Table of Contents

Welcome to the family!

The computer is the center of modern music production. Yet, it is only 20 years ago that the MIDI standard has opened the door to this entirely flexible studio environment. Today, all components of a sound studio are available on the home computer – in the form of plug-ins. In order to guarantee best possible smooth integration of the neuronal synthesis into this environment, we have developed Neuron VS – the Neuron Virtual Synthesizer.

The neural synthesis so far was only available with the exclusive Neuron Synthesizer Keyboard. With the help of the intelligent computer algorithms used here it is possible to change sounds in a very elegant way, which has not been known before. The possibilities are that spectacular that Neuron became a much discussed topic shortly after its launch. In the meantime, the neuronal synthesis has become an inherent part of multiple exclusive sound studios. And we are proud that some of the greatest artists of our times are working with Neuron.

With Neuron VS many musicians now get the chance to use an important part of the Neuron Synthesizer for their music. As software synthesizer, it provides almost the same sound-sculpting possibilities as the hardware variant. And <Nuke>, the controller box, additionally enables unique, intuitive handling of the software.

We wish you many creative hours with your new instrument. To enable you to use the various possibilities of this synthesizer to their full extent, we recommend you read this manual carefully. You will find many helpful tips for creating your own sounds and additionally learn a bit about the history of this still young type of synthesis.

Welcome to the family!

Axel Hartmann

The Neuron VS Team

- Neuron VS Software:
  Sound Engine: Stephan Bernsee
  User Interface: Jürgen Fornof, Josef Pogadl
- <Nuke> Controller:
  Software: Stephan Stenzel
  Hardware: Axel Hartmann, Boris Schneider, Frank Schneider
- Project Management: Josef Pogadl, Axel Hartmann, Stefan Rapp, Frank Schneider
- Design: User Interface, CD / CI: Axel Hartmann, Design Box.
- Sound design: Jörg Hüttner (Management)
- User Manual: Volker Fischer (bfj document partner), Axel Hartmann, Tom Green, Maren Murphy (Translation English)

Thanks to:

(In alphabetical order): Werner Bernd, Design Box, Wolfgang Düren, Joachim Flor, Andreas Hafen, Martin Herbst, Russ Jones, Lothar Krell, Stephan Leitl, Prosoniq, Stefan Rapp, Schlafhorst Electronics, Manfred Tillmann, Hans Zimmer

Stephan Bernsee special thanks: My wife Melisande for her patience, Heidi Bouché, Barbara Post, Christiane Hansmann, Anika Brauch and all the others for their support and cooperation during the development of the technology, all coffee exporting nations, the Yellowtools gang for being the worst Marathon players ever, Bernhard Bouché for his crisis management, Bird's Custard, Seppi Pogadl and his girlfriend Charlotte for their unceasing patience, work and hospitality, Thad Brown for not hating me even though I don't answer his emails often, all people at Naham and Haham, UK, for providing acoustic assistance in clearing our throats, the gang at comp.dsp, the German railway for providing me with lots of wondrous journeys and plenty of time to work abroad, Denis "Big D" Gökdag for his invaluable input and weird ideas, and all the people I forgot to mention."

Copyright

License agreement

By using the Neuron VS software, you accept the conditions contained in the license agreement. The license agreement can be found on the data carriers supplied.

The manual ...

Your Neuron VS manual tells you how you get (or stay) rich, happy, gorgeous and famous – of course not. But presumably this would be an argument for everybody to read this manual…

We know very well: Reading operating manuals is a pain. So the question is: Who should read what in this manual?

... for pros

If Neuron VS is the latest in a long list of VST instruments 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 screens, 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!

Our Quick Start Guide starts on page 17 . 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** page 107 so that you can obtain any desired information in a hurry.

System requirements

PC version

- Processor: Intel Pentium III, IV a. compatible.
  Processor: minimum 850 MHz
  recommended > 2 GHz
- Main memory (RAM): minimum 256 MB
  recommended 512 MB
- Hard disc: min. 4 GB free storage space
- Operating system: Windows® XP
- Host application: VST 2.0 compatible
- Sound card: 44.1 kHz, 16 bit stereo
- connected controller keyboard.

Please also observe the system requirements of the used host application!

MAC version

- Processor: G4, G5
- Processor: minimum 800 MHz
  recommended > 1 GHz.
- Main memory (RAM): minimum 256 MB
  recommended 512 MB
- Hard disc: min. 4 GB free storage space
- Operating system: MAC OS Version OS X 10.2
- Host application: VST 2.0 compatible
- Sound card: 44.1 kHz, 16 bit stereo (all MACs)

Please also observe the system requirements of the used host application!

A word on CPU load ...

The performance of a VST instrument decisively depends on the resources of the machine on which the instrument is installed. But: Even if the recommended system requirements were made available on your machine, additional factors play a role for the actual performance power. For example, the configuration of the machine is not to be underestimated. Which processes run in the background while Neuron VS is executed?

Neuron-specific factors also have an impact on performance: Depending on the model, the resynators have to process different complex and large quantities of data, and depending on the selected blender type, the blender module requires more or less processing power. Furthermore, how many Neuron instances are being used, i.e. how many “neurons” are being played at the same time?

If the number of the actually playable voices is reduced, this indicates a CPU load that is too high. (In this context, also check the **Voice Limit** scroller on the Remote screen, with which you can determine the number of voices – see page 13.)

What do I do if the CPU has reached its limit?

- **Decreasing number of voices**: The **Voice limit** scroller is located on the Remote screen, with which you can set the number of available voices.
- **Switching off modules, changing effects/ parameters/blender type**: The load of the CPU naturally increases with each added Neuron module. Switch off as many (effect) modules as required and as few as possible. **Filters** especially are very computer-bound! Under certain circumstances, it might already be sufficient to use effects that use less processing power, as one effect is not like any other with regard to load. Or: Select a different blender type…
- **Latency settings in the host application**: The fact is: Latency values set very low cause the CPU to reach its limit faster. For this reason, in case of permanently high load it is recommended to increase the buffer size of the in- and outputs set in the host application (in most host applications, this setting is carried out in an ASIO control panel).
  As a rule, the minimum of required latency times (<12 ms = „just about inaudible“) can relieve the CPU.

Latency times

Latency times are a nuisance and in most cases occur when using a MIDI keyboard. They are usually caused by the sound card and/or the MIDI interface. For this reason, latency times should not occur when you feed Neuron VS via a MIDI track.

In case of latencies occurring, make sure that the sound card used has the required capacity! High-quality sound cards with fast ASIO 2.0 drivers that guarantee a latency of 2-10 milliseconds decrease the latency to an inaudible extent.

Installing Neuron VS

Standard accessories

Your Neuron VS package includes

- the installation CD,
- the <Nuke> with USB cable
- this operating manual (sad stab at a joke),
- and the registration card.

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

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 registration card and send it to your local distributor or to the address printed on the card.

Installing the software

Installing Neuron VS under Windows

Before you start: Make sure that the host application is installed and configured correctly (sound card and controller keyboard configured)!

Install Neuron VS on the hard disc of your machine as follows:

- Insert the Neuron VS CD into the CD drive. If the Autorun feature is enabled for your machine, the installation routine starts automatically. Otherwise, browse to the directory of the CD ROM drive with the Windows Explorer and start the installation program **setup.exe** from there.
- Follow the instructions of the installation program.

Once installation of Neuron VS is complete, first install the Neuron remote control - the <Nuke> - (see below) and then configure your neuronal synth in the host environment (see page 9).

Deinstalling Neuron VS under Windows

Open the system control panel ('Windows Start Menu | Settings | Control Panel') and open the list with the software installed ('Add or Remove Programs'). Click on the entry 'Neuron VS' and then on the 'Remove' button. Follow the instructions on the screen.

Installing Neuron VS under MacOS

Before you start: Make sure that the host application is installed and configured correctly (sound card and controller keyboard configured)!

Install Neuron VS on the hard disc of your machine as follows:

- Insert the Neuron VS CD into the CD drive.
- Open the directory on the Neuron VS CD by double-clicking on the icon of the CD drive.
- Start the installation by double-clicking on the icon of the installation program.
- Follow the instructions of the installation program.

Deinstalling Neuron VS under MacOS

Start the installation program and select the menu option 'Uninstall' in the popup menu (upper left corner).

Installing the <Nuke>

Installing the <Nuke> under Windows

You can connect the <Nuke> with the USB interface of your machine while the host application and Neuron VS are open.

Proceed as follows:

- Connect the supplied cable with the <Nuke> and a USB port of your machine. The operating system detects the new connected hardware (message "New Hardware detected – Neuron Stimulus") and opens the hardware wizard.
- In the hardware wizard, select the option 'Automatic Installation (recommended)' and click on 'Next'. The hardware wizard now looks for the <Nuke> driver on the Neuron VS CD and starts installation.
- A Windows dialog is opened in which you need to confirm the installation of the <Nuke> driver by clicking on the 'Continue installation' button.

When installation is complete, you will receive a respective confirmation message; the Neuron <Nuke> is entered in the Windows Device Manager and is ready for use.

In the next step you can configure the <Nuke> - if you do not want to keep the preset routing of the controllers on the <Nuke>. Information on how to proceed can be found on page 16.

Deinstalling the <Nuke> under Windows

The deinstallation of the <Nuke> driver is performed in the Windows Device Manager:

- Select 'Windows Start Menu | Settings| Control Panel | System'.
- In the 'System Properties' dialog, click on the 'Hardware' tab and on the 'Device Manager' button.
- In the 'Device Manager' dialog, extend the list of installed USB controllers: Here, the entry „Hartmann Neuron <Nuke>" can be found.
- Right-click on the entry and select 'Uninstall' from the context menu.
- Now follow the instructions on the screen.

Installing the <Nuke> under MAC OS

Connect the supplied cable with the <Nuke> and a USB port of your machine. The <Nuke> is now ready.

Configuring and starting the Neuron VS in the host application

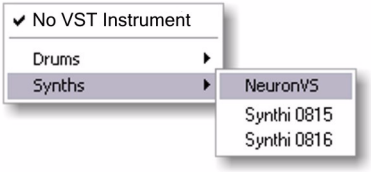
Before you start: Make sure that the host application is installed and configured correctly (sound card and controller keyboard configured)!

As an example, we will show you the procedure for configuration and opening Neuron VS for Steinberg host applications (Cubase SX, Nuendo). The procedure is similar for other products (almost identical). More information can be found in the documentation of your host application.

► **Your Neuron VS is configured as VST instrument as follows:**

- Open the window ‚VST Instruments' in the host application (menu 'Devices | VST Instruments').

- Click on a free slot in the text 'No VST Instrument' and in the menu that now appears, open the 'Synths' group. Here you will find Neuron VS and can select it by clicking on it.



Neuron VS is now opened automatically and is switched on already.

- Allocate a MIDI track to Neuron VS in the host application.

Additional details can be found in the documentation for your VST host. There you can also find information about closing or muting Neuron VS etc. (although we cannot really imagine why you would want to do that...).

The user interface of Neuron VS

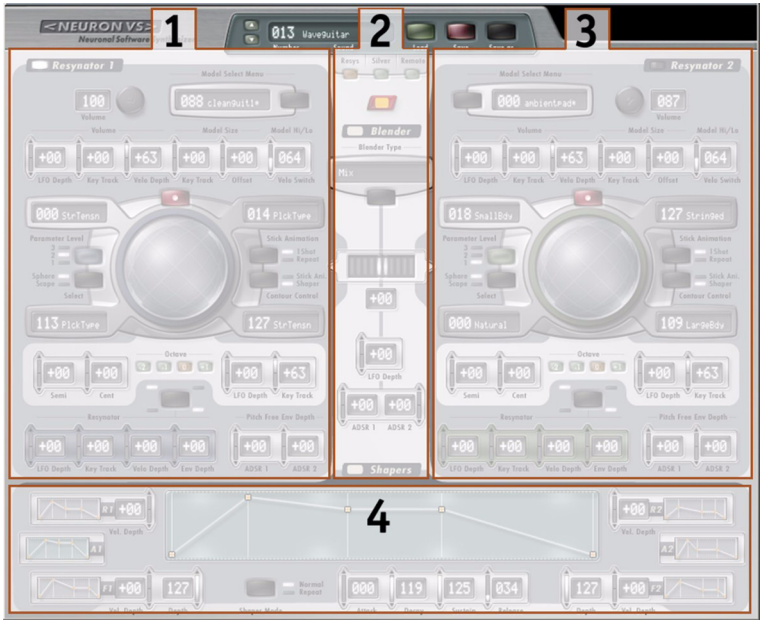
The Neuron VS screens

The Neuron VS user interface is divided into three areas, which we refer to as ‘screens’.

On all screens, the **Programmer** is visible at the very top, which is the sound management center of Neuron VS.

In the **Programmer** you load and save sounds (see page 24). Here you will also find the three buttons ‘Resys’, ‘Silver’ and ‘Remote’, with which you can switch between the three Neuron VS screens.

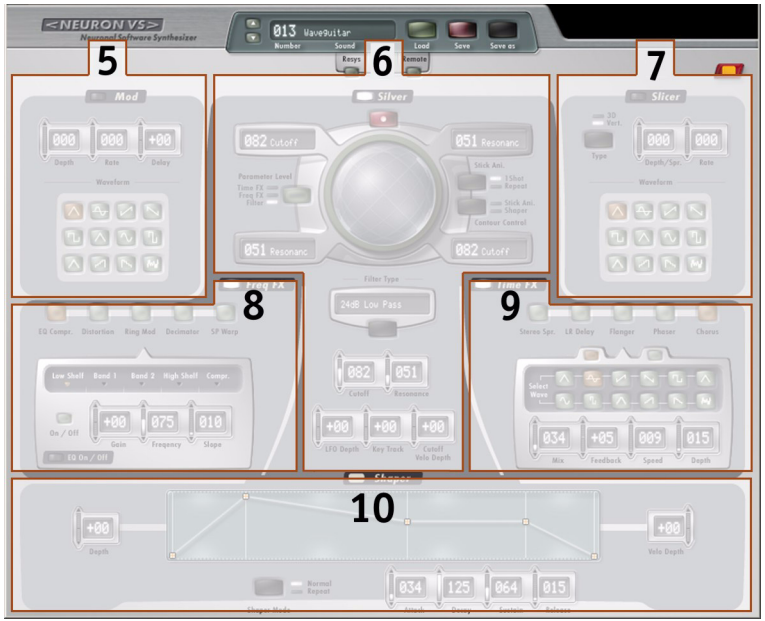
The Resys screen



(1) and **(3)** are the two **resynators** (description from page 26). This is where the sonic revolution starts! Resynators are the interface between Neuron's models and your creative powers.

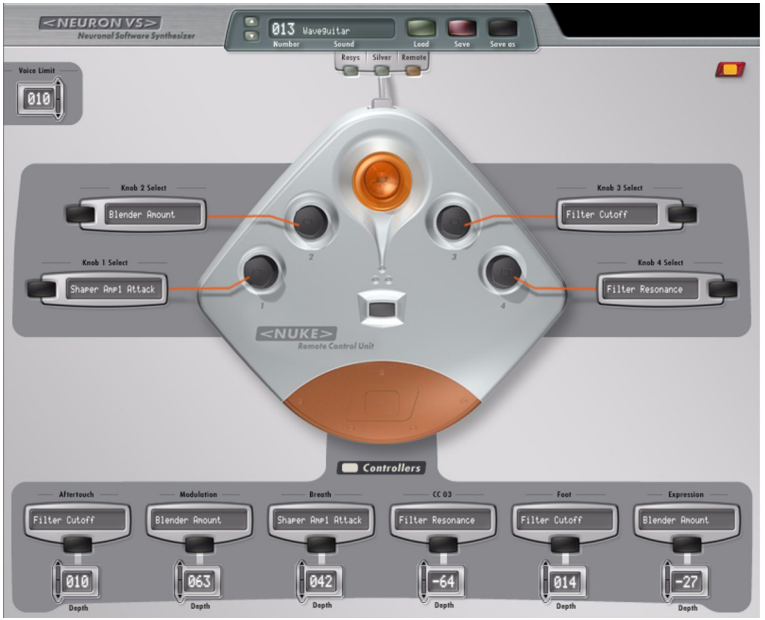
(2) The **blender** is the arbitrator between the two resynators (description from page 48). **(4)** The **shaper** includes a total of six flexible envelope generators (see page 54).

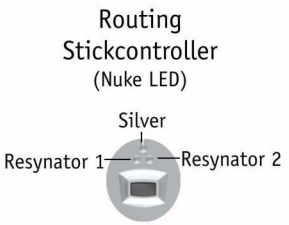
The Silver screen



(5) Lurking beneath the **mod**'s unassuming exterior is a powerful LFO generator serving as a freely assignable modulation source (page 61). **(6)** The **silver** module is a multi-effect sporting a top-flight multimode filter (page 69). Typically for Neuron, the parameters can also be defined easily via the <Nuke>. **(8)** and **(9)** To the left and right of the filter settings, the silver frequency effects FreqFX and the time-based effects TimeFX can be found. **(7)** The slicer: An unusual variation of an LFO (page 66). **(10)** In the silver **shaper**, an ADSR envelope is provided for the filter (page 96).

The Remote screen





The Remote screen is the configuration side for the <Nuke> connected via USB. With a mouse click on the buttons next to the displays you determine which parameter is to be controlled via the respective **<Nuke> knob** (see page 16). Below the stick you will find the picture of a button, which has three LEDs. These indicate which module is currently controlled via the stick controller of the <Nuke>. Switching is carried out externally on the <Nuke>. In the **'Controllers'** area, you route external controllers and determine their depth (see page 102). With the **Voice limit** scroller, the number of voices can be set (see page 5).

The Neuron <Nuke>

The <Nuke> as remote control is a very important interface between your creativity and the nearly inexhaustible supply of sonic goods of the Neuron VS. Its control features include the stick controller for controlling the model parameters in the resynators as well as the silver parameter and four rotary encoders which can be routed on 3 levels to four parameters each of any modules.

At the same time, the <Nuke> is the Neuron VS hard key, your legitimation!

<Nuke> 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. The same can be said of the resynator. The stick controller located on the <Nuke> 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.

▶ **This is how you route the stick to one of the resynators or the silver module**

Which Neuron VS module is controlled by moving the <Nuke> stick controller is determined by repeated pressing of the button below the stick.

The LED (on the <Nuke> and on the Remote screen) displays which module is currently selected for the stick (also see the illustration on page 13). Left: Resynator 1, top middle: Silver, right: Resynator 2.

The stick controller has its functional counterpart on the Resys and Silver screens: The bubble in the porthole of the respective resynator or silver respectively moves simultaneously to the stick movement and indicates its position.

Every porthole 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.

Parameter values can **not** be changed directly via the porthole with the bubble "floating" in it or the cross-x display. Value changes are only possible via the <Nuke> stick.

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.

Position of the stick when loading new parameters

There is no motor stick on the <Nuke>, which after switching to a different parameter level or after loading a different sound, model, filter or effect retrieves the current parameter values and then positions itself accordingly. 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.

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.

Stick animation

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

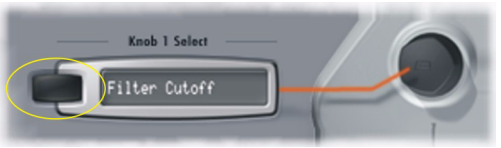
For a detailed description of stick animation, check out page 45.

<Nuke> knob

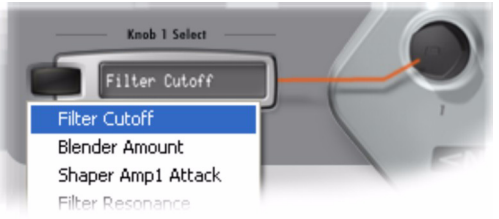
Each of the four knobs can be routed to **nearly any parameter** of the Neuron modules on three levels, i.e. a total of 12 parameters can be controlled remotely.

▶ **This is how you allocate parameters to the knobs**

- Select one of the three levels by pressing the button below the stick controller on the <Nuke>. The LED above the button displays the selected level (left: Resynator 1, middle: Silver, right: Resynator 2).
- Click on the respective button in the Remote screen next to the display.



- A dropdown menu is displayed, from which you can select the desired parameter.



If you then turn the respective knob on the <Nuke>, the allocated parameter changes correspondingly.

Let the games begin...

Once Neuron VS has been configured as VST instrument and now glimmers in front of you on the screen and you have already been made familiar with the basics of the Neuron VS interface, the journey into the astonishing world of sound of neuronal synthesis can begin.

If at any point you cannot contain your excitement any longer and want to find out the order and hierarchy of modules in the signal flow: A detailed diagram can be found on page 22/23 that should answer all your questions.

Loading and playing sounds

You have three options for loading sounds:

- You can either doubleclick onto the programmer display (at the top of the screen) and enter the three-digit sound number via the computer keyboard (the sound is loaded immediately after entering the third digit),
- or press the **up**/**down** buttons on the left of the display to load the next/previous sound,
- or click on **Load** and select the desired sound in the dropdown dialog.

You will find further information in the topic „Programmer: Programming sounds“ ab Seite 25.

Silver effects on/off

The FreqFX and TimeFX units can be switched on or off individually via the buttons **Freq FX** and **Time FX**. You can also opt to switch the entire silver module on and off via the **on/off** button.

For a detailed description of the silver module, see page 69.

Using the <Nuke> stick controller/knob!

For the preset sounds, all controllers on the <Nuke> are routed to certain parameters by standard. The Remote screen shows which ones they are.

Repeated pressing of the button below the stick controller on the <Nuke> changes the routing of the stick controller from resynator 1 via resynator 2 to silver etc., and at the same time changes the routing level of the <Nuke> knobs.

By any means, try out the stick and controller when testing the sounds. This will give you a first impression of their amazing sound-shaping possibilities. The topic „The Neuron <Nuke>“ ab Seite 14 describes how to change the routing of the <Nuke> control features.

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 26.

Use external controllers!

Neuron provides the option to integrate external controllers like Aftertouch, Expressionpedal, Breath Controller etc. into the modulation matrix. Routing and depth of the controller are determined on the Remote screen. Many of the preset sounds are already allocated to these controllers.

To learn more about this, read the chapter „Routing the controller (<Nuke> & external)“ ab Seite 101.

Neuron VS basics

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 and display features. The tactile experience of generating sound via Neuron is something entirely apart from what you have encountered with conventional (VST) synthesizers.

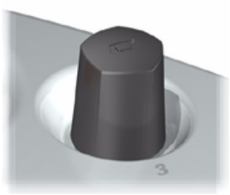
Stick controller on the <Nuke>

Central control feature of the resynators as well as the silver module is the stick controller which is located on the <Nuke> connected via USB interface. Detailed information about the <Nuke> stick controller can be found on page 14.

Knobs (encoders) in the screens

Some Neuron parameters are set „onScreen" via **encoders**. To change a value, click on the respective knob and move the mouse upwards **while pressing down the mouse button** (increasing the value) or downwards (decreasing the value). The changed value is shown directly in the display.

Rotary encoders on the <Nuke>



The remote controller <Nuke> connected via USB interface also has 4 knobs which can be routed to four parameters each on the Remote screen on three levels, i.e. 12 different parameters can be controlled remotely with the <Nuke>.

Information about knobs and linking parameters can be found on page 16.

Scrollers in the screens

Most parameters are entered via so-called **scrollers**. Similar to a slider in the real world, the value changes by moving the scroller up or down. The current value is displayed in the respective display. The LED next to the display gives a quick overview.

Left-click on the scroller bar or the respective knob and move the mouse upwards **while pressing down the mouse button** (increasing the value) or downwards (decreasing the value).

Single steps: By clicking on the arrow above or below the scroller bar, the value is increased or decreased by a value of 1.

Value input via computer keyboard

All parameter values that are determined via scroller or encoder can also be entered via the computer's keyboard. For this purpose, double-click on the respective display with the left mouse button and enter the value into the "empty" display. Confirm the entered value by pressing the Return button.

Hierarchies: The Neuron memory model

Like the food chain in the real world, Neuron is ordered into hierarchies. We differentiate between two main hierarchies.

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 sound-shaping options, and the sky is the limit.

In our download center under www.hartmann-music.com you will find additional models in future for downloading, created by our sound designers or also by enthusiastic Neuron users (also see page 44).

The model files containing all *sphere* and *scape* parameters come in different sizes depending on complexity, which is why performance can fluctuate depending on the models used.

In the topic „The idea behind Neuron models“ ab Seite 27 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 second 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.

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

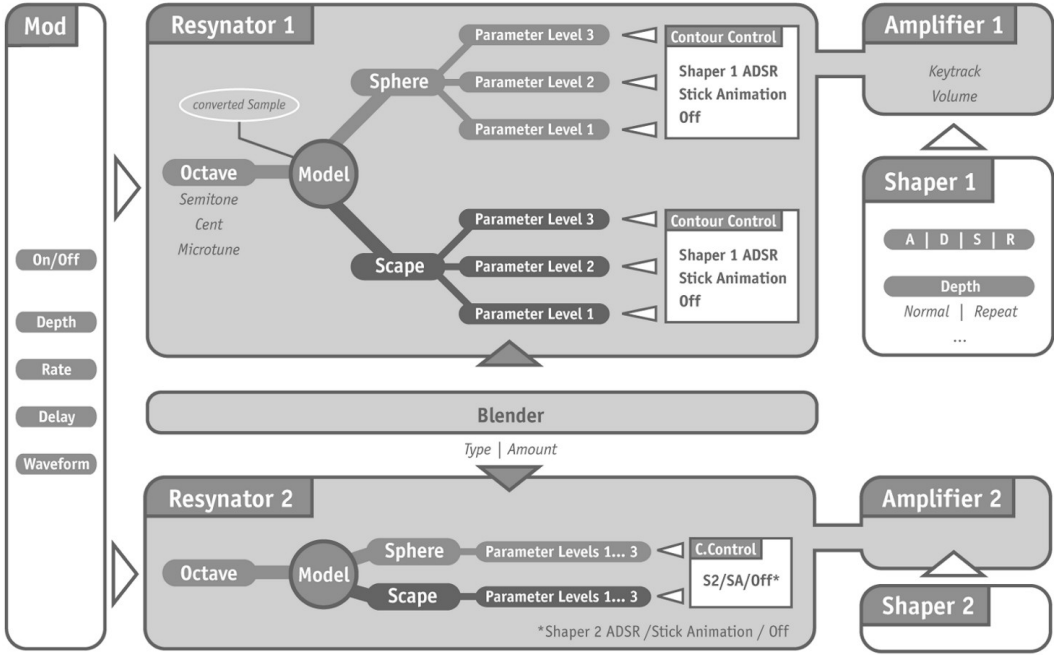
- The name and number of the sound.
- References (or links) to the employed model numbers of both resynators.
- Settings of all parameters of both resynators (see page 30).
- Blender settings (see page 49).
- Envelope settings (see page 59).
- Mod settings (see page 63).
- Slicer settings (see page 68).
- Silver settings (see page 80).
- Controller routings (see page 101).

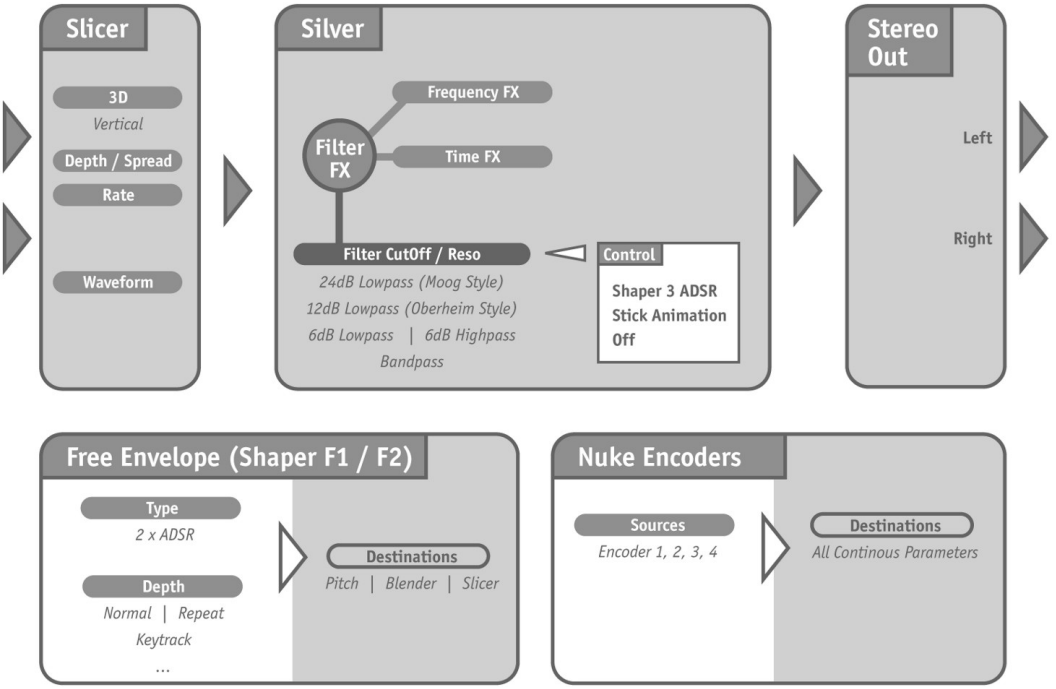
Unlike many other synthesizers, Neuron has no need for sound banks, because all sounds are archived sequentially. For purposes of MIDI addressing, consider sounds 0 to 99 to be a "virtual" first bank, sounds 100 to 199 a second bank, and so forth.

Neuron VS modules

Signal flow

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





Signal flow (part II)

Module: Programmer

In the Programmer you load and store sounds and switch between the different screens. The programmer is visible in all three screens.

Programmer: Control features

Down and **Up** buttons	With the **Down** button you scroll down through the stored sounds. Press the **Up** button to load the next higher sound. After selecting a sound, all data stored for this sound are loaded into the Neuron modules.
Load button	Opens a dropdown dialog for selecting a sound. After selecting a sound, all data stored for this sound are loaded into the Neuron modules.
Save button	Stores the current sound (see page 25). Existing sound cards are overwritten.
Save as button	Stores the currently loaded sound with all its associated parameters under a different name. A dialog is displayed in which you can allocate the new sound name and a number.
Resys, **Silver** and **Remote** buttons	Switches between the different Neuron VS screens (overview on page 10).

Table 1: Programmer control features

Programmer: Programming sounds

▶ How to load a stored sound

You have three options for loading sounds:

- In order to step through all sounds successively, press the **up** or **down** button in the programmer. In each step, the next sound is loaded and indicated in the main display.
- Click on the **Load** button and select the desired sound in the dropdown dialog.
- Double-click onto the programmer display and enter the three-digit sound number via the computer keyboard (the sound is loaded immediately after entering the third digit),

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

▶ 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 22.

- You want to use an available sound as basis for a new sound? In this case, you must first load it, as described above.
- Then load other models into the resynators (see page 42) and change their parameters (page 42).
- Use the blender (page 48)!
- Use envelopes (page 54).
- Shape the sound using the mod module (page 64), the slicer (page 66), or the filters/ effects in the silver unit (page 69).

▶ How to store a sound

If you like your new creation, store it. All parameters pertaining to a sound are stored with the sound as properties.

- Click on the **Save** button to overwrite the parameters of the current sound with the new settings.
- Click on **Save as** to store the current settings under a different name and a different sound number.

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 found a feasible solution to the user 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 parameters names like *big*, *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:

The neural synthesis engine works with precisely defined classifications. It 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 <Nuke> 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

Each model is subdivided into two parameter regions: A *Scape* and a *Sphere* region.

A *scape* puts 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 26.

The Neuron library contains models of classical instruments; after all, bending the commonplace sounds of adaptable algorithms 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 neural synthesis.

The first time you fire up the synthesis engine, it will dawn on you what astonishing sound-shaping possibilities the stick controller in the resynator offers!

Manipulating scape and sphere

The actual editing of a model – that is, invasive sound sculpting – is performed in real-time using the <Nuke> 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 one 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 toggling the stick. For its *Scape* parameters, our flute is assigned at one of the three levels "wide / narrow" and "clear / rough". This way, the flute sound can be changed in its breadth and roughness.

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 shaper on the Resys screen serves as envelope generator: The envelope generators R1 and A1 on the left side belong to resynator 1, resynator 2 is modulated by envelope generators R2 and A2 respectively.

For controlling the resynator's pitch, the two shapers additionally provide freely routable ADSR envelopes (F1 for resynator 1, F2 for resynator 2). The curve parameters are defined in the shaper, the *depth* (and therefore its routing) is determined in the given resynator (*FreeEnv Pitch*, see page 40).

To learn how to handle the shapers, read the section „Module: Shaper (resynators)“ ab Seite 54.

As an alternative, stick movements can be recorded in real-time and applied selectively to control the parameters at the *Scape/Sphere* level.

We call this process **stick animation** and have dedicated an entire chapter to it starting on page 45.

Pitch, volume and parameter modulation

The volume of every resynator output as well 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 64.

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

To this end, the *LFO depth* parameters are available for pitch, volume, and L1 scape 1/3 to L3 sphere 2/4. All parameters are described in Tabelle 2 from page 30.

Resynator: Control features and parameters

The following table describes the control features and parameters of the two resynators. The different elements/ parameters are listed in the order in which they can be found in the resynators form left to right and from top to bottom.

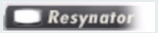
On/Off button 	On/off switch for the resynator. Pressing this button can mute every resynator.
Encoder **Volume**	Determines the volume of the resynators. This lets you adjust and balance the relative levels of the two resynators. Value range: 0 to 127.
Button and display **Model select/menu**	By pressing the button next to the display you can select and load a model for the resynator. The display shows the name and number of the currently loaded model.
Scroller **Volume: LFO depth**	Determines the modulation depth of the mod-generated LFO oscillation module 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 63). Global *LFO depth* is offset against this modulation destination's *depth* value.

Table 2: Parameters/resynator control features

Scroller **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 assigned to the given zone. 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 41.
Scroller **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 (up to a maximum of 127). This means 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.

Table 2: Parameters/resynator control features (cont.)

Scroller **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 models remains largely unchanged when it is transposed. This yields a more natural, organic sound. 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 offsets* 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 2: Parameters/resynator control features (cont.)

Scroller **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 is smaller than the original sample.
Scroller **Model Hi/Lo: Velo switch**	**Heads up**: This parameter is enabled only when the model loaded in the resynator distinguishes between lo and hi 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 hi velocity zone plays. If the force of your key attack falls short of the defined threshold value, the model's lo 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 2: Parameters/resynator control features (cont.)

Stick controller (<Nuke>) and porthole in the screen	The stick controller is located on the <Nuke>. Routing of the stick to the resynators or the silver is performed by repeated pressing of the button below the stick on the <Nuke>. The LEDs on the <Nuke> and on the Remote screen display the current routing (left = resynator 1, middle = silver, right = resynator 2). **Resynator porthole**: The position of the <Nuke> stick controller is indicated by the bubble in the porthole of the respective resynator. For scape parameters, the bubble is curved inwardly, for sphere the bubble is curved outwardly. **Color marking**: Depending on the selected parameter level (see **Parameter level** button), the resynator porthole is displayed in a different color. Green = level 1, blue = level 2 and red = level 3. **Resetting all model parameters**: By clicking on the porthole while holding the <Ctrl> button, the parameters of the current module are reset to standard values.
Displays around the porthole	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 porthole. **Resetting an individual parameter value**: By clicking on a display while holding the <Ctrl> button, the parameter is reset to the default value.
Button **Parameter level**: 1 / 2 / 3	*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 the stick. **Colour marking:** Depending on the selected level, the ring around the porthole and the resynator parameters *LFO depth, Key track, Velo depth* and *Env depth* are displayed in a different colour: Green = level 1, blue = level 2 and red = level 3.
Button **Select: Scape / Sphere**	The parameters of every model are subdivided into *Scape* and *Sphere* parameters (see page 28). 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 2: Parameters/resynator control features (cont.)

Button for stick recording 	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 45.
Button **Stick animation**	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. 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 45.

Table 2: Parameters/resynator control features (cont.)

Button **Contour control**	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. It is important here that the respective envelope (**R1** or **R2**) is defined in the shaper. *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 35). **Manual stick movements have no effect on the current parameter level while stick animation is activated!**
Buttons **Octave: -2** to **+1**	The pitch for the given model can be edited in octaves. Value range -2 to +1. In this context, also take note of the *Pitch* parameter *Semi* and *Cent* (see below).
Scroller **Semi** and **Cent**	Tune the resynators. • *Semi*. Value ranges from -24 to +24. The scroller detunes in semitone. • *Cent*. Value ranges from -99 to +99. The scroller detunes in cent steps.

Table 2: Parameters/resynator control features (cont.)

Scroller **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 63). Global *LFO depth* is offset against this modulation destination's *depth* value.
Scroller **Pitch: Key track**	Determines the key tracking for the resynator's pitch. Value range: -64 to +63. Default value: 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 41.
Parameter selection button 	Selects the parameter pair of the currently set parameter level on which the scrollers in the **resynator** region are supposed to have an effect (**LFO depth**, **Key track**, **Velo depth**, **Env depth**). More information on this can be found in the following lines in the table.

Table 2: Parameters/resynator control features (cont.)

Scroller **Resynator: LFO depth**	**Caution:** The set value refers to the parameter pair which is selected via the parameter selection button (see above) and the buttons **Parameter level** and **Scape/Sphere** . Determines the modulation depth of the mod-generated LFO oscillation module 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 63). Global *LFO depth* is offset against this modulation destination's *depth* value.
Scroller **Resynator: Key track**	**Caution:** The set value refers to the parameter pair which is selected via the parameter selection button (see above) and the buttons **Parameter level** and **Scape/Sphere** . 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 notes below C3. The higher the value, the further this weighting is shifted to the right of the keyboard. ...Continued on next page

Table 2: Parameters/resynator control features (cont.)

	Negative values: Notes below the center key (C3) are weighted lower than for notes above C3. The lower the value, the further this weighting is shifted to the left. See also the illustration on page 41.
Scroller **Resynator: Velo depth**	**Caution:** The set value refers to the parameter pair which is selected via the parameter selection button (see above) and the buttons **Parameter level** and **Scape/Sphere** . 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.
Scroller **Resynator: Env depth**	**Caution:** The set value refers to the parameter pair which is selected via the parameter selection button (see above) and the buttons **Parameter level** and **Scape/Sphere** . Determines the modulation depth of the envelope R1 or R2 on individual *scape* and *sphere* cross-x parameter pairs of resynator 1 or 2 respectively. Value range: -64 to +63 *EnvDepth* = 0: Parameters are not modulated. *EnvDepth* > 0: Starting at the current value, the parameter value increases in accordance with the envelope (up to a max. value of 127). *EnvDepth* < 0: The value decreases in accordance with the envelope.

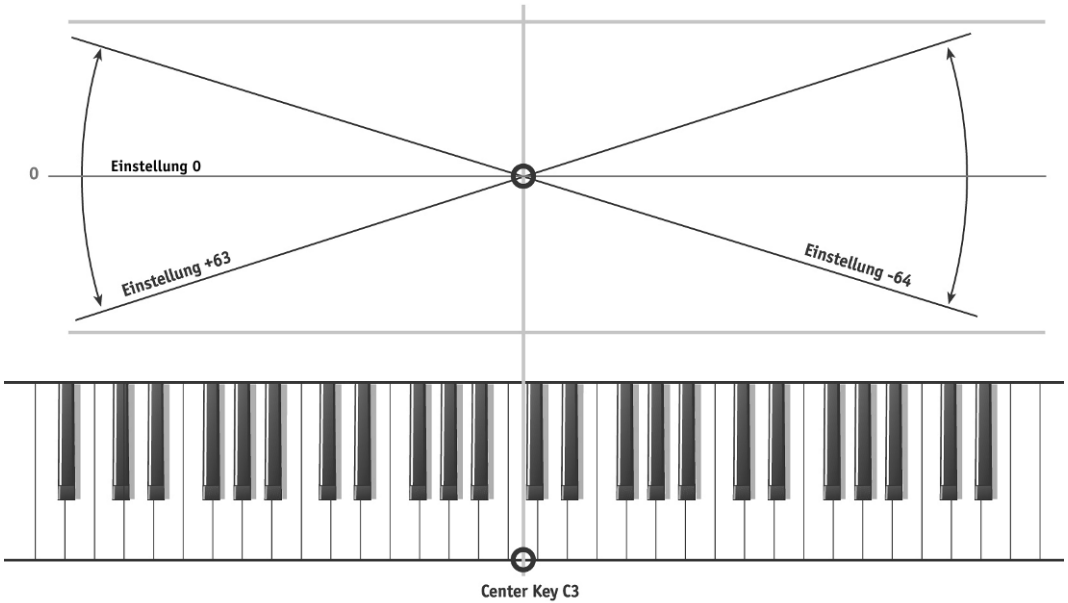
Table 2: Parameters/resynator control features (cont.)

Scroller **Pitch Free Env Depth** **ADSR1** and **ADSR2**	Determines the modulation depth of the free ADSR envelope F1 or F2 respectively generated by the shaper and the intensity of its effect on the 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. Note in this context the *global depth* of the envelope, , which is defined directly in the shaper (page 60). This global *Depth* is offset against the *Free Env Depth* value determined at this modulation destination.

Table 2: Parameters/resynator control features (cont.)

Key tracking

You can define key tracking performance for every resynator (scroller **volume: Key track** (page 31), **resynator: Key track** (page 38), **Pitch: KeyTrack** (page 37)) and for the filters of the silver unit (page 83).



Starting from the center key, this parameter weights a module or a parameter in 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

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

- Activate the given resynator (**on/off** button).
- Press **Model select**.
  A dropdown menu is displayed, from which you can select the desired model.

The model is loaded with which values?

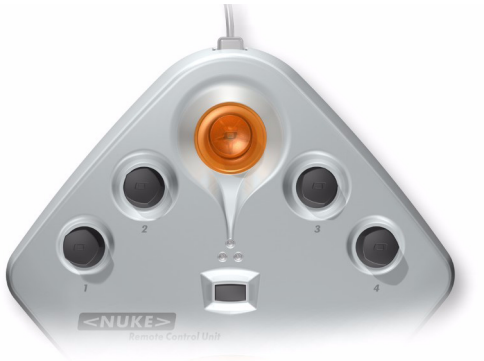
When loading a new model, not the stored default values of the model are loaded into the resynator, but the current settings are retained. The model is used for the current parameter environment for the sound.

Resetting the parameters to default values:

In order to set a single parameter to its default value, click on the respective parameter display while holding the <Ctrl> button. In order to set all parameters to their default value, click on the porthole while holding the <Ctrl> button.

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

- To edit a model's parameter values, first select the parameter region (**Select: Scape/Sphere** button), followed by the desired level (**Parameter level**) button. The ring around the porthole and the frame of the resynator scroller (at bottom of resynator) change color, depending on the set parameter level.
- On the <Nuke>, press the button above the stick controller several times until the LED indicates that the stick is routed to the desired resynator (left: Resynator 1, middle: Silver, right: Resynator 2).



- Edit the current levels parameters using the stick controller. The four displays around the stick indicate the current values, the bubble in the porthole of the resynator "follows" the movement of the stick:

Resetting the parameters to default values:

In order to set a single parameter to its stored value, click on the respective parameter display while holding the <Ctrl> button. In order to set all parameters to their default value, click on the porthole while holding the <Ctrl> button.

- Tune the resynator up or down using the **Octave** buttons. Use the **Semi** and **Cent** scrollers to detune the model in semistone or cent steps.
- **Velocity**: In order to modulate the resynator volumes via key pressure, use the **Volume: Velo depth** (page 31) scroller

If you want to modulate cross-x parameters via key pressure, first select the desired parameter pair (**Parameter level** button, **Scape/Sphere** button and parameter selection button, see page 37), and define the velocity value via the **Resynator: Velo depth** scroller (page 39).

- **Key tracking**: If desired, define volume key tracking for the entire resynator (**Volume: Key Track** scroller) or select a parameter pair (**Parameter level**, **Scape/Sphere**, parameter selection button) and determine the key tracking for this specific pair via the **Resynator: Key track** scroller.
- **LFO**: If you want to modulate the model via an LFO oscillation, first define the oscillation in the mod module (page 64), then define the modulation depth in the resynator.
  Pitch: **Pitch: LFO depth scroller**
  Volume: **Volume: LFO depth scroller**
  individual parameter values: first of all selection of the parameter pair via the **Parameter level**, **Scape/Sphere** and parameter selection button, see page 37, and the **Resynator: LFO depth** scroller.

- **Contour control**: Use the **Contour control** 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 stored for the given level. For more on this, read the section starting on page 45.

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

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

► **This is how the models are "imported":**

Importing models which you have for example downloaded from the Internet or exported from the "great" Neuron is very simple:
During installation, the "NeuronDB" folder is created (you can determine its path yourself). In this folder, all models must be stored so that they can be loaded into the resynators.
Simply copy the new models into this NeuronDB directory – and you're done.

Already stored models with the same number are overwritten with this procedure!

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".

Next to envelopes, stick animation is your other option for editing 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 means 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 the freq FX.
- You can play back a stored track at the parameter level at which it was recorded. You must press the **Contour control** button to specifically select an animation and play it back for each level (see page 36).
- With the **Stick animation** button you can 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.
- Exclusively 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 control**), then this level responds exclusively to the animation. No other type of manipulation – say, toggling 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 maximum duration of a recording depends on the number of recorded tracks and the intensity of stick movements. No worries,

though: under normal conditions, you are unlikely to push any boundaries!

- Stick recordings are stored with the sound. If you exit a sound without storing it, the recorded tracks evaporate in the digital ether!

► **How to record a stick movement:**

A new recording on the same track (and at the same parameter level) overwrites a previously stored 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.
- On the <Nuke>, press the button above the stick controller several times until the LED indicates that the stick is routed to the desired resynator (left: Resynator 1, middle: Silver, right: Resynator 2).

- In the resynator, press the **Record stick** button in order to switch the recording function to standby. The LED above the button flashes.

- Start the actual recording by moving the stick.

  The Record button lights up continuously during the recording process.

Every movement of the stick controller is recorded.

- You complete the recording by pressing the Record 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 or switch Neuron VS 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 create an animation.

  Press the **Contour control** button for this level repeatedly so that the *Stick animation* LED lights up.

  Repeat this step for every desired parameter level.

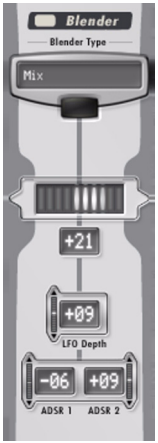
- With the **Stick animation** button, determine for each *Scape-/Sphere* parameter level in which mode the stick animation is supposed to occur: *1Shot* or *Repeat* (see parameter table on page 35).

▶ **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 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 imaginary 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 housing of a grand concert or a snare striking the strings of a guitar – what would that sound like?

Practically the only boundary is your zeal for experimentation, particularly when you consider the complex intra-resynator routing options that various blender types (see page 51) put at your disposal. Especially the more abstract models 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 F1 and F2 (see **Depth** scroller on page 49 or **ADSR** scroller on page 50).

Blender: Control features and parameters

Button/display **Blender type**	Selection or display of the blender type. The blender type determines how the two resynators influence each other. The available blender types are described and illustrated on page 51. Once you have clicked on the button next to the display, a dialog for selecting the blender type appears.
Blender scroller	The blender scroller 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 model (see the section „Blender: Types“ ab Seite 51). The *amount* can be modulated via the LFO oscillation of the mod or the free envelopes of shaper 1 and 2. For this purpose, respective *Depth* scrollers are available (see page 49).
Scroller **LFO depth scroller**	Determines the modulation depth of the mod-generated LFO oscillation module and 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 63). Global *LFO depth* is offset against this modulation destination's *depth* value.

Table 3: Control features/parameters of the blender

Scroller **ADSR 1** and **ADSR 2**	Determines the modulation depth of the free ADSR envelope F1 or F2 respectively generated by the shaper and the intensity of its effect on the *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). *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. This global *Depth* is offset against the *Free Env Depth* value determined at this modulation destination.

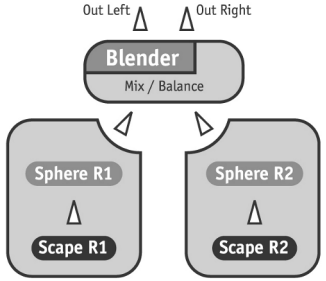
Table 3: Control features/parameters of the blender (cont.)

Blender: Types

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

Mix

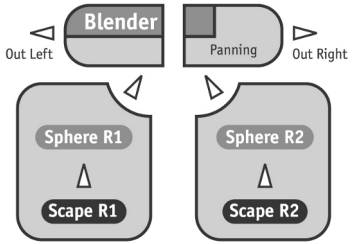
Scape 1 plays through sphere 1, scape 2 plays through sphere 2. The results are mixed in the blender and sent to the output. *Amount* controls the balance between the two results.



Blender type: Mix

Stereo

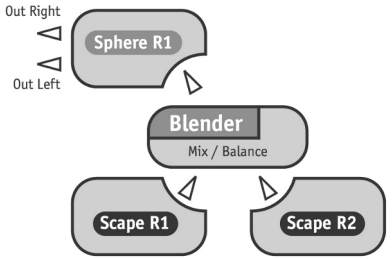
Scape 1 plays through sphere 1, scape 2 plays through sphere 2. Each result is sent to a separate output channel. *Amount* determines the panorama position.



Blender type: Stereo

Mix singlesphere

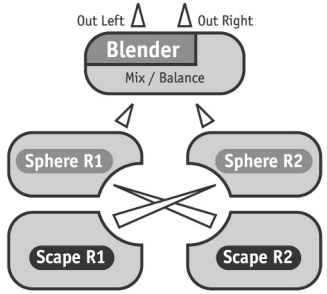
Scape 1 and scape 2 play and are mixed in the blender. The composite signal is routed through sphere 1 to the output. *Amount* controls the balance between scape 1 and scape 2.



Blender type: Mix singlesphere

Chromophonic

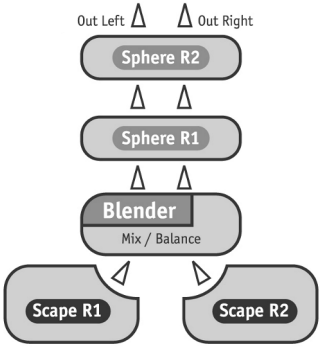
Scape 1 plays through sphere 2, scape 2 plays through sphere 1. The results are mixed in the blender and sent to the output. *Amount* controls the balance between the results.



lender type: Chromophonic / Velo chrome

Dual sphered

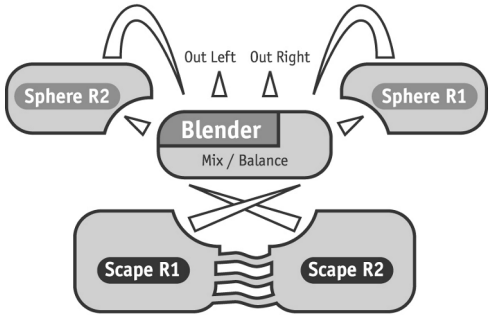
Scape 1 and scape 2 are mixed proportionally in the blender, sent through sphere 1 and sphere 2 consecutively, and then routed to the output. *Amount* controls the balance between scape 1 and scape 2.



Blender type: Dual sphered

Intermorph

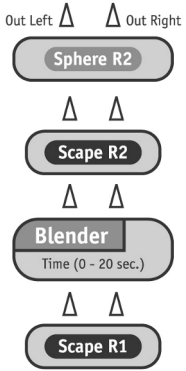
Scape 1 and scape 2 are split up into a complementary (or opposite) frequency band (for example, one frequency band contains low frequencies, the other high frequencies). Then these bands are mixed cross-x and proportionally in the blender and the signal is patched to the other sphere. The result is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



Blender type: Intermorph

Dynamic transsphere

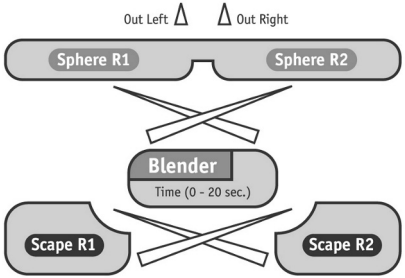
Scape 1 cross-fades over to scape 2 within a definable time. The resulting signal is patched through sphere 2 and then to the output. *Amount* controls the cross-fade time (up to 20 seconds).



Blender type: Dyn. transsphere

Dynamic crossmorph

After a definable period elapses, scape 1 and scape 2 are cross-faded or morphed reciprocally 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).



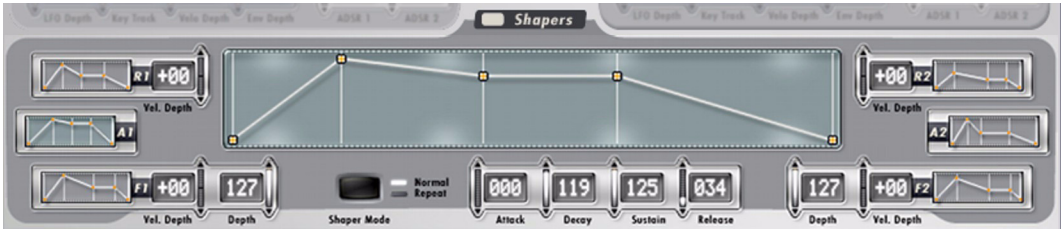
Blender type: Dyn. crossmorph / Velo crossmorph

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" resynators 1 and 2.

Module: Shaper (resynators)

The shaper is an extremely versatile envelope generator. It is flexible as the envelopes can influence different parameter and modulation destinations.



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, in contrast, is a single trigger function. This means that after starting it by pressing the first key, it runs through once only (*Normal*) or it is cycled (*Repeat*). For more on this, read page 57.

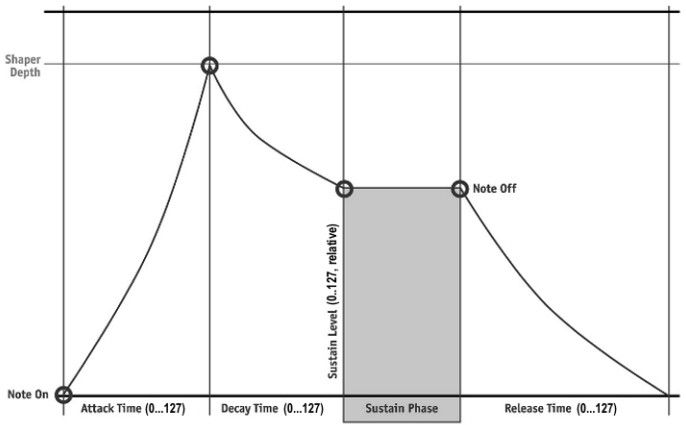
ADSR envelope

Like many classic synthesizers, every Neuron shaper offers a handy four-phase **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

Modulating volume via an ADSR envelope

Say you opt to use the aforementioned ADSR envelope to modulate the amplitude of a sound, 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 **A1** defined on the left in the shaper influences resynator 1, the routing of envelope **A2** is fixed: it is "hard-wired" to resynator 2.

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

Modulating volume via an ADSR envelope

In the shapers, you can define free ADSR envelopes (**F1** and **F2**) to modulate either of the two resynators' pitches.

The free ADSR curve's depth is defined via an „overall" depth (see **Depth** scroller for the F envelopes in the respective shaper) **and** via the **Pitch: FreeEnv Depth** (**ADSR1** and **ADSR2** scrollers) in the respective resynator (see page 40).

Modulating model parameters

An envelope can modulate the amplitude and frequency (pitch) of a signal alongside other parameters.

Neuron's two resynators and the sound models loaded to them offer infinite sound-shaping without adding envelopes 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 makes 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. And once you have released the key, the metallic sheen fades during the release phase. You see: Not hard to envisage!

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: For a *Metallicity* value of 70, the envelope modulates the parameter within the value range of 70 and 127.

So how does this modulation get configured in Neuron? The envelope **R1** defined in the shaper on the left modulates the resynator 1's model parameters, envelope **R2** influences resynator 2's parameters. As a prerequisite for the modulation, the given resynator's **Contour control** button must be set to *Shaper*. The envelope's depth can be determined separately for every parameter level in the resynator (**Resynator: Env depth** scroller, page 39).

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 from page 60).

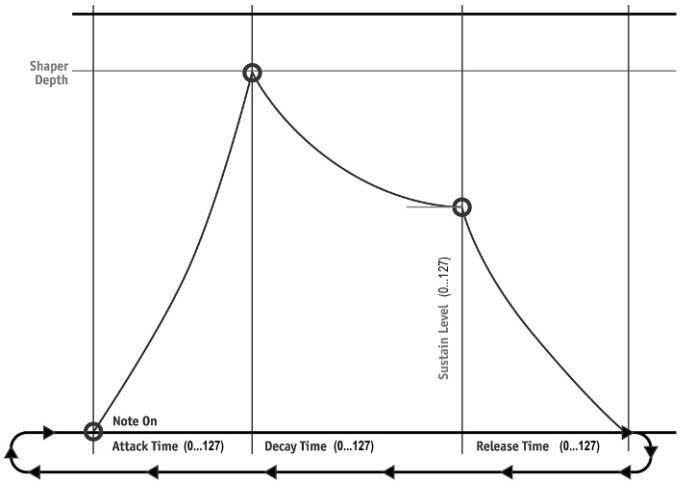
Normal or repeat?

You already learned that pressing a key triggers an envelope. Let us look at it from the opposite perspective: pressing any key launches the time-based process that is an envelope. But what happens next? Neuron distinguishes between two modes (also see **Shaper Mode** button, page 60):

In *Normal* mode, the envelope runs through once. After the release time elapses, it takes a new note to re-trigger the envelope.

The envelope is cycled when you select the *Repeat* option. However, the envelope does not run its full course because the sustain phase is truncated. 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 loop continues for as long as the key is held down. Releasing the key stops the envelope immediately.

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



ADSR envelope in repeat mode

Shaper 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.

The *amplifier* envelope **A1** is "hard-wired" to resynator 1's amplifier and therefore modulates the signal's amplitude or volume. The same applies to envelope A2 and resynator 2.

The *Parameter level* envelopes **R1** and **R2** are „hard-wired" to its resynator's model parameters. The *Depth* can be determined separately for each of the three *Scape* and *Sphere* parameter levels of the resynators (**Resynator: Env Depth** scroller in the resynator, see page 39). This means that the modulation intensity can be varied selectively for every cross-x parameter pair at the six parameter levels, even if the same curve is assigned to all parameters.

F envelopes as modulation source for pitch and blender

The *Free envelopes* **F1** and **F2** can be assigned to two modulation destinations compared to the A and R envelopes. Use the respective *Depth* parameter of the desired modulation destination to route free envelopes:

- Modulating the resynator pitch:
  Use the scrollers **Pitch Free Env Depth ADSR1** and **ADSR2** in the resynators (see page 40).
- Modulating blender amount:
  For the intensity of the envelope's effect on the *Amount* blenders, set the desired value at the blender scrollers **ADSR1** and/or **ADSR2** (page 50).

If a modulation destination's *Depth* = 0, the given envelope will not modulate it.

Shaper (resynators): Control features and parameters

Envelope miniatures **R1/2, A1/2, F1/2**	On the left and right hand side of the shaper region there are 6 LEDs, in which the defined envelopes are displayed. They have the following meanings: • R = Resynator: Modulating model parameters • A = Amplifier: Modulating the resynator volume • F = Free envelope. Modulation of the resynator pitch and/or the blender amount • The following routing applies to the R and A envelope: 1 = Resynator 1, 2 = Resynator 2.  In order to edit an envelope, click on the respective miniature. The envelope is highlighted in blue and copied to the large editing field (see next table line).
Envelope editing field	In order to edit an envelope you first have to „copy“ it to the large editing field via mouseclick. The envelope in question can be detected by the color marking of the respective miniature.  You can edit the envelope in the editing field in two ways: • You click on the handles (at the separating line between two envelope phases each), hold the mouse button and drag the point to the desired position. • You can set the values with the **Attack**, **Decay**, **Sustain** and **Release** scrollers.
Scroller **Attack / Decay / Sustain / Release**	Input for the envelope parameters. Click on the respective display and while holding the mouse button, move the mouse upwards (increase value) or down (decrease value). The influence of the *Sustain* level setting is - like the *Depth* setting - relative to the defined target parameter value. The parameters of an ADSR envelope are described on page 54.

Table 4: Parameters/control features of the resynator shaper

Scroller **R1/2 Vel. Depth**	The *Env depth* parameter, which you set per parameter level in the resynator (**Resynator: Env depth** scroller, see page 39) defines the intensity of the envelope's effect on the model parameters. 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.
Scroller **F1/2 Vel. Depth**	As for parameter *R1/2 Vel. depth*, the depth set at the modulation destination (resynator pitch and/or blender amount) is also modulated via the velocity. The value ranges are identical with those of the *R1/2 Vel. depth* parameter (see above).
Scroller **F1/2 Depth**	Overall depth of the free envelope F1 or F2 respectively. When using free envelopes, please bear in mind the relevance of the *Depth* value determined at the modulation destination! See also page 58.
Button **Shaper mode**	Defines the envelope mode. For more on this, read also page 57. The mode can be selected for all envelope types (A, R and F). • *Normal*: Playing a note triggers the envelope once only • *Repeat*: Playing a note triggers the envelope. After the release phase, a new cycle is launched with the attack phase.

Table 4: Parameters/control features of the resynator shaper (cont.)

Module: Mod

The Mod module houses a polyphonic, freely routable low frequency oscillator (LFO).

The Mod module is located in the Silver screen.

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 and the cutoff frequency of the filter currently selected in the silver module. Help is near 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 between 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 55) 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 resynator's volume.

Next 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 modulation source option the mod **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 module). For example, in order to modulate the pitch of resynator 1 via an LFO oscillation, set the **Pitch: LFO depth** scroller in the resynator 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 directly in mod (**Depth** scroller). 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 (**Pitch: LFO depth** resynator scroller), volume (**Volume: LFO depth** scroller) and all cross-x parameter pairs of every *Scape* and *Sphere* parameter level (**Resynator: LFO depths** scroller, see page 38).
- Blender: amount (see page 49).
- Silver: Cutoff frequency of the current filter. (**LFO depth** silver scroller, see page 83).

Mod: Control features and parameters

On/Off button 	Switches the modulator on/off.
Scroller **Depth**	Amplitude of the LFO oscillation. The higher the amplitude, the more pronounced the modulation effect. 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.
Scroller **Rate**	Frequency of the LFO oscillation. Value range: 0.0 to 20.0 Hz in 0.02 Hz steps.

Table 5: Mod parameters and control features

Scroller **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.
Selection field **Waveform**	Waveform of the modulating oscillation. All waveforms are pictured on page 65.

Table 5: Mod parameters and control features (cont.)

Mod: Handling

- Switch on the LFO generator Mod.

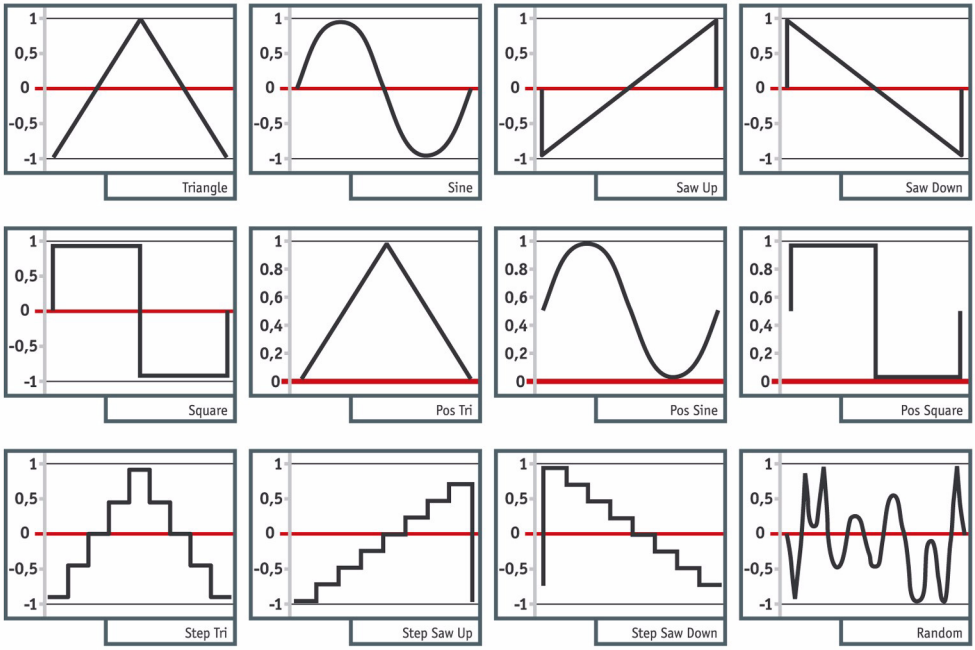
- Route the LFO oscillation to the desired modulation destinations by setting a value other than zero for the *LFO depth* parameter at every desired modulation destination. All modulation destinations are listed on page 62.

  If you determine the routing before defining the *Wave*, *Rate*, and *Depth* LFO parameters, you will be able to hear every change made to the LFO oscillation and its on 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

You can select the following waveforms in the **Waveform** selection field:



Module: Slicer

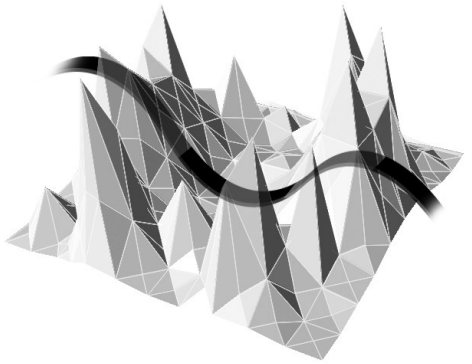
... the "cutting machine".

If you surmised that the slicer in the Silver screen 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 knob **Depth**. 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

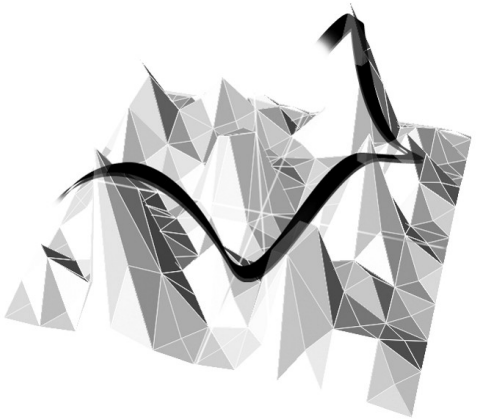
Analogy time again: Imagine, as we do, the resynators' output to be a three-dimensional sonic cloud (similar to the image of a spectral model gained in a Fourier analysis). Slicer is an animating force: it generates down/updrafts (by way of the selected oscillation) that changes the altitude of this 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. Apart from pure sound modulation, an animation within the stereo image takes place at the same time. *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.

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 a time-consuming task requiring lots of brainwork.



Slicer in 3D mode

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. That is a pity because particularly contemporary synthesizers 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 frontier. Right there in the heart 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.

Slicer: Control features and parameters

Button **Type**	On/off switch and selector button for Slicer mode. Select the mode pressing it several times. Slicer is deactivated if the LED is extinguished.
Scroller **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. Value range: 0 to 127.
Scroller **Rate**	Adjusts the frequency of the slicer oscillation. Value range: 0.0 to 20.0 Hz in 0.1 Hz steps.
Selection field **Waveform**	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 65.

Table 6: Control features and parameters of the slicer

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 the control features on the <Nuke> and on the Silver screen. 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 each of the selected frequency or time-based effect using the same method.

With up to three parameter levels and three two-way parameter sets to choose from, you can create many musically meaningful combinations. Then you can sweep back and forth between the opposed parameters of these parameters sets simultaneously, processing them via any of the time- or frequency-based effects that you have at your disposal.

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 73.

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 from page 71. Additional filter types are currently being designed!

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 type filter (high-, low- or band-pass page 71). 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. It thus runs through a certain frequency range. This procedure is called **filter sweep**.

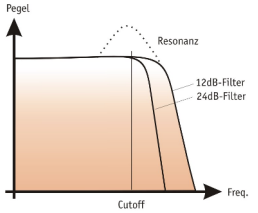
- **Resonance:** One property of filters is that they boost the frequencies in the immediate vicinity of the cutoff frequency. The higher the resonances, the more the frequencies surrounding the cutoff frequency (or the center frequency in the case of band-pass filters) are boosted in relation to other 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 tones 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

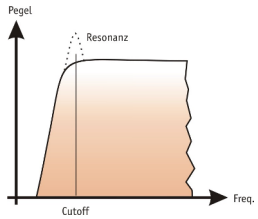


A low-pass filter allows only frequencies below the cutoff frequency to pass. Higher frequencies - that is, the upper-range frequencies responsible for brightness - are cut from the soundscape. The result is a softer sound. Think of the low-pass as the David Hamilton of filters...

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.

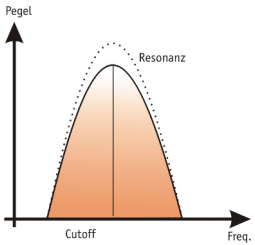
Neuron provides three (count 'em!) low-pass filters of dB, 12 dB and 24 dB. All filters can be directly requested via the Silver button **Filter type** .

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. In Neuron, there is a high-pass with a quality of 6 dB – it can be found in the Filter dropdown menu (press the **Filter type** 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 is 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.

The Neuron band-pass can also be found in the Filter dropdown menu (**Filter Type** silver button).

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 95).
- The silver shaper 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 100.
- 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 62).
- You can modulate the filter's cutoff frequency via your attack dynamics. Velocity depth is determined via the *Velo depth* parameter (see page 84).

Frequency-base effects (Freq FX)

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

Depending on the selected effect, different parameters and control features are visible in the lower region.

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 page 84.

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 own *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 and 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).

Depending on the selected effect, different parameters and control features are visible in the lower region.

This effects group is equipped with a dedicated On/Off switch: **Time FX**.

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

The parameters and control features of the Time FX parameters are explained in the tables from page 92.

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 on 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 LFO 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 to do 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 it 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 instrument 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 and 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**).

The different parameters and elements are listed in the order in which they can be found in the respective region from left to right and from top to bottom on the screen.

General and filter-specific elements

On/Off button 	Silver on/off switch. When silver is switched off, all effects including the filter unit are bypassed.
Stick (on the <Nuke>) and porthole on the Silver screen	You read earlier that intuitive handling and fast results were our top priority in designing the resynators. The can be said of silver. The two most important parameters of the selected silver effects can also be controlled via the stick on the <Nuke> . For the filters, these are the cutoff and resonance frequencies. You will find more on this in the parameter tables. **Routing the <Nuke> stick on the silver**: In order to be able to control the <Nuke> stick, press the button below the stick repeatedly on the <Nuke>, until the medium one of the three LEDs lights up. The **Parameter level** button determines which settings (Filter, Freq FX or Time FX parameters) are assigned to the stick. As for the resynator the Silver screen displays a porthole, in which a moveable bubble indicates the current position of the stick. The ring around the porthole changes its color depending on the set parameter level: Filter: green, FreqFX: blue, TimeFX: red.
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 7: Silver: Control features and filter parameters

Button **Parameter level**	This button determines which parameters are assigned to the stick. Example: If *Filter* is the defined parameter level, you can toggle the stick to edit the defined 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! Depending on the selected parameter level, the button and the porthole change its color: Filter green, FreqFX: blue, TimeFX: red.
Button for stick recording 	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 95.
Button **Stick ani.**	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. 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 95.

Table 7: Silver: Control features and filter parameters (cont.)

Button **Contour control**	The **filter unit** of the silver can be modulated either by an ADSR envelope defined in the silver shaper (filter envelope, not available for Freq FX/Time FX) or by a previously recorded movement of the stick controller)also for Freq FX/Time FX). By pressing this button several times, you can select between: • Off (no LED lights up): An envelope or stick animation does not manipulate the filter or the effect. • Shaper: The ADSR envelope in the selected shaper is assigned to the current filter type. To learn how to define the envelope and the intensity of the shaper's effect on the envelope via the **Depth** scroller, read page 100. • Stick animation: The stick movement previously recorded (see above in the table) is played back in *1Shot*or *Repeat* mode, depending on the *Stick animation* setting (**Stick Ani. button)** (see page 95).
Button/display **Type (filter)**	Selection or display of the blender type. 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 71.
Scroller **Cutoff**	Cutoff frequency of the selected filter. For more on this, read also page 70. Value range: 0 to 127 (covers the entire frequency range).
Scroller **Resonance**	Resonance of the selected filter. Value range: 0 to 127.

Table 7: Silver: Control features and filter parameters (cont.)

Scroller **LFO depth scroller**	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 63). Global *LFO depth* is offset against the *Depth* value set here.
Scroller **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. 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 41

Table 7: Silver: Control features and filter parameters (cont.)

Scroller **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 7: Silver: Control features and filter parameters (cont.)

Freq FX parameters

Effects are selected by clicking on an effect button. Depending on the selected effect, the control features are displayed for defining the effect parameters. The effects are described in the section starting on page 73.

Parameters/Control features: EQ/Compressor

LowShelf	The parameters are only visible when **LowShelf** is 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 8: Silver: Parameters/control features for FreqFX EQ Compr.

B1 Gain
B1 Freq

Band 1	The parameters are only visible when **Band 1** is 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	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
Compressor	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.

Table 8: Silver: Parameters/control features for FreqFX EQ Compr. (cont.)

Parameters/control features: Distortion

Buttons **Clip Curve**	Determines how the incoming oscillation is cut when the amplitude exceeds the clip point. You have various types of curves to choose from.
Scroller **In Drive**	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.
Scroller **Pre filt cut**	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).
Scroller **Out volume**	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.

Table 9: Silver: Parameters/control features for FreqFX distortion

Parameters/control features: Ring modulator

Buttons **Wave**	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 65.
Scroller **Mix**	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.
Scroller **Mod Freq**	Determines the ring modulator's carrier frequency. Value range: 0 to 127 corresponds to 0 Hz to 5 kHz.

Table 10: Silver: Parameter/control features for FreqFX ring modulator

Scroller **Speed**	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.
Scroller **Depth**	Determines the modulation depth of the carrier frequency (*Mod freq*) via the LFO oscillation. Value range: 0 to 127.
Scroller **X-over delay**	Visible on "page 2" of the RingMod parameter. Determines the amount (dry/wet) of delayed signal sent back to the ring modulator's input from its output via feedback loop. Value range: 0 to 127.
Scroller **X-over time**	Visible on "page 2" of the RingMod parameter. Determines delay time for the signal sent back to the ring modulator's input from its output via feedback loop. Value range: 0 to 1000 corresponds to ms.
Scroller **X over del. Feedb**	Visible on "page 2" of the RingMod parameter. 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.

Table 10: Silver: Parameter/control features for FreqFX ring modulator (cont.)

Parameters/control features: Decimator

Scroller **Mix**	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.
Scroller **S&H factor**	Determines to which extent the original signal is reduced by the sample&hold circuit. Value range: 0 to 127.
Scroller **Pre filt cut**	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).

Table 11: Silver: Parameters/control features for FreqFX decimator

Parameters/control features: SPWarp

Scroller **Mix**	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.
Scroller **Frequency**	Center frequency at which the spectrum of the incoming audio signal is inverted. Value range: 0 to 127.
Scroller **Tilt**	Determines the down-sampling factor. The sampling rate and pitch decreases in accordance with this value. Value range: 0 to 127.
Scroller **Damping**	6 dB low-pass filter. Value range: 0 to 127 (covers the entire frequency range).
Scroller **Speed**	Determines the frequency of the modulating LFO oscillation. Value range: 0.0 to 20.0 Hz in 0.1 Hz steps.
Scroller **Depth**	Determines the LFO oscillation's modulation depth. Value range: 0 to 127.

Table 12: Silver: Parameters/control features for FreqFX SPWarp

Time FX parameters

Effects are selected by clicking on an effect button. Depending on the selected effect, the control features are displayed for defining the effect parameters. The effects are described in the section starting on page 77.

Parameters/Control features: Stereo spread

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

Table 13: Silver: Parameters/control features for TimeFX stereo spread

Parameters/Control features: LR delay

Scroller **Mix**	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.
Scroller **Time**	Determines delay time. The value applies to both stereo channels. Value range: 0 to 1000 (ms).
Scroller **Feedback**	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.

Table 14: Silver: Parameters/control features for TimeFX LR delay

Parameters/Control features: Flanger

Buttons **Select Wave**	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 65.
Scroller **Mix**	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.
Scroller **Feedback**	Defines the amount of signal routed back to the effect's input via feedback loop. Value range: -64 to 63.
Scroller **Speed**	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.
Scroller **Depth**	Determines the LFO oscillation's modulation depth. The higher the value, the stronger the flanging effect. Value range: 0 to 127.
Scroller **Stereo phase**	Visible on "page 2" of the Flanger parameter. 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 15: Silver: Parameters/control features for TimeFX flanger

Parameters/Control features: Phaser

Buttons **Select Wave**	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 65.
Scroller **Mix**	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.
Scroller **Feedback**	Defines the amount of signal routed back to the effect's input via feedback loop. Value range: -64 to +63.
Scroller **Speed**	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.
Scroller **Depth**	Determines the LFO oscillation's modulation depth. The higher the value, the stronger the phaser effect. Value range: 0 to 127.
Scroller **Stereo phase**	Visible on "page 2" of the Phaser parameter. 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 16: Silver: Parameters/control features for TimeFX phaser

Parameters/Control features: Chorus

Buttons **Select Wave**	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 65.
Scroller **Mix**	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.
Scroller **Feedback**	Defines the amount of signal routed back to the effect's input via feedback loop. Value range: -64 to 63.
Scroller **Speed**	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.
Scroller **Depth**	Determines the LFO oscillation's modulation depth. The higher the value, the stronger the chorus effect. Value range: 0 to 127.
Scroller **Stereo phase**	Visible on "page 2" of the Chorus parameter. 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.
Scroller **PreDelay**	Visible on "page 2" of the Chorus parameter. 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 17: Silver: Parameter/control features for TimeFX Chorus

Silver: Handling

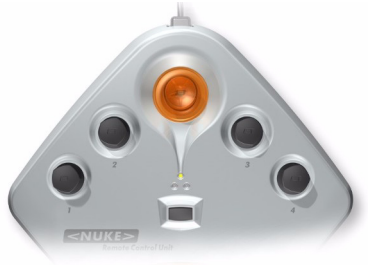
▶ How to select/define a filter

Filter types and parameters are described on page 70. You will find explanations of the parameters in page 80.

- Switch silver on (**On/Off** button).

- Press the silver **Parameter level** button repeatedly so that the *Filter* LED lights up.
- Press the **Filter Type** button and select a filter type.

- On the <Nuke>, repeatedly press the button below the stick controller until the medium LED lights up. The <Nuke> stick is now routed to the silver unit.



- Toggle the stick controller to edit the cutoff frequency and resonance.

- If required, route certain silver parameters to the knob of the <Nuke>. For this purpose, scroll to the Remote screen, click on the button of the desired knob and select the parameter.

Resetting the parameters to default values:

In order to set a single parameter to its default value, click on the respective parameter display while holding the <Ctrl> button. In order to set all parameters to their default value, click on the porthole while holding the <Ctrl> button.

▶ How to select/define an effect

A **Frequency effect** serves as the example in the following description. Proceed accordingly for time-based effects.

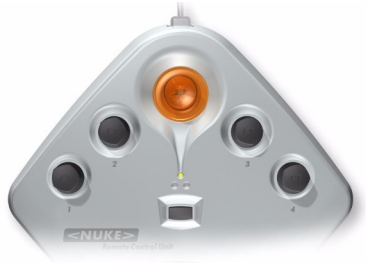
Bear in mind that only one frequency effect and one time-based effect can be active at any given time!

- Switch silver on (**On/Off** button).

- Switch the FreqFXgroup on so that you can hear the effects of parameter changes immediately while editing.

- Press the silver **Parameter level** button repeatedly so that the *Freq FX* LED lights up.
- Select the desired effect:

- Define the effect parameter.
- On the <Nuke>, repeatedly press the button below the stick controller until the medium LED lights up. The <Nuke> stick is now routed to the silver unit.



- You can toggle the stick to edit the two most important parameters of the selected effect. In our example using "Sp_warp," these are *Mix* and *Frequency*.

- If required, route certain effect parameters to the knob of the <Nuke>. For this purpose, scroll to the Remote screen, click on the button of the desired knob and select the parameter.

Resetting the parameters to default values:

In order to set a single parameter to its default value, click on the respective parameter display while holding the <Ctrl> button. In order to set all parameters to their default value, click on the porthole while holding the <Ctrl> button.

► Stick recording and animation in the silver

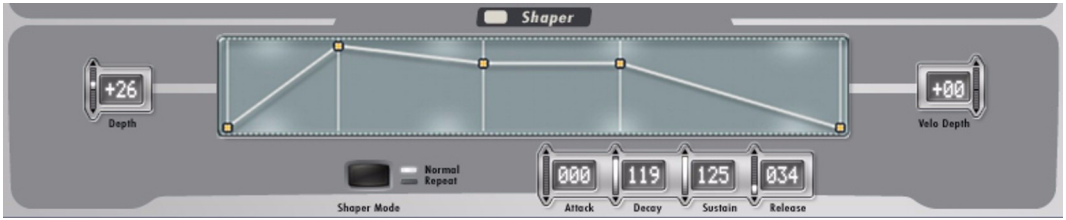
Remember the rules on recording resynator stick movements? The same applies to the silver sticks. The procedure for recording and playing animations is also identical.

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 45.

Module: Silver shaper

In the section “Dynamic filtering via envelope, stick, LFO and velocity” on page 73 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 the silver shaper’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 95).

The silver shaper provides an **ADSR envelope** that is "hard-wired" to the silver module’s filter unit.

The silver shaper must be activated in silver via **Contour control** so that the envelope can modulate the selected silver filter (see page 82).

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 54.

A filter envelope shapes the sound far more perceptibly than, for example, an amplifier envelope. This predestines it 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 the silver shaper's *Velo depth* parameter (see the parameter description on page 99).

Normal or repeat?

As described for the resynator shaper, 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 if holding the key down issues a note-on command. Then the curve re-enters the attack phase. This loop continues for as long as the key is held down. The release phase does not end until the key is actually released.

On page 57 you will find an illustration of an ADSR envelope in *Repeat* mode.

Shaper (silver): Control features and parameters

Envelope editing field	 You can edit the envelope in the editing field in two ways: • You click on the handles (at the separating line between two envelope phases each), hold the mouse button and drag the point to the desired position. • You can set the values with the **Attack**, **Decay**, **Sustain** and **Release** scrollers.
Scroller **Attack / Decay / Sustain / Release**	Input for the envelope parameters. Click on the respective display and while holding the mouse button, move the mouse upwards (increase value) or down (decrease value). The influence of the *Sustain* level setting is - like the *Depth* setting - relative to the defined target parameter value. The parameters of an ADSR envelope are described on page 54.
Scroller **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 18: Control features and parameters of the silver shaper

Scroller **VeloDepth**	The *Env depth* parameter (see the illustration above) determines the intensity of the envelope's effect on the filter. The *Velo depth* parameter lets you manipulate *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).
Button **Shaper 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. After the release phase, a new cycle is launched with the attack phase. For more on this, read also page 97.

Table 18: Control features and parameters of the silver shaper (cont.)

Shaper 3: Handling

▶ **How to use a filter envelope**

- The silver shaper 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.
- With the **Shaper Mode** button, select one of the *Normal* or *Repeat* modes.
- Now set the ADSR parameter values. For this purpose, you either click on handles in the editing field and drag the handles to the desired values or use the **Attack**, **Decay**, **Sustain** and **Release** scrollers.
- Define the intensity of the envelope's effect on the filter with the **Depth** scroller.
- If you want to modulate the *Depth* of the envelope via velocity, define the parameter *VeloDepth* (see page 99).

Routing the controller (<Nuke> & external)

<Nuke> Controller (knobs)

The stick controller and the four knobs are located on the <Nuke>. For information on how to route the stick controller to one of the resynators, read page 14.

Each of the knobs can be routed to almost any Neuron VS parameter. Information on this and on routing can be found on page 16.

External controllers

For purposes of performance-based sound shaping, Neuron offers freely definable continuous controllers whose *destinations* can be defined in the Remote screen.

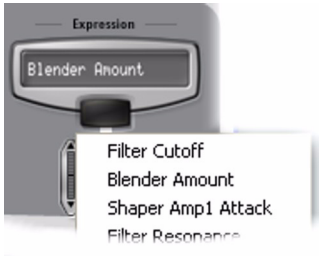
Controller settings are stored at the sound level, so they can vary from sound to sound! When you change or reload a sound, controller values are reset to 0! Stored links and the respectively defined *Depth* are of course retained.

The following controllers can be integrated into the Neuron VS modulation matrix:

- Aftertouch. Refresher course: 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: In Neuron, aftertouch is monaural, meaning that the aftertouch modulation affects the entire sound rather than individual voices.
- Modulation (modulation wheel).
- Breath (breath controller).
- CC03 (continuous controller 03).
- Foot (cont. foot pedal).
- Expression (expression pedal).

► **How to route external controllers**

- Open the Remote screen.
- In the lower region of the Remote screen, click on the button of the desired controller and select the target parameter from the dropdown menu.



- Define the *Depth* for this controller. In this context, also refer to the section „How does the Depth value work?“ ab Seite 103.

Velocity as an additional controller

Although strictly speaking they are not true hardware controllers, there is an additional control signal source, which – like the aftertouch modulation source – can be found on a connected keyboard. The **Velocity**.

Compared to aftertouch, whose modulation target and *Depth* are set in the Remote screen, the modulation destinations for velocity are determined at the destination via the respective *VeloDepth* parameter. 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 31).
- Resynator shaper (in *Par.Level* and *Free* status): Envelope *Depth*.
- Silver: Cutoff frequency (*Velo depth* parameter, see page 84).
- Silver shaper: *Depth* of the envelope (see page 99).

How does the *Depth* value work?

The effect of the *Depth* value is explained in the following 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 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 several controllers (i.e. expression and velocity) aim 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.

MIDI control

All Neuron VS parameters can be addressed via MIDI.

Unlike many other synthesizers, Neuron has no need for sound banks, because all 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.

Controller list

Control no. Type

0. . . . . Bank Select
1. . . . . [Reserved]
2. . . . . [Reserved]
3. . . . . [Reserved]
4. . . . . [Reserved]
5. . . . . [Reserved]
6. . . . . [Reserved]
7. . . . . [Reserved]
8. . . . . Blender Mix
9. . . . . Blender Type
10. . . . . [Reserved]
11. . . . . [Reserved]
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. . . . . [Reserved]
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 . . . . . [Reserved]
67 . . . . . LFO On/Off
68 . . . . . Resynator1 On/Off
69 . . . . . Resynator2 On/Off
70 . . . . . Shaper A1 Attack
71 . . . . . Shaper A1 Decay
72 . . . . . Shaper A1 Sustain
73 . . . . . Shaper A1 Release
74 . . . . . Shaper A2 Attack
75 . . . . . Shaper A2 Decay
76 . . . . . Shaper A2 Sustain
77 . . . . . Shaper A2 Release
78 . . . . . Shaper R1 Attack
79 . . . . . Shaper R1 Decay
80 . . . . . Shaper R1 Sustain
81 . . . . . Shaper R1 Release
82 . . . . . Shaper R2 Attack
83 . . . . . Shaper R2 Decay
84 . . . . . Shaper R2 Sustain
85 . . . . . Shaper R2 Release
86 . . . . . [Reserved]
87 . . . . . [Reserved]
88 . . . . . [Reserved]
89 . . . . . [Reserved]
90. . . . . [Reserved]
91. . . . . [Reserved]
92. . . . . [Reserved]
93. . . . . [Reserved]
94. . . . . [Reserved]
95. . . . . [Reserved]
96. . . . . [Reserved]
97. . . . . [Reserved]
98. . . . . NRPN LSB
99. . . . . NRPN MSB
100. . . . . RPN LSB
101. . . . . RPN MSB
102. . . . . Shaper F1 Attack
103. . . . . Shaper F1 Decay
104. . . . . Shaper F1 Sustain
105. . . . . Shaper F1 Release
106. . . . . Shaper F2 Attack
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