relevant basic settings

To access the basic settings, press the **basic settings** button located below the main display. Scroll to the desired parameter using the navigation stick.

- *MIDI Glb Ch:* Determines the global send and receive channel for MIDI data (MIDI global channel) for **sound mode**. In sound mode, Neuron responds to incoming MIDI data only when the defined MIDI global channel and send channel numbers are identical.

  Value range: 0 to 16. 0 denotes omni, meaning that Neuron processes incoming messages on all MIDI channels.

  In **setup mode**, the individual sound-related MIDI channel settings in the setup menu apply - see page 61.
- *Local:* Deactivates/activates Neuron's synthesis engine via the keyboard as well as via controls 1 to 4, the footswitch, the sustain pedal and aftertouch.

  Local = Off: Neuron's keyboard is disabled. It cannot address the internal synthesis engine; all controls are deactivated. Neuron can play incoming MIDI data or serve as a MIDI master keyboard.
  Local = On: The internal synthesis engine can be controlled using Neuron's keyboard as well as via incoming MIDI data; Neuron can also serve as a master keyboard. All controls (see above) are enabled.

  Note in this context the function of the *local* setup parameter, which serves the same purpose for every sound within a setup (see page 61). If the global *local* parameter is set to *off*, the setup parameters of the same name are overruled, meaning that all four sounds are *off* regardless of the respective *local* parameter setting.

- *SysXDeviceID:* Defines the device identification for system exclusive MIDI messages.
  Hexadecimal values range from 00 to 7F.

MIDI-relevant setup settings

- *MIDI*: Determines MIDI data send and receive channel for sounds in setup mode.
  A sound responds to incoming MIDI data only when the defined MIDI channel and send channel numbers are identical.

  Value range: 0 to 16. 0 denotes omni, meaning that Neuron processes incoming messages on all MIDI channels.

  In **sound mode**, the global MIDI channel settings defined in the basic settings apply (see page 178).
- *Local*: Deactivates/activates Neuron's synthesis engine via the keyboard as well as via controls 1 to 4, the footswitch, the sustain pedal and aftertouch.

  Local = Off: Neuron's keyboard is disabled for this sound so that it cannot control the internal synthesis engine; the controls are deactivated. However, the sound can be played via incoming MIDI data and send MIDI data.

  Local = On: The internal synthesis engine can be controlled for this sound via Neuron's keyboard as well as via incoming MIDI data. All controls are enabled.

  Note in this context the function of the *local* basic settings parameter (see page 178): If this global parameter *local* is set to *off*, the settings of the four setup parameters of the same name are overruled.

SysEx commands (System exclusive data)

SysEx commands are channel-independent MIDI messages, meaning that the information conveyed therein apply to the entire MIDI device. This data is called "exclusive" because it cannot be interpreted by any other device type; it is in a language only Neuron can speak.

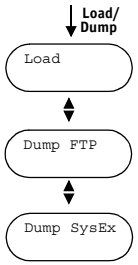
For this reason, SysEx commands require special identification. Called a SysEx device ID, you can define it via the basic settings parameters *SysXDeviceID*. The value range for the ID is 00 to 7F. A value of 7F denotes omni, meaning that Neuron accepts incoming SysEx commands with any SysEx device ID. This setting is recommended if you encounter problems during data transfer.

A SysEx data transfer lets you upload and download data to and from Neuron that are not addressed by any other MIDI command, for example, complete sounds or setups (see the following sections).

In addition to SysEx loading/dumping, Neuron enables ftp loading/dumping. For more on this see the topic "Updates and Backups" starting on page 185.

► How to send SysEx data

A SysEx dump is launched in the load/dump menu. Open the menu by pressing the programmer **load/dump** button.



You will find the **`dump SysEx`** item below the ftp load/dump options. Twist the knob to determine which data you want to dump.

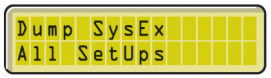
You have the following options:

- *Current*: When you choose this option in **sound mode**, Neuron sends the currently loaded sound to the MIDI out; in **setup mode**, it sends the currently loaded setup to the MIDI out. The models and sounds used therein are also exported.
- *All Sounds*: All stored sounds are sent to the MIDI out. Models contained therein are not exported.
- *All SetUps*: All stored setups are sent to the MIDI out. Sounds and models contained therein are not exported.

Example: The following example takes you through a SysEx dump of all setups. Proceed accordingly to dump other SysEx data.

- Ensure that the MIDI device connected to Neuron's MIDI out port is ready to receive MIDI data.
- Check if Neuron's device identification (*SysExDeviceID*) is set correctly in the basic settings (see page 179).
- Press the **load/dump** button. **Stick.down** to scroll to the menu option

- Twist the knob to select the option



- Press **enter**.
  Neuron sends the parameters of all setups to the MIDI out interface.

► How to receive SysEx data

During a SysEx load, Neuron receives system exclusive data from another MIDI device connected to the MIDI in port. Data transfer is launched at the connected device; Neuron processes the incoming MIDI commands autonomously.

If the data transfer process is bound to be lengthy, a message appears in Neuron's display indicating as much.

Before launching a data transfer, make sure that Neuron's device identification as defined in the basic settings (*SysExDeviceID*) agrees with the setting entered to the connected MIDI device. When in doubt, enter a value of *7F* = omni for *SysExDeviceID* (see page 179).

Controller list

Control no. Type

0 . . . . . Bank Select
1 . . . . . Control 1 Up
2 . . . . . Control 1 Down
3 . . . . . Control 2
4 . . . . . Control 3
5 . . . . . Reserved
6 . . . . . Data Entry MSB
7 . . . . . Channel Volume (Sound in Setup)
8 . . . . . Blender Mix
9 . . . . . Blender Type
10. . . . . Pan
11. . . . . Control 4
12. . . . . Resynator 1 Volume
13. . . . . Resynator 2 Volume
14. . . . . Resynator1 L1 Scape Parameter 1/3
15. . . . . Resynator1 L1 Scape Parameter 2/4
16. . . . . Resynator1 L1 Sphere Parameter 1/3
17. . . . . Resynator1 L1 Sphere Parameter 2/4
18. . . . . Resynator1 L2 Scape Parameter 1/3
19. . . . . Resynator1 L2 Scape Parameter 2/4
20. . . . . Resynator1 L2 Sphere Parameter 1/3
21. . . . . Resynator1 L2 Sphere Parameter 2/4
22. . . . . Resynator1 L3 Scape Parameter 1/3
23. . . . . Resynator1 L3 Scape Parameter 2/4
24. . . . . Resynator1 L3 Sphere Parameter 1/3
25. . . . . Resynator1 L3 Sphere Parameter 2/4
26. . . . . Resynator1 Octave
27. . . . . Resynator1 Semi

28 . . . . . Resynator1 Detune
29 . . . . . Slicer Type
30 . . . . . Slicer Depth Spread
31 . . . . . Slicer Rate
32 . . . . . Reserved
33 . . . . . Resynator2 L1 Scape Parameter 1/3
34 . . . . . Resynator2 L1 Scape Parameter 2/4
35 . . . . . Resynator2 L1 Sphere Parameter 1/3
36 . . . . . Resynator2 L1 Sphere Parameter 2/4
37 . . . . . Resynator2 L2 Scape Parameter 1/3
38 . . . . . Data Entry MSB
39 . . . . . Resynator2 L2 Scape Parameter 2/4
40 . . . . . Resynator2 L2 Sphere Parameter 1/3
41 . . . . . Resynator2 L2 Sphere Parameter 2/4
42 . . . . . Resynator2 L3 Scape Parameter 1/3
43 . . . . . Resynator2 L3 Scape Parameter 2/4
44 . . . . . Resynator2 L3 Sphere Parameter 1/3
45 . . . . . Resynator2 L3 Sphere Parameter 2/4
46 . . . . . Resynator2 Octave
47 . . . . . Resynator2 Semi
48 . . . . . Resynator2 Detune
49 . . . . . LFO depth
50 . . . . . LFO Rate
51 . . . . . Silver Filter Type
52 . . . . . Silver Filter Cutoff
53 . . . . . Silver Filter Resonance
54 . . . . . Silver Frequency FX On/Off
55 . . . . . Silver Frequency FX Parameter 1
56 . . . . . Silver Frequency FX Parameter 2
57 . . . . . Silver Time FX On/Off
58 . . . . . Silver Time FX Parameter 1
59. . . . . Silver Time FX Parameter 2
60. . . . . Silver surround On/Off
61. . . . . Silver surround Position X
62. . . . . Silver surround Position Y
63. . . . . Silver surround Sub Mix
64. . . . . Sustain pedal
65. . . . . Reserved
66. . . . . Switch Pedal
67. . . . . LFO On/Off
68. . . . . Resynator1 On/Off
69. . . . . Resynator2 On/Off
70. . . . . Shaper 1 Amp Attack
71. . . . . Shaper 1 Amp Decay
72. . . . . Shaper 1 Amp Sustain
73. . . . . Shaper 1 Amp Release
74. . . . . Shaper 2 Amp Attack
75. . . . . Shaper 2 Amp Decay
76. . . . . Shaper 2 Amp Sustain
77. . . . . Shaper 2 Amp Release
78. . . . . Shaper 1 Parameter Attack
79. . . . . Shaper 1 Parameter Decay
80. . . . . Shaper 1 Parameter Sustain
81. . . . . Shaper 1 Parameter Release
82. . . . . Shaper 2 Parameter Attack
83. . . . . Shaper 2 Parameter Decay
84. . . . . Shaper 2 Parameter Sustain
85. . . . . Shaper 2 Parameter Release
86. . . . . Reserved
87. . . . . Reserved
88. . . . . FX Delay On/Off
89. . . . . FX Reverb On/Off

90 . . . . . FX Delay L Time
91 . . . . . FX Delay Mix
92 . . . . . FX Delay R Time
93 . . . . . FX Reverb Mix
94 . . . . . FX Delay Feedback
95 . . . . . FX Delay Feedback Damp
96 . . . . . Data increment
97 . . . . . Data decrement
98 . . . . . NRPN LSB
99 . . . . . NRPN MSB
100 . . . . . RPN LSB
101 . . . . . RPN MSB
102 . . . . . Shaper 1 Free Attack / Level 1
103 . . . . . Shaper 1 Free Decay / Time 1
104 . . . . . Shaper 1 Free Sustain / Level 2
105 . . . . . Shaper 1 Free Release / Time 2
106 . . . . . Shaper 2 Free Attack / Level 3
107 . . . . . Shaper 2 Free Decay / Time 3
108 . . . . . Shaper 2 Free Sustain / Level 4
109 . . . . . Shaper 2 Free Release / Time 4
110 . . . . . Shaper 3 Silver Attack
111 . . . . . Shaper 3 Silver Filter Decay
112 . . . . . Shaper 3 Silver Filter Sustain
113 . . . . . Shaper 3 Silver Filter Release
114 . . . . . Shaper 3 Silver Filter Depth
115 . . . . . FX Reverb Type
116 . . . . . FX Reverb Decay Time
117 . . . . . FX Reverb Diffusion
118 . . . . . FX Reverb HF Damp
119 . . . . . Reserved
120 . . . . . All Sound Off
121. . . . . Reset All Controllers
122. . . . . Local Control
123. . . . . All Notes Off
124. . . . . Omnimode Off
125. . . . . Omnimode On
126. . . . . Monomode On
127. . . . . Polymode On

MIDI implementation chart

Function	Transmitted	Recognized	Remarks
Basic Default	1	1	
Channel Changed	1 - 16	1 - 16	
Default	3	3	
Mode Messages	X	X	
Altered	*********	*********	
Note	0 - 127	0 - 127	
Number True Voice	0 - 127	0 - 127	
Velocity Note ON	0	0	
Note OFF	0	0	
Pitch Bend	0	0	
Control Change	0	0	Refer to controller list for details
Prog	0	1 - 100	n00 - n99
Change True #	*********	1 - 100	Bank Select LSB sets 100s Offset (n)
System Exclusive	0	0	
System Song Pos	X	X	
Common Song Sel	X	X	
Tune	X	X	
System Clock	X	X	
Real Time Commands	X	X	
Local on/off	0	0	
Aux All Notes Off	X	0	
Messages Active Sense	X	X	
Reset	X	0	
All Sound Off	0	0	Issued by 'Panic'
Notes			

Mode 1: OMNI ON, POLY
Mode 2: OMNI ON, MONO
Mode 3: OMNI OFF, POLY
Mode 4: OMNI OFF, MONO

O: Yes
X: No

Updates and Backups

A word on the USB interface

The USB interface is a baby born to the mother of home data processing, the PC. This I/O interface was begat by the desire to put an end to the confusion of connectors fostered by all the peripheral junk (I/O devices, external disk drives, scanners, speakers, cameras, etc.) suffering users have to deal with. USB is foolproof because it connects all devices using a uniform connector.

In Neuron, the USB interface serves to connect the device to a computer network for the purpose of transferring data to and from a PC/MAC. Neuron is the host (that's the big boss) in the USB system. Because Neuron's operating system does not allow a direct USB-host-to-USB-host link, Neuron must be connected to computers via an USB network adapter.

Check out our home page at www.hartmann-music.com for the scoop on recommended USB net adapters.

The Neuron USB interface devices can be plugged in and out without disconnecting Neuron, a process that in computerese is called hot plugging.

Neuron has a fixed IP address used for identification purposes. The USB interface does not require configuring.

The USB interface can be used...

- ... to load new models into Neuron via PC/MAC. Creating models based on your own sample material is always done on an external computer using the tool ModelMaker. We will send the ModelMaker software to you when we receive your registration!
- ... to load software updates (see page 189).
- ... to load/dump sounds, setups or models from and to the connected computer. This lets you archive your fave sounds and make backups of your setup library (see page 190).

► How to connect a PC/MAC and log on to Neuron

You need an USB net adapter and a suitable network cable to connect Neuron to a PC/MAC via USB. In addition, the TCP/IP Internet protocol and ftp client software that controls communication at the computer's end must be installed on your computer.

- Connect your PC/MAC to Neuron's USB interface via the USB net adapter.
- Configure a new LAN network link on your computer or open the properties/options menu of an existing connection.

  In the TCP/IP Internet protocol properties/ options menu, tell your computer to use the address entered by you rather than an automatically assigned IP address. Enter an IP address that – with the exception of the digits following the last dot - matches Neuron's address. Neuron's IP address reads:

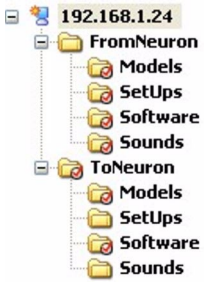
  192.168.1.24

  You could enter an address like 192.168.1.**10** for your computer.
- Launch the ftp client software on your PC.
- Log on to Neuron using the client software. To this end, indicate Neuron's IP address and enter `neuron` (lowercase!) as the user name and password.

  You can create a server profile if your ftp client supports this option. Then you will not have to log on to Neuron manually at every future network session.
- After you log on, the ftp root directory on Neuron's internal hard disk appears in the client software's file browser (see below).
- Copy your data to or from the given ftp subdirectories.

The ftp directory in Neuron

The ftp directory tree on Neuron's internal hard disk contains two folders that hold various subordinate folders. Consider Neuron's IP address by which the device is identified to be the root directory.



Note that Neuron is able to process incoming data only if you store it in the proper directory. Case in point: Neuron searches exclusively the `ToNeuron/Models` directory for the menu command `Load Models` and the `Software` folder for new software versions. During a dump, Neuron automatically writes data into the corresponding subdirectory in the `FromNeuron` folder.

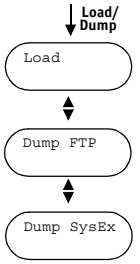
The load/dump function

The load/dump menu and the folders in the ftp directory on Neuron's internal hard disk are the gateway to the non-neural world outside. These are the tools required to upload and download data.

Load/dump: Menu

Open the menu by pressing the programmer **load/dump** button.

Every menu item offers several options (page 188) that you can select using the knob. The selected option determines which data will be up-/downloaded.



The load/dump menu is exited automatically when you change a parameter in any module. If you quit the load/dump menu by pressing the **load/dump** button again, Neuron jumps to the most recently edited menu. In both cases, the device remembers the most recently edited load/dump menu option and displays it immediately when you call the menu up later.

Load/dump: Options

Load	Loads data from the corresponding ftp subdirectory. Use the knob to select among the following options: • Software (folder `ToNeuron/Software`) • Models (folder `ToNeuron/Models`) • Sounds (folder `ToNeuron/Sounds`) • Setups (folder `ToNeuron/SetUps`) After you confirm an option via **enter**, Neuron loads all data held in the corresponding folder and stores it. For models, sounds and setups, uploaded data is stored under the same number in the corresponding database. Existing models/ sounds/setups are overwritten!
Dump ftp	Dumps data into the corresponding ftp subdirectory. Use the knob to select among the following options: • *Current* (`FromNeuron/*`). This option dumps - in **sound mode** - the currently loaded sound into the `Sound` folder and the models used therein into the **`Models`** folder, Continued on next page...

Table 25: Load/dump options

	- in **setup mode** - the loaded setup into the `SetUp` folder, the sounds contained in that into the `Sounds` folder and the models used therein into the **`Models`** folder. • *All Models* (folder `FromNeuron/Models`). • *All Sounds* (folder `FromNeuron/Sounds`). Unlike for the *current* option (see above), the constituent models are not exported. • *All SetUps* (folder `FromNeuron/SetUps`). Unlike for the *current* option (see above), the constituent sounds and models are not exported. • *Info* (folder `FromNeuron/Software`). Copies the files named ModelNames, SoundNames and SetUpNames. Every info file contains a separate line for each model/sound/ setup indicating the respective number and name, which are separated by a tab stop. After you confirm an option via **enter**, Neuron copies the data into the corresponding subordinate ftp folder.

Table 25: Load/dump options (cont.)

Dump SysEx	The options available here are almost identical to those of the menu item *Dump ftp*. However, this operation is not a data transfer in accordance with the FTP protocol. Instead, MIDI SysEx data is sent to the MIDI out interface. To learn more about this, read the section "How to send SysEx data" starting on page 180. Note that a SysEx data transfer takes a lot longer than an ftp load/dump.

Table 25: Load/dump options (cont.)

▶ How to load a software update

Hartmann Music distributes software updates via Internet or music stores.

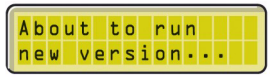
Hartmann Music will automatically inform you of new updates, if you have sent your registration to us and indicated an email address! You can tell if the version provided to you is newer than the one currently installed on your Neuron by comparing software version numbers (basic settings).

An update can contain lots of great stuff, including improvements to the system, expansions of previously implemented features, and new features.

- Copy the software update from a connected computer into the ftp directory **`ToNeuron/Software`** on Neuron's internal hard disk (see page 187).
- Press the **load/dump** button.
- Twist the knob to select the *software* option for the menu item *load*:

- Press **enter**.

- After Neuron has copied the update from the software folder, the following message appears:



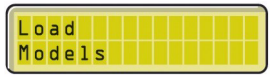
After some three seconds, the new software version is initialized and started.

Then Neuron deletes the data in the **ToNeuron/Software** directory.

► How to load models (sounds and setups)

The following walks you through the procedure for loading models. Proceed accordingly to load sounds and setups. Note that data must be stored in the corresponding **ToNeuron** subdirectory!

- Copy the desired models from a connected computer into the ftp directory **ToNeuron/Models** on Neuron's hard disc (see page 187).
- Press the **load/dump** button.
- Twist the knob to select the *models* option for the menu item *load*:



- Press **enter**.

Neuron loads the models into the model database and indicates the copying operation in the display. Existing models archived under the same numbers are overwritten!

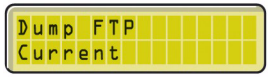
After Neuron has copied the models, the display reads **Done**.

Then Neuron deletes the data in the **ToNeuron/Models** directory.

► How to dump data

The following takes you through the procedure for exporting the current sound including models therein. Proceed accordingly to dump all models, sounds and setups.

- Switch Neuron to sound mode (we want to dump the current sound).
- Press the **load/dump** button.
- Twist the knob to select the *Current* option for the menu item *Dump*:



- Press **enter**.
- Neuron exports the current sound into the ftp subdirectory **FromNeuron/Sounds** and

the models referenced (linked) therein into the folder **`FromNeuron/Models`**.

Existing models or sounds archived under the same numbers are overwritten!

- You can transfer data from there to the connected computer using the ftp client software.

  By the way: we recommend that you delete data in Neuron's ftp directory after transferring it to your personal computer.

When you export all stored sounds via the *all sounds* option, the models contained therein are not exported along with the sounds!

Note that models are referenced by number in the sounds. When you re-import sounds (via *load/all sounds*), later, make sure that the referenced models have not been edited or deleted in the meantime. To be on the safe side, you may prefer to export and re-import the constituent models as well.

The same applies to dumped setups containing references to sounds!

Just feed it

Converting samples into Neuron models

Hartmann developed a special software called ModelMaker so you can create Neuron models from your own sample material and load them into Neuron via USB interface, that is, store these models in the model database on Neuron's internal hard disk.

You will receive ModelMaker as soon as your Neuron user registration arrives at the Hartmann offices.

This software of course comes with detailed documentation. It takes you step by step through the procedure for converting samples into Neuron models and loading your models onto Neuron.

How do you round-up "home-made" models and herd them into Neuron? By

- connecting a PC/MAC to Neuron, logging on to Neuron via network link (see page 186),
- copying the model data into the ftp subdirectory `ToNeuron/Models` (see page 187)
- and loading the models from there into the database via load command (see page 190).

Technical data

Operating conditions:

Ambient temperature range . . . . . .15° to 35°C
Humidity max.75%
Operating altitude . up to 2000 m above mean sea level

Power supply:

Mains voltage . . . . . 100 V AC to 240 V AC
Power frequency . . . . . .47 Hz to 63 Hz
Power consumption . . . . . .250 W
Nominal current consumption . . . . . max. 4 A

Analog audio outputs:

(6 x mono or 3 x two-channel stereo or 5.1 surround)
Peak level. . . . . .typ. 8 dBu (2 V RMS)
Signal-to-noise ratio (S/NR) . . . . . 109 dB(A)
Output impedance . . . . . typ. 221 ohms unbalanced
Frequency response . . . . . 20 Hz to 20 kHz
Total harmonic distortion (THD). . . . . < 0.006%
Conversion . . . . . 24-Bit Linear PCM Encoding
. . . . . 44.1 kHz sampling rate

Headphones output:

(stereo, signal same as stereo 1)
Class A headphones amp

Analog audio input:

(1 x Stereo)
Peak level . . . . . + 4 dBu
Signal-to-noise ratio (S/NR) . . . . . 100 dB(A)
Frequency response . . . . . 20 Hz to 20 kHz
Input impedance. . . . . .typ. 10 kOhms, unbalanced
Total harmonic distortion (THD) . . . . . .< 0.002%

Digital inputs/outputs:

Standard S/PDIF ports, 44.1 kHz / 24 bits

EWS TECHNOLOGY

EWS Technology is a trademark of TerraTec Electronic GmbH

Dimensions and weight:

Dimensions (W x H x D) . . . 952 mm x 98 mm x 373 mm
Weight. . . . . 17.5 kg

Connections for footswitches:

Switch pedal, sustain pedal, continuous controller pedal (10 to 100 kOhms recommended).

MIDI ports:

5-pin DIN connectors, one each for MIDI IN, MIDI out and MIDI THRU.

Basic data:

32-bit internal signal path, 32-bit/64-bit digital signal processing, high-end CPU with 256 Mbytes RAM, internal 20 Gbytes hard disk.

CE Declaration of conformity

Pursuant to directive EN 45014 the manufacturer **Hartmann GmbH**, Tettnanger Straße 311, 88214 Ravensburg, Germany, declares at its own risk and based on an examination of its design, that the product **Neuron Synthesizer**
complies with the following directives, laws and standards:

- 73/23/EEC Low Voltage directive
- 89/336/EEC EMC directive
- EMC directive Electromagnetic compatibility
- EN 60065 Safety requirements for audio, video and similar electronic devices
- EN 55103-1 Product family standard for audio, video, audio-visual and entertainment lighting control apparatus for professional use; Part 1: Emission
- EN 55103-2 Product family standard for audio, video, audio-visual and entertainment lighting control apparatus for professional use; Part 2: Immunity
- EN 55013 Limits and methods of measurement of radio disturbance characteristics of broadcast receivers and associated equipment
- EN 55020 Electromagnetic immunity of broadcast receivers and associated equipment
- EN 50081 Generic standards for emission requirements
- EN 50082 Generic standards for immunity requirements
- EN 61000-4-2 ESD (electrostatic discharges)
- EN 61000-4-3 Radiation
- EN 61000-4-4 Burst
- EN 61000-4-5 Surge
- EN 61000-4-6 Radio-electric fields
- EN 61000-4-11 Decreases in voltage

The development and manufacturing facilities of **Schlafhorst Electronics GmbH** are certified according to the evaluation standards ISO 9001 (1994) and ISO 9002 (1994) (Quality Management) for management systems.

Ravensburg, 2002 Axel Hartmann, General Manager Joachim Flor, General Manager

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