StudioFactory 0.30

Software based desktop audio/video studio
User & Reference manual

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1. Introduction

1.1. The desktop audio/video studio

StudioFactory is based on SynFactory (the modular software synthesizer) and can load any file created with it. In addition to editing and playback of virtual analog synthesizer patches, the system has a very advanced MIDI sequencer with audio support. The output of the sequencer can be send to the internal synthesizer or to external MIDI equipment. The SynFactory based synthesizer is extended to support multi timbral and polyphonic playback. There is no predefined program limitation on the number of tracks or synthesizer patches active in a single project (of course there is a limit what the computer can handle).

1.2. Installing StudioFactory

Installer not yet developed.

1.3. Quick tour

1.4. Midi routing and ports

StudioFactory has many features to work with MIDI (Musical Instrument Digital Interface) messages. The MIDI protocol allows electronic devices (usually synthesizers, but also computers, light show controllers, VCRs, multi-track recorders, etc.) to interact and work in synchronization with other MIDI compatible devices.

Each MIDI connection supports up to 16 channels, communication goes in a single direction. Each channel has it's own instrument attached with it's own note and control events. The timing pulses and clocks when using a sequencer is global for all 16 channels however. Because most of the modern MIDI keyboards have many voices (62+) and are multi timbral (can play multiple sounds at the same time), a single MIDI port can become insufficient quite fast.

Depending on the setup a single midi connection can become too limited. Therefore StudioFactory can support up to 26 ports, each port has its own midi clock and 16-MIDI channels for a total of 416 MIDI-channels and 26 clocks. MIDI cables run in a single direction and can only support one connection, so to fully connect an instrument 2 cables are necessary. The ports in StudioFactory are different and support multiple sources, so multiple devices can drive the same port and multiple devices can listen on the same port. This allows the same features as on a MIDI-patchbay, like merging and distributing signals from multiple sources to multiple destinations without any limits (up to the maximum of 416 channels and 26 clocks). For example to make a 'soft-thru' connection, specify the same port on both the MIDI-In and the MIDI-Out and all messages received on the input port will be transmitted to the output port.

Ports are identified with a single capital letter. Two numbers indicate the channel when required, so **A01** is the first channel on port A. Because StudioFactory doesn't limit the direction of messages in one direction, all MIDI-in and MIDI-out ports should be connected to their own port unless a permanent soft-thru is required. Therefore in practice the maximum number of channels which can be used is less as the absolute maximum of 416 (unless *every* channel on *every* MIDI-in and -out port is used, which is very unlikely).

For specific routing and merging operations the MIDI-router component can be activated. This component supports filtering and translation of MIDI-events. The MIDI activity monitor and MIDI scope components can be used to get information about the MIDI-events flowing inside StudioFactory.

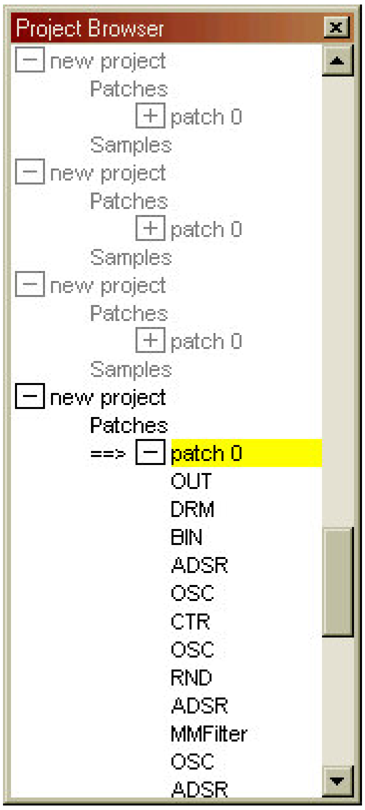
2. Program components

2.1. The Project Browser

The project browser gives a overview of all projects and files loaded into StudioFactory. There is only one project active at the same time. This project is shown in black the inactive projects are light gray.

One project can contain many other objects and sub-projects. By clicking on the [+] icon the project can be unfolded and the contents of the project is shown. Items from the unfolded view can be selected. The currently selected items are highlighted in yellow. Multiple items can be selected by holding the Ctrl key while making the selection. Also items, modules and tracks can be selected from the associated editor screens. The selection made there is reflected in the project window also.

Pressing DEL while the project browser is the current window will delete all selected items. This can include modules, samples but also complete projects.



2.2. Time line

2.2.1. Tracks

The time line shows a number of tracks. Each track supports one task or activity at a time (when one activity is finished on a track, another one can start). These tasks or activities can be one of the following:
* Playing a sample.
* Playing MIDI notes and other MIDI data.
* Playing a video clip.
* Showing a picture.

Each track has a stereo audio output, a midi port and a video layer attached. The audio output can be connected either to the audio mixer or to a SynFactory module in the patch editor. The module has a left and right audio output and a few control signals. During sample playback there are some extra commands available used for emulating MOD-tracker like effects. The commands control both the sample being played and the extra outputs on the SynFactory module.

If the track is used for MIDI playback the MIDI data is send to one of the 26 internal MIDI ports. This way the tracks can control either the patches or external equipment (or a combination of the two). The track has a channel overrule option so MIDI data is send to this channel even if the original stream was directed to other channels.

2.2.2. Patterns

2.2.3. Songs

Songs are buildup from a sequence of patterns.

2.2.4. Phrases

2.3. Midi event editor

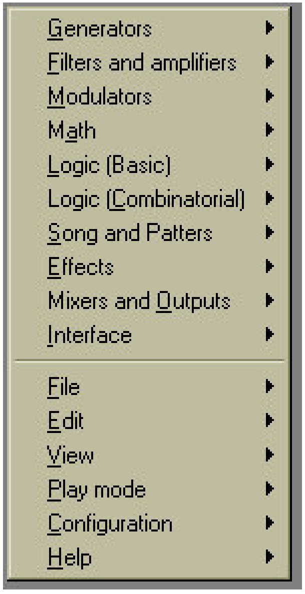
2.4. SynFactory patch editor

2.4.1. Introduction

The patch editor is used to build a setup (patch) for the internal modular synthesizer. This synthesizer is fully compatible with SynFactory the predecessor of StudioFactory. The sound is buildup from multiple modules which are connected by virtual cables. It works much like the modular analog synthesizers from the past, except now without the limitations. No tuning problems and an (almost) unlimited supply of exotic modules. As long as the PC can handle it, the patch can be extended with extra modules when the there is a need.

2.4.2. Adding modules

Modules are added by pressing right mouse button (or pressing the 'enter' key on the keyboard). A popup menu becomes visible. By selecting a module from the menu it is inserted in the patch on the location where the mouse was, when right mouse button (or 'enter' key) was pressed.

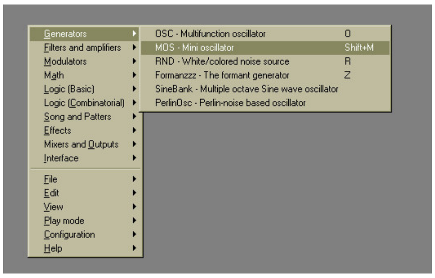


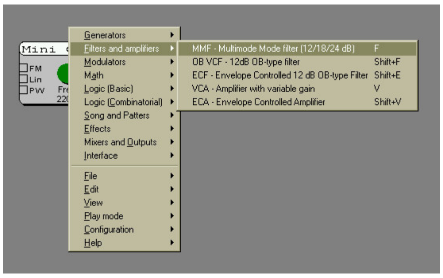
The modules are grouped together depending on the main function of the particular module. There are currently ten groups defined. Of course the grouping is only an indication and actual use is not limited in any way. For example the delay lines are found in the **effects** group because they are normally used for making echo and reverb, but for physical modeling they can be used as oscillators.

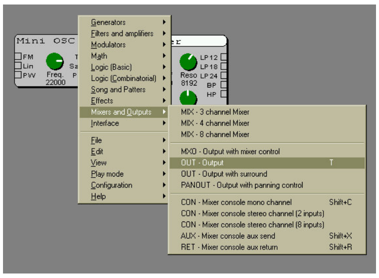
There are about 80 different modules available in the system, see chapter 5 for a complete overview of the modules. There is no limit for a particular module. Any combination of modules can be added to a patch until the computing power is used up or the program limit of 1022 modules is reached (this is for a single project, so each project can have up to 1022 modules).

2.4.3. Connecting the cables

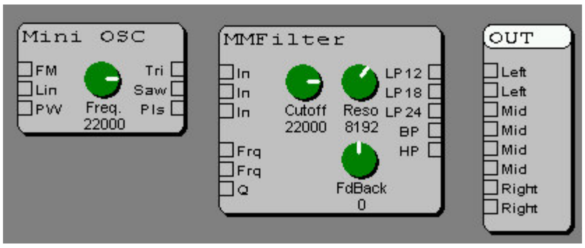
First we insert some modules to play with. Select a MOS from the oscillator menu, a MMF from the filter menu and a OUT from the Mixers and Outputs menu.


Generators
Filters and amplifiers
Modulators
Math
Logic (Basic)
Logic (Combinatorial)
Song and Patters
Effects
Mixers and Outputs
Interface
File
Edit
View
Play mode
Configuration
Help
OSC - Multifunction oscillator O
MOS - Mini oscillator Shift+M
RND - White/colored noise source R
Formanzzz - The formant generator Z
SineBank - Multiple octave Sine wave oscillator
PerlinOsc - Perlin-noise based oscillator

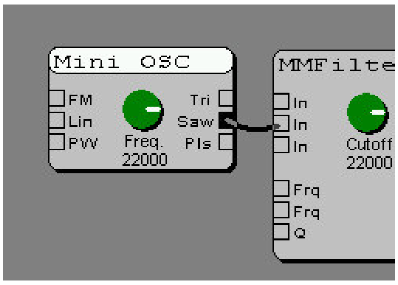

Mini
FM
Lin
PWV
Generators
Filters and amplifiers
Modulators
Math
Logic (Basic)
Logic (Combinatorial)
Song and Patters
Effects
Mixers and Outputs
Interface
File
Edit
View
Play mode
Configuration
Help
MMF - Multimode Mode filter (12/18/24 dB) F
OB VCF - 12dB OB-type filter Shift+F
ECF - Envelope Controlled 12 dB OB-type Filter Shift+E
VCA - Amplifier with variable gain V
ECA - Envelope Controlled Amplifier Shift+V

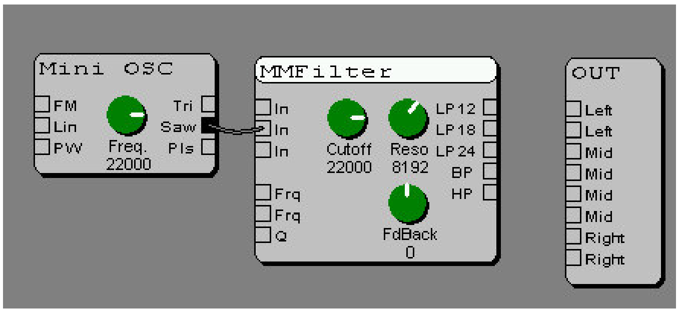


The screen should now look close to this:

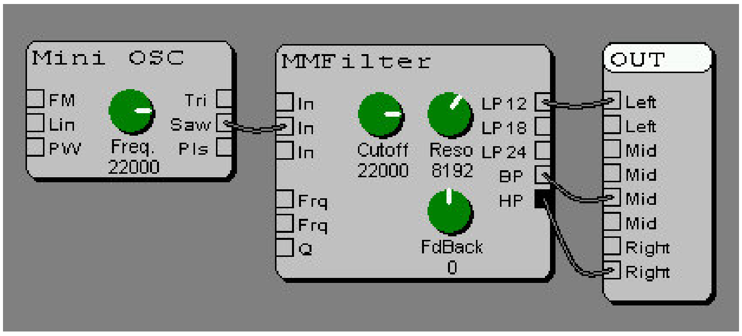


Now select the **Saw** output of the Mini OSC with the left mouse button and while holding it drag a cable to one of the **In** ports of the MMFilter and release the mouse button. An other way to connect cables is clicking on the output (it will become black) releasing the mouse button and clicking on an input. If the input already has a connection it will be disconnected.





Now in a similair way connect the MMFilter **LP12** or **BP** outputs to the OUT module. Which output to which input is at this stage not really important. It can always be changed at a later time. The result so far should look something like this:



Disconnecting a cable is done by clicking left on the place where it is connected to an input. A single output can be connected to any number of inputs, but an input can only be connected to one output at a time. As can be seen in the picture the MMFilter has multiple **In** ports to make it easier for connecting multiple oscillators to it. If three ports is not enough however an ADD module can be placed before the MMFilter.

2.4.4. Changing values

Changing the values of the virtual knobs is done with the mouse. Click and hold the left mouse button when the mouse is above a knob. Move the mouse up or down to increase or decrease the current value. If the value changes too fast, pressing and holding the right mouse button (together with the left button) while moving the mouse up and down changes the value 16 times slower.

The value of the knob can be set to zero by pressing left mouse button and at the same time double clicking with the right button.

2.4.5. Moving modules

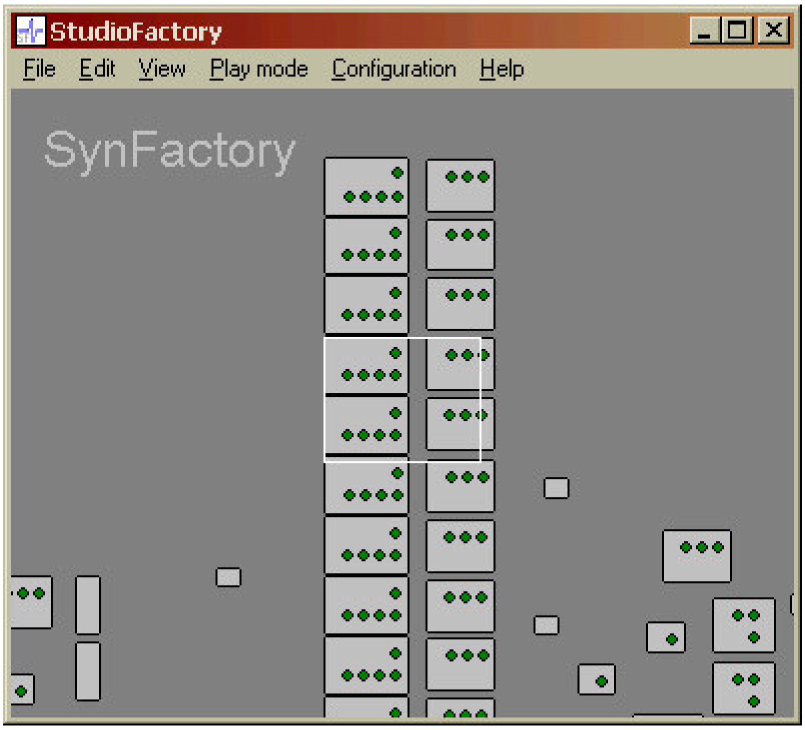
Press and hold down the left mouse button when the cursor is above the name of the module (the part that turns white on selected modules). Moving the mouse moves the module to a new location. When multiple modules are selected, holding down the Ctrl key allows moving all selected modules at the same time.

2.4.6. Scrolling the screen

Pressing and holding the right mouse button makes it possible to scroll the screen with the mouse. This works also when dragging or selecting modules or drawing cables. Just press the right mouse button while holding the left down also. This is very useful when the modules which you want to connect are far away from each other.

2.4.7. Scrolling with zoom

When scrolling with only the right mouse button pressed, pressing the left mouse button together with the right enables the overview mode. The screen zooms out 5 times in both horizontal and vertical direction. This enables a good overview of the patch and makes it easy to navigate fast across big patches.



Because this overview uses both mouse buttons it is not available when scrolling is combined with dragging cables or drawing the selection rectangle. Only the normal scrolling is possible in this situation.

2.4.8. Mouse and keyboard control

The table below gives an overview of all the mouse button combinations and their usage within the patch editor.

Mouse operation	Effect
Left click on module	Select module
Ctrl key + left click on module	Select multiple modules
Left double click on module	Open extra edit window (only for some modules)
Left click and hold on module name	Select and move module
Ctrl key + left click and hold on module name	Move multiple modules
Left click and hold on background in editor	Select all modules inside the rectangle
Ctrl key + left click and hold on background	Add all modules inside rectangle to selection
+ Right click and hold	Scroll screen until right mouse button release
Left click on output	Select output as active (for new connections)
Left click and hold on output (release above an input)	Drag new cable from output to input
+ Right click and hold	Scroll screen until right mouse button release
Left click on not connected input	Connect cable from active output to this input
Left click on connected input	Disconnect cable
Left click and hold on knob	Change value
+ Right click and hold	Change value more slowly
+ Right double click	Reset value to zero
Right click	Access popup menu
Right click and hold	Scroll view
+ Left click and hold	Zoom out 5 times (large overview)
Hover over knob. Type 0-9, '-' or backspace	Change value/position of knob.
Hover over knob. Type '[', ']', '{' or '}'.	Increase/decrease value with 1 ('[' ']') or 10 ('{' '}')
Hover over label. Type characters or backspace	Change label.

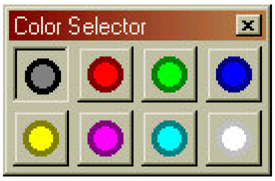
2.4.9. Midi Control

2.5. Instrument and sample editor

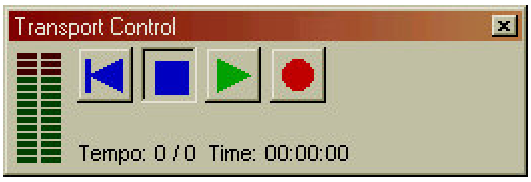
2.6. Bitmap picture editor

2.7. Vector editor

2.8. Color selector



2.9. Transport control



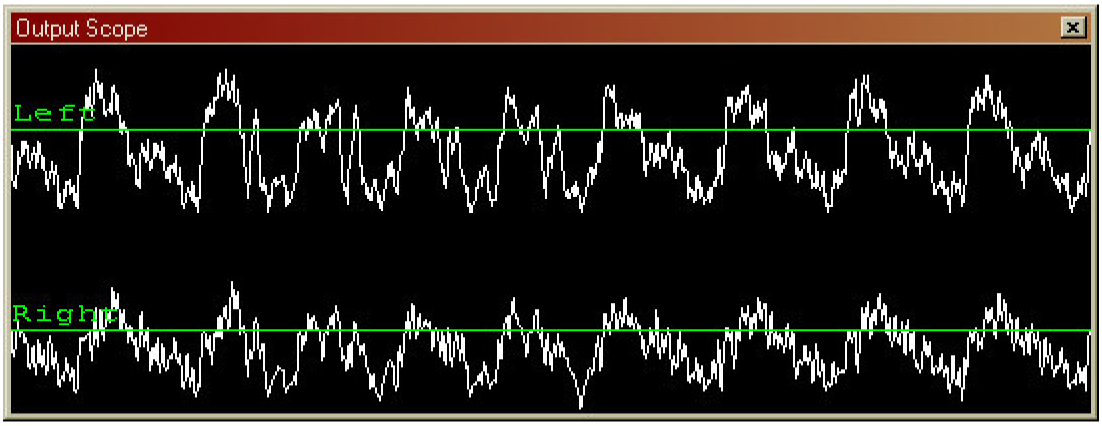
Tempo: 0 / 0 Time: 00:00:00

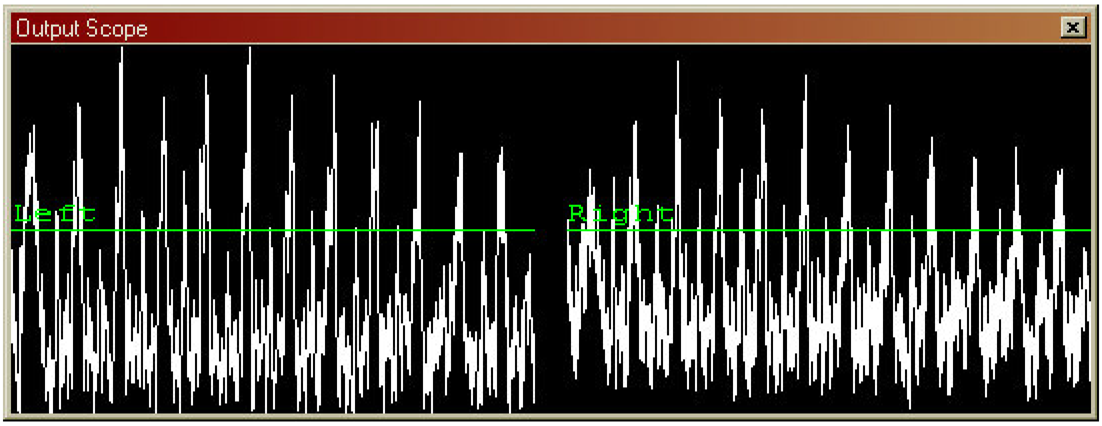
2.10. Audio mixer

Not available in the current software release.

2.11. Audio output scope

The audio output scope shows the waveform currently send to the sound card (and capture-file when in recording mode). In the default setup the top waveform shows the left channel and the bottom waveform shows the right channel. By clicking with the right mouse button in the window an alternative representation can be activated. In some cases it is possible the scope window will show the waveform a little earlier than it is heard on your speakers. Depending on the buffer sizes and driver settings this time difference can be up to one second.



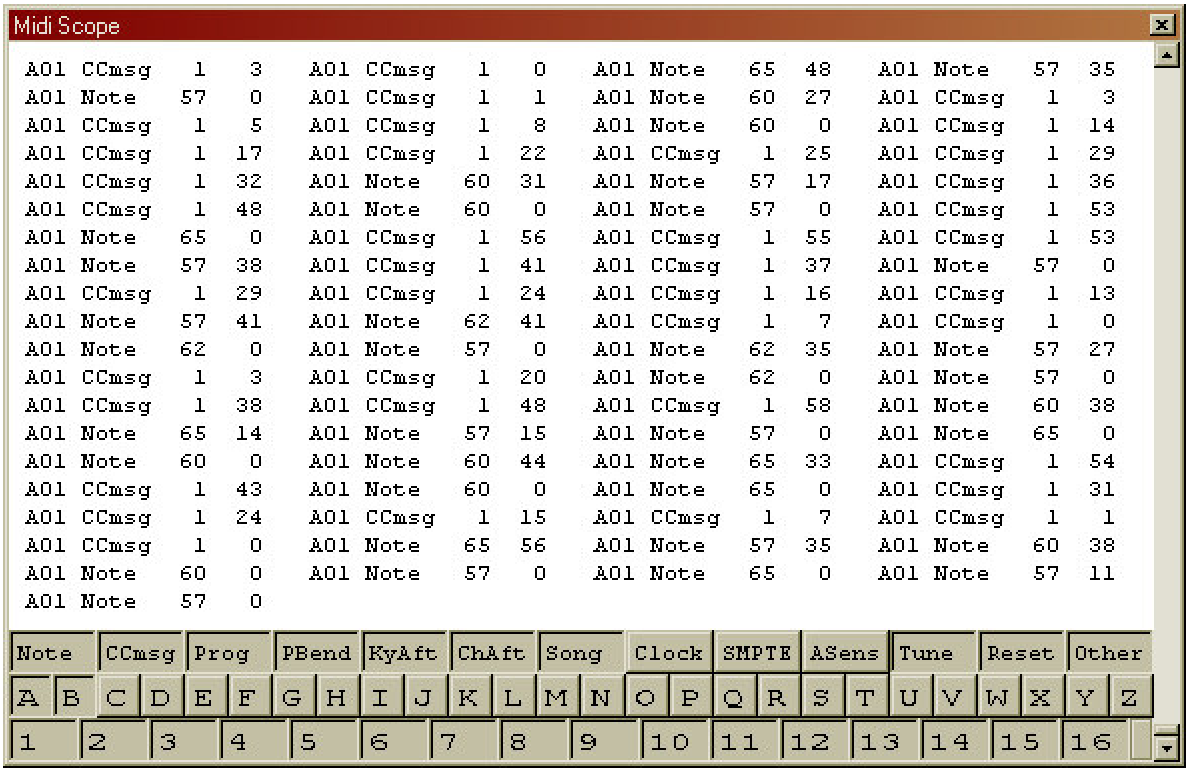


2.12. Midi router

Not available in the current software release.

2.13. Midi scope

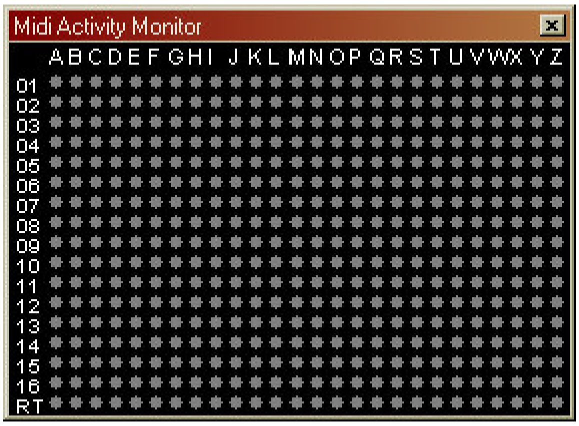
The MIDI-scope can be used to show specific MIDI messages flowing on the various buses inside StudioFactory. There are 26 buses available, each with 16 separate channels. The pushbuttons on the bottom rows select which messages are being monitored. The buses are selected with the buttons labeled **A** to **Z**. The buttons labeled **1** to **16** select the specific MIDI channel(s). The real-time messages (selected with **Song**, **Clock**, **SMPTE**, **ASens**, **Tune**, **Reset** and **Other**) are not send to a particular channel, thus are shown even if all channel select buttons are deselected.



```
A01 CCmsg   1   3    A01 CCmsg   1   0    A01 Note   65  48    A01 Note   57  35
A01 Note   57   0    A01 CCmsg   1   1    A01 Note   60  27    A01 CCmsg   1   3
A01 CCmsg   1   5    A01 CCmsg   1   8    A01 Note   60   0    A01 CCmsg   1  14
A01 CCmsg   1  17    A01 CCmsg   1  22    A01 CCmsg   1  25    A01 CCmsg   1  29
A01 CCmsg   1  32    A01 Note   60  31    A01 Note   57  17    A01 CCmsg   1  36
A01 CCmsg   1  48    A01 Note   60   0    A01 Note   57   0    A01 CCmsg   1  53
A01 Note   65   0    A01 CCmsg   1  56    A01 CCmsg   1  55    A01 CCmsg   1  53
A01 Note   57  38    A01 CCmsg   1  41    A01 CCmsg   1  37    A01 Note   57   0
A01 CCmsg   1  29    A01 CCmsg   1  24    A01 CCmsg   1  16    A01 CCmsg   1  13
A01 Note   57  41    A01 Note   62  41    A01 CCmsg   1   7    A01 CCmsg   1   0
A01 Note   62   0    A01 Note   57   0    A01 Note   62  35    A01 Note   57  27
A01 CCmsg   1   3    A01 CCmsg   1  20    A01 Note   62   0    A01 Note   57   0
A01 CCmsg   1  38    A01 CCmsg   1  48    A01 CCmsg   1  58    A01 Note   60  38
A01 Note   65  14    A01 Note   57  15    A01 Note   57   0    A01 Note   65   0
A01 Note   60   0    A01 Note   60  44    A01 Note   65  33    A01 CCmsg   1  54
A01 CCmsg   1  43    A01 Note   60   0    A01 Note   65   0    A01 CCmsg   1  31
A01 CCmsg   1  24    A01 CCmsg   1  15    A01 CCmsg   1   7    A01 CCmsg   1   1
A01 CCmsg   1   0    A01 Note   65  56    A01 Note   57  35    A01 Note   60  38
A01 Note   60   0    A01 Note   57   0    A01 Note   65   0    A01 Note   57  11
A01 Note   57   0
```

2.14. Midi activity monitor

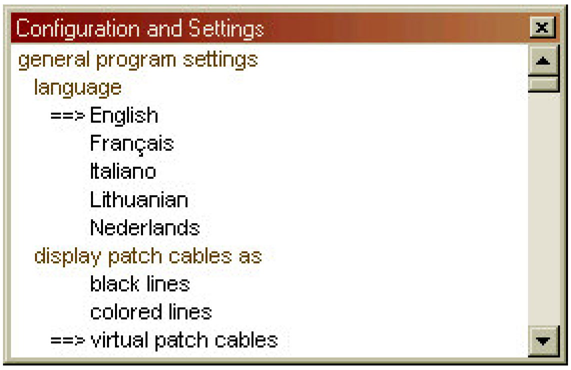
This window gives a quick overview of the activity on all the MIDI messages and routing buses. This can be a helpful tool while debugging a complex MIDI-setup. If a MIDI-message is received, the corresponding dot will blink for 0.2 seconds. There are 17 dots for each midi port. The first 16 show the status of all the channel specific messages (one dot for each channel). The RT dot blinks when realtime messages are received (like clock, start, stop, continue, tune-request and active-sensing). If more details about the messages is required use the **Midi Scope** window, which shows a textual description for each individual message.



2.15. Video preview

2.16. Configuration and settings

This window shows all configuration settings and makes it possible to change them. The changes take effect immediately so there is no conformation box. All the settings can be changed at any time. Even when audio playback is active.



Configuration and Settings

general program settings

language

==> English

Français

Italiano

Lithuanian

Nederlands

display patch cables as

black lines

colored lines

==> virtual patch cables

2.16.1. Language

Sets the language the program uses for menus and help texts. Not all languages are fully translated. English texts will be used for the parts that are not translated yet.

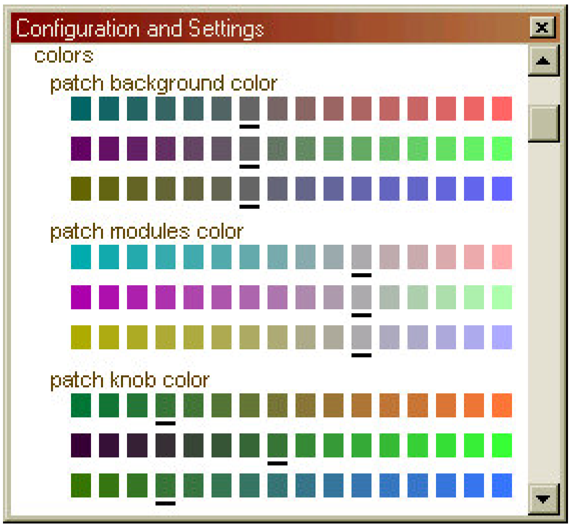
2.16.2. Display patch cables as

Selects the way connections between modules in the patch editor are displayed. Black lines will show all connections as tin black lines in depended of selected color. Colored lines shows the connections as strait lines in the selected color. The setting virtual patch cables will render all connections as hanging cables, giving the patches an analog synthesizer look.

2.16.3. Colors

Some of the colors that are used in StudioFactory can be customized. The color selection is done with 3 bars. The top bar controls the amount of red, the middle the amount of green and the bottom bar the amount of blue. Black lines below the color bars show the currently selected amount of red, green and blue. The bars are divided in 16 blocks and each block have the color that will result when the block is selected with the mouse. So moving the black line in the red bar (by clicking on one of the blocks) changes the green and blue bars to show the color that will result when the black lines are moved in these bars. The bar blocks which have the black lines below them show the currently active color.

If the black lines are directly above each other, the result is an amount of gray (black when fully left or white when fully right).



Configuration and Settings

colors

patch background color

patch modules color

patch knob color

2.16.4. Audio input device

Selects the device used for audio input. This can be on the same audio card used for output if the card is full duplex or it can be on a different audio card. The audio input stream is synced to the audio output. If the input and output sample frequencies are slightly different this can create small artifacts in the input stream. Therefore StudioFactory tries to match the streams over a longer period of time to reduce these artifacts. It is recommended to stop audio playback before changing this setting.

2.16.5. Audio output device

Selects the device used for audio output. The use of the DirectSound driver is recommend because of the lower latency attainable with this driver. The WaveMapper setting will use the default audio device assigned by Windows.

2.16.6. Number of buffers

Sets the number of buffers used for sending audio data to the sound card. Observe the latency values for determining the effect of this setting.

2.16.7. Buffer size

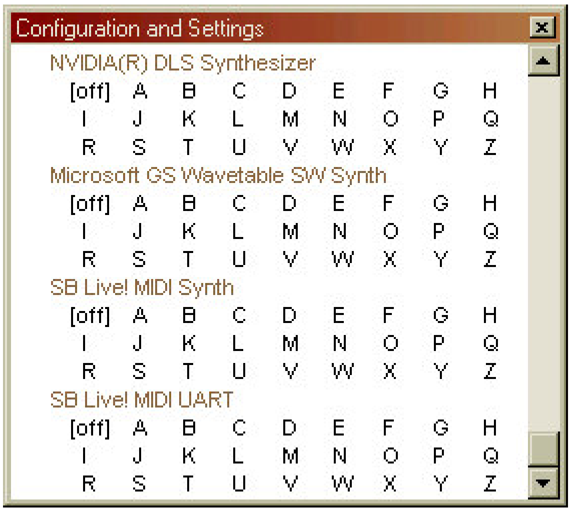
Sets the size of the buffers used for sending audio data to the sound card. Observe the latency values for determining the effect of this setting.

2.16.8. Latency

This shows the effect of the 'number of buffers' and 'buffer size' configuration settings. It shows the maximum delay between making changes in the patch and hearing it at the audio output. A low latency gives smoother operation, but is especially important when controlling StudioFactory from external MIDI equipment. Two values are shown. The first value is the latency of a single audio buffer and the second value (if present) is the maximum total latency of all buffers. The latency becomes better by lowering the number of buffers and/or the buffer size. The attainable latency depends on the system configuration. On modern systems it can be as low as 50 ms for the WaveMapper and 15 ms for the DirectSound (sf_dsound.dll) driver. Using many small buffers is better as having a few big ones.

2.16.9. MIDI input devices

This is a list with all MIDI-hardware and software drivers in the system. For each interface there is a selection which StudioFactory port it should use. When set to [off] the device is not used and all MIDI data received on this device is ignored by StudioFactory. Setting it to on of the ports (A-Z) opens the device and all received data is send to the internal port (only exception is sysex data which is not supported). The mapping between real devices and device drivers and the internal ports of StudioFactory makes it possible to design synthesizer patches and sequences and play them on very different hardware configurations.



NVIDIA(R) DLS Synthesizer

[off]	A	B	C	D	E	F	G	H
I	J	K	L	M	N	O	P	Q
R	S	T	U	V	W	X	Y	Z

Microsoft GS Wavetable SW Synth

[off]	A	B	C	D	E	F	G	H
I	J	K	L	M	N	O	P	Q
R	S	T	U	V	W	X	Y	Z

SB Live! MIDI Synth

[off]	A	B	C	D	E	F	G	H
I	J	K	L	M	N	O	P	Q
R	S	T	U	V	W	X	Y	Z

SB Live! MIDI UART

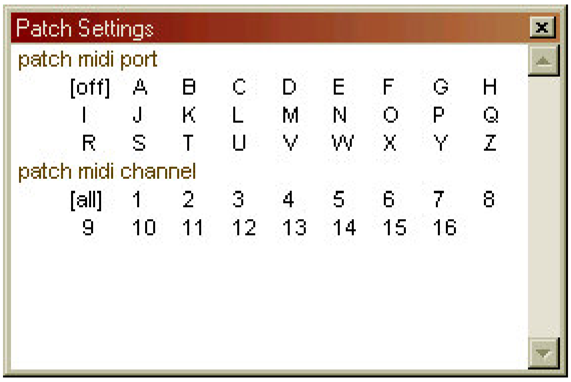
[off]	A	B	C	D	E	F	G	H
I	J	K	L	M	N	O	P	Q
R	S	T	U	V	W	X	Y	Z

2.16.10. MIDI output devices

Midi output is not supported in the current software version.

2.17. Patch Settings

In this window the MIDI port and channel for the current patch can be set. The MIDI modules in the patch only receive data send to the port and channel set in this window. If the midi channel is set to **all** it doesn't matter on which channel the MIDI data is received. Each patch has separate settings for the port and channel, so in a project multiple sounds can be mapped to different MIDI channels (one patch for each sound).



2.18. Playlist and slideshow

2.19. MacroMagic

2.20. Online help window

3. Menus

3.1. File menu

3.1.1. New...

Create a new project or add a new empty patch, sample or track to the current project.

3.1.2. Open... *(Ctrl+O)*

Load a file from disk and create a new project for it's contents.

3.1.3. Add/Merge

Load a file from disk and add content to the current active project.

3.1.4. Close

3.1.5. Close project

Remove the active project from memory.

3.1.6. Save *(Ctrl+S)*

Store the project, overwriting original file used to load the project. If it is a project created with the 'new' command no filename is assigned yet, so a 'Save as' is executed instead.

3.1.7. Save as

This command is used to save the current project under a new name. If the new name already exists a confirmation box will be displayed asking if the old file should be replaced with the new one.

3.1.8. Save All

Save all modified projects. For each new project a 'Save as' is executed.

3.1.9. Exit program

This will exit the program (same as clicking on the 'X' on the right top of the patch window). The current projects are automatically stored in a file called 'autoload.stf' together with the current program settings. This file is reloaded on startup of StudioFactory. This makes it possible to leave at anytime without losing any unsaved work.

3.2. Edit menu

3.2.1. Cut *(Ctrl+X)*

Move all currently selected modules from the patch to the clipboard. They will be removed from the patch.

3.2.2. Copy *(Ctrl+C)*

Place a copy of all currently selected modules on the clipboard.

3.2.3. Paste *(Ctrl+V)*

Place a copy of the modules stored on the clipboard to the current patch.

3.2.4. Delete *(Del)*

Remove the currently selected module(s) from the patch area. All cables running to and from the module(s) are also removed from the patch.

3.2.5. Select All *(Ctrl+A)*

Select all modules in the patch.

3.2.6. Clone *(Ctrl+D)*

Clone currently selected modules. This duplicates the modules inclusive all the settings of the controls and the wiring within the set of selected modules. The newly created module(s) are selected (so they can be moved to a new location).

3.2.7. Select cable color

This selects the color used for new patch cables. The cables already connected will keep their color. Its like you have eight boxes with patch-cables sorted on color and select which box to use. This menu is only available if 'Patch cable display' in the config-submenu is NOT set to mode 0.

3.3. View menu

3.3.1. Project Browser *(F2)*

3.3.2. Color Selector

3.3.3. Transport Control

3.3.4. Audio Output Scope

3.3.5. Audio Mixer

Not available in current software version. (gives only a blank window)

3.3.6. Video Preview

Not available in current software version.

3.3.7. Midi Scope

3.3.8. Midi Activity Monitor

3.3.9. Console and messages Window *(F11)*

Not available in current software version.

3.4. Play mode menu

3.4.1. Rewind

Starts playback from the beginning. All sequencers and synthesis modules are reset to the default value and start position. This button can be pressed both in Stop and Play state.

3.4.2. Stop

Stops playback. The scope window freezes on the last generated audio information.

3.4.3. Play

Starts playback of the generated audio.

3.4.4. Record

Opens a file dialog to set the filename and type of the capture file. Possible recording file types available depend on the installed drivers. StudioFactory supports WAV with 16 bits resolution and 44.1 KHz sampling rate, MP3 at 128 kbit/sec or OGG-Vorbis. StudioFactory uses external DLLs for MP3 and OGG recording so these need to be present and correctly installed. Capturing will start immediately after closing the dialog with OK. If the filename already exists a confirmation box will appear asking if the original file must be overwritten. During capture the sound will also be played through the sound card. Selecting this option again will close the capture file and stops further capturing. If the record button (on the playback control window) and this menu is not 'checked' after selection of the filename, an error has occurred with opening the file (either the file could not be created or the required external drivers are not present).

3.5. Configuration menu

3.5.1. Global settings

3.5.2. Patch settings

3.5.3. Save Settings As

The current program settings (including window positions) are saved in a new file. This can be used to maintain multiple configurations for the program.

3.6. Help menu

3.6.1. Context menu *(F1)*

Help window will open displaying help corresponding with current context. This is most of the time the current selected item or the item directly below the cursor.

3.6.2. Editor help *(Shift+F1)*

Help window will open showing help for current active editor screen.

3.6.3. Menu help

Help window will open showing an information page about the menus.

3.6.4. Introduction

Help window will open showing a small introduction into the basics of using StudioFactory.

3.6.5. About StudioFactory

Help window will open showing detailed licensing and version information of StudioFactory.

4. Building patches

4.1. Basic synthesizer patch

4.2. Using the ECF and ECA modules

4.3. Frequency and pulse width modulation

Making a song

- Pulsar and BIN (Rhythm)
- Step sequencer
- Drum sequencer
- Note Script

Sound effects

- Delay
- Flanger
- Chorus

4.4. Using the audio input and the vocoder modules

Midi Control

Sample playback

Time line

5. SynFactory Modules

5.1. Generators

5.1.1. OSC - Multifunction oscillator

This is the standard oscillator, it can provide 5 different waveforms selectable with a block of icons (there are 6 icons but one is not currently active). The 5 waveforms are: Triangle, Saw, Pulse, Sine and Triggered Noise. The Pulse waveform has a variable pulse width. Use the PWidth control and/or the PW inputs to change the pulse width. With the control at 0 gives a 50% waveform. At 32767 (or -32768) the wave is fully DC. The Triggered Noise waveform is comparable with a white noise source followed by a Sample and Hold gate. The trigger speed of the gate is set by the oscillator speed. The effect is useful as stepped random control at low speed, or at higher speeds to generate special effects like spaceships, storms and sea-waves.

Controls:
Freq - Sets frequency, this is a logarithmic control. To make life easier the actual frequency is displayed below the control in Hertz (number of cycles a second).
PWidth - Sets the pulse width, only functional when the Pulse waveform is selected.
Ampl - Sets the amplitude of the output signal. When set to 0 there is no signal. The value can also be negative and reverses the waveform (useful for the Saw waveform).

Inputs:
FM (2x) - (frequency modulation) modulates the oscillator frequency in a logarithmic (musical) way.
Lin - Also a frequency modulation input but with a linear response, usefull for vibrato and FM synthesis.
PW (2x) - PulseWidth modulation, sets the width of the Pulse waveform (only active when the Pulse waveform is selected).
AM - Amplitude modulation input, it is added to the amount set by Ampl control. The amplitude control is linear.
Sync - Hardsync, can be used to let two or more oscillators run synchronized to each other, even if both run at different frequencies. The trigger point is when the input signal becomes positive.

Outputs:
Single output providing the currently selected waveform.

Available:
SynFactory: All versions.
StudioFactory: All versions.

5.1.2. MOS - Mini oscillator

This is a more simple oscillator as the OSC. It has less inputs and controls. It provides only 3 waveforms, but these are available simultaneously. This can be usefull when combined with a selector or switch so the waveform can be changed by signals available in the patch.

Controls:
Freq - Sets frequency, this is a logarithmic control.

Inputs:
FM - (frequency modulation) modulates the oscillator frequency in a logarithmic (musical) way.
Lin - Also a frequency modulation input but with a linear response, usefull for vibrato and FM synthesis.
PW - PulseWidth modulation, sets the width of the Pulse waveform.

Outputs:
Tri - Triangle wave output
Saw - Saw-wave output
Pls - Pulse wave output (only this one can be controlled with the PW input)

Available:
SynFactory 1.00 or higher.
StudioFactory: All versions.

5.1.3. RND - White and colored noise source

White noise source, with an additional 6db/oct lowpass filter.

Controls:
Color - Sets the cutoff frequency of the lowpass filter.
Ampl - Sets the peak amplitude of the resulting noise.

Inputs:
AM - Controls the peak amplitude of the resulting noise.

Outputs:
Single output providing the (filtered) noise.

Available:
SynFactory 0.99 or higher version.

5.1.4. Formanzzz - The formant oscillator

The formanzz module generates sound with very distinct sound spectra. It is usefull as raw material to filter or otherwise process. As pure sound source it is less usefull due to its harsh sound. It can be used to emulate electric gitars or other sounds with much overtones. The formant control selects one of the available waveforms and must be set to something different as zero (0) to generate sound. There are over 30000 different sounds spectra to choose from.

Controls:
Freq - Sets frequency, this is a logarithmic control (same scale as OSC and MOS oscillators).
Formant - Selects the generated waveform. Set this to something different as zero (0) otherwise there is no sound.
Ampl - Sets the amplitude of the output signal. When set to 0 there is no signal. The value can also be negative and reverses the waveform.

Inputs:
FM - (frequency modulation) modulates the oscillator frequency in a logarithmic (musical) way.
Lin - Also a frequency modulation input but with a linear response, usefull for vibrato and FM synthesis.
Frmt - Sets the formant, this value is added to the **formant** control.
AM - Amplitude modulation input, it is added to the amount set by Ampl control. The amplitude control is linear.

Outputs:
Single output providing the generated waveform.

Technical details:
The formanzzz module is actually a pseudo random noise generator, but it gets retriggered by a buildin oscillator. Due to the repeating character of the noise a tone with specific spectra is generated. The noise source is specifically 'badly' designed so its repetitive, something a normal noise source shouldn't be. The formant control sets the start point for the pseudo random number generator (seed) and is multiplied by a internal value to spread the actual available sounds over a huge range. Its undo able to describe all 30000+ spectra so experiment yourself.

Available:
SynFactory 0.99 or higher version.

5.1.5. SineBank - Multiple octave Sine wave oscillator

Oscillator generating 9 sinewaves at the same time, each one higher in frequency. This oscillator can be used to experiment with additive synthesis (usefull to make organ and bell like sounds).

Controls:
Freq - Sets frequency, this is a logarithmic control. To make live easier the actual frequency is displayed below the control in Hertz (number of cycles a second).
Base - Sets amplitude for sinewave of base harmonic.
Base*2-Base*9 - Sets amplitudes for sinewaves of higher harmonics (number gives multiplication to base frequency).

Inputs:
FM (2x) - (frequency modulation) modulates the oscillator frequency in a logarithmic (musical) way.
Lin - Also a frequency modulation input but with a linear response, usefull for vibrato and FM synthesis.
FB-F9 - Control input for amplitude modulation of each of the 9 sinewaves.

Outputs:
Single output providing the sum of the 9 generated sinewaves.

Available:
SynFactory 1.12 or higher version.

5.1.6. PerlinOsc - Perlin-noise based oscillator

This module is provided to replace the Formanzzz oscillator. It is a pseudo random number generator but with interpolation filters. So it goes smoothly from one value to the next. With the harmonize knob extra harmonics can be added to the sound spectra.

Because of the smoothing filters, it can be used either as complex waveform oscillator, or at low frequencies as a complex control signal source. Different waveforms can be selected but they all sound much alike, but small harmonic variations are possible. The waveform selector also has a smoothing function so PWM like sounds can be generated.

Controls:
Freq - Sets frequency, this is a logarithmic control. An exact frequency can not be displayed because this oscillator generates a complex waveform.
Wave - Select one of the possible waveforms.
Harm - Higher values of this setting will add more harmonics to the generated waveform.
Ampl - Sets the amplitude of the output signal. When set to 0 there is no signal. The value can also be negative and reverses the waveform.

Inputs:
FM - (frequency modulation) modulates the oscillator frequency in a logarithmic (musical) way.
Lin - Also a frequency modulation input but with a linear response, usefull for vibrato and FM synthesis.
Wave - Select one of the possible waveforms.
Harm - Higher values of this input will add more harmonics to the generated waveform.
AM - Amplitude modulation input, it is added to the amount set by Ampl control. The amplitude control is linear.

Outputs:
Single output providing the generated waveform.

Available:
SynFactory 2.00 or higher version.

5.2. Filters and amplifiers

5.2.1. MMF - Multi Mode Filter (12/18/24 dB)

This is a 4 stage filter with multiple outputs. It has a very natural character and can be used for most filtering purposes. Because of its 4 stages it can sound a little dull, use the feedback control to 'lighten up' the sound.

Controls:
Cutoff - Sets cutoff frequency for the filter. All frequencies above the cutoff frequency will be filtered.
Reso - Sets the filter resonance amount. It amplifies frequencies around the cutoff point. Generates a distinct peak in the audio spectrum. At high settings the filter will self oscillate.
FdBack - Enhances the higher tones in the spectrum. Higher feedback settings give a brighter sound.

Inputs:
In (3x)- Audio input, this is the signal which is filtered.
Frq (2x)- Cutoff control input. Same scale as Cutoff control.
Q - External control of resonance, input is combined with Reso control.

Outputs:
L12 - Lowpass output, the audio is filtered with a 12 db/oct slope.
L18 - Lowpass output, the audio is filtered with a 18 db/oct slope.
L24 - Lowpass output, the audio is filtered with a 24 db/oct slope.
BP - Bandpass output.
HP - Highpass output.

Technical details:
The filter has 4 stages with 6 db/oct filters. The BP and HP are generated by taking the difference between some outputs of the stages. This result in only between 6 to 12 db/oct for the BP and HP outputs. More strong filtering would make these outputs too dull. Use the OB-VCF filter if a little more heavy BP filtering is necessary. The OB-VCF has very strong feedback and therefore more steep filtering. The Feedback control is accomplished by sending part of the lowpass filtered output back to the input, because these will be out of phase they cancel each other out. This results in LP outputs which sound brighter.

Available:
SynFactory 1.00 or higher version.

5.2.2. OB VCF - 12dB OB-type filter

This filter emulates the sound of the Oberheim voice-expansion filter. It is a two stage filter with much feedback, so it gives a very strong sound. Use it for those classic analog sounds like leads and strings. Because of its resonance characteristic, its also useful for noise filtering in percussion sounds.
Due to the power of the filter, there is a build in limiter to prevent 'lockup' at high signal inputs.

Controls:
Cutoff - Sets cutoff frequency for the filter. All frequencies above the cutoff frequency will be filtered.
Reso - Sets the filter resonance amount. It amplifies frequencies around the cutoff point. Generates a distinct peak in the audio spectrum. At high settings the filter will self oscillate.

Inputs:
In (3x)- Audio input, this is the signal which is filtered.
Frq (2x)- Cutoff control input. Same scale as Cutoff control.
Q - External control of resonance, input is combined with Reso control.

Outputs:
LP - Lowpass output, the audio is filtered with a 12 db/oct slope.
BP - Bandpass output.
HP - Highpass output.

Technical details:
The filter has 2 stages with 6 db/oct lowpass filters. Due to a feedback loop from the last stage to the input, the filter will operate as a multimode filter providing LP, BP and HP outputs simultaneous. This filter has some special characteristics. The resonance peak lies higher as the cutoff frequency. The BP and HP outputs are much stronger as compared to the LP (except when self oscillating). Although the MMF-filter has a feedback loop, using it will not result in the same sound. The MMF-filter has the resonance peak around the cutoff, while this filter has it about 2 octaves higher.

Available:
SynFactory 1.00 or higher version.

5.2.3. ECF - Envelope Controlled 12 dB OB-type Filter

This module is a combination of 3 other modules. It contains a 3 channel audio mixer, an envelope generator and an Oberheim type filter.

Controls:
Lev 1 - Control the mixing level of the **In 1** input (linear response).
Lev 2 - Control the mixing level of the **In 2** input (linear response).
Lev 3 - Control the mixing level of the **In 3** input (linear response).
Cutoff - Sets cutoff frequency for the filter. All frequencies above the cutoff frequency will be filtered.
A - Sets the attack rate for the envelope generator.
D - Sets the decay rate for the envelope generator.
S - Sets the sustain level for the envelope generator.
R - Sets the release rate for the envelope generator.
Reso - Sets the filter resonance amount. It amplifies frequencies around the cutoff point. Generates a distinct peak in the audio spectrum. At high settings the filter will self oscillate.

Inputs:
In1 - Audio input 1.
In2 - Audio input 2.
In3 - Audio input 3.
Mod - Amount control input.
Frq (2x)- Cutoff control input. Same scale as Cutoff control.
Q - External control of resonance, input is combined with Reso control.
Gate - When gate is high (>0), Attack/decay stage is started. On gate is low (≤0) release stage is entered.

Outputs:
LP - Lowpass output, the audio is filtered with a 12 db/oct slope.
BP - Bandpass output.
HP - Highpass output.

Available:
SynFactory 1.00 or higher version.

5.2.4. VCA - Amplifier with variable gain

This module which is named after its analog counterpart (Voltage Controlled Amplifier), is used to amplify a signal depending on the value of the control inputs. There is also a front panel control to set the default gain of the amplification. The range of the gain is 0% (≤0) to 400% (32767).

Controls:
Gain - Initial gain (range 0% to 400%).

Inputs:
In - Input signal.
Exp - exponential control input (same as Gain knob).
Lin - Linear control input, sometimes usefull for control by an ADSR. Because this module has 2 quadrant modulation only, it can't be used for ringmodulation. Use a MUL module instead.

Outputs:
Single output providing the attunated or amplified signal.

Technical details:
Output = (**In** * (**Lin** + SCALEDEXP(**Exp** + **Gain**))) / 8192

Available:
SynFactory 1.00 or higher version.

5.2.5. ECA - Envelope Controlled Amplifier

This module is a combination of 3 other modules. It contains a three channel mixer, an envelope generator and an amplifier with variable gain. In most analog synthesizer a module like this one is used as last stage before it goes to the output mixer.

Controls:
Lev 1 - Control the mixing level of the **In 1** input (linear response).
Lev 2 - Control the mixing level of the **In 2** input (linear response).
Lev 3 - Control the mixing level of the **In 3** input (linear response).
Volume - The mixed signal of the 3 inputs are scaled by the output curve of the envelope. This Knob sets the maximum amplification level for the envelope.
A - Sets the attack rate for the envelope generator.
D - Sets the decay rate for the envelope generator.
S - Sets the sustain level for the envelope generator.
R - Sets the release rate for the envelope generator.

Inputs:
In1 - Audio input 1.
In2 - Audio input 2.
In3 - Audio input 3.
Vol - External control for the **Volume** setting.
A - Attack rate control input.
D - Decay rate control input.
R - Release rate control input.
Gate - When gate is high (>0), Attack/decay stage is started. On gate is low (≤0) release stage is entered.

Outputs:
Single output providing the mixed and enveloped signal.

Available:
SynFactory 1.00 or higher version.

5.3. Modulation

5.3.1. CTR - Signal controller

This module can change the gain and offset of a control signal. The gain can change the amplitude of the control signal from -200% to 200%. The offset setting will add an additional static level to the signal (DC offset).

Controls:
Gain - Change gain (amplification) of the input signal.
Offset - Add DC offset to the output signal.

Inputs:
In - Signal input.
Mod - External control of gain, input is added to value of Gain control.
Offs - External control of offset, input is added to value of Offset control.

Outputs:
Single output providing the modified control signal.

Technical details:
Output = (**In** * (**Gain** + **Mod**)) / 16384 + **Offset** + **Offs**

Available:
SynFactory 0.99 or higher version.

5.3.2. ENV - ADSR Envelope generator

Controls:

A - Sets the attack rate for the envelope generator.
D - Sets the decay rate for the envelope generator.
S - Sets the sustain level for the envelope generator.
R - Sets the release rate for the envelope generator.
Amount - Set the maximum level the envelope will reach.

Inputs:

Mod - Amount control input.
A - Attack rate control input.
D - Decay rate control input.
S - Sustain level control input.
R - Release rate control input.
Gate - When gate is high (>0), Attack/decay stage is started. On gate is low (≤0) release stage is entered.

Outputs:

Single output with envelope signal.

Available:

SynFactory 0.99 or higher version.

5.3.3. AHD - Attack/Hold/Decay envelope generator

Small envelope generator which uses a trigger input. It has a **hold** setting, because normally the sustain time is determined by a gate input. But this envelope generator has only a trigger input.

Controls:
Attack - Set total attack time.
Hold - Set time the envelope will wait after attack phase before starting decay phase.
Decay - Set total decay time.
Amount - Set the maximum level the envelope will reach.

Inputs:
Mod - Amount control input.
A - Attack time control input.
H - Hold time control input.
D - Decay time control input.
Trig - Trigger input, envelope starts on positive trigger. It will retrigger even if A, H or D stage is not yet completed.

Outputs:
Single output with envelope signal.

Available:
SynFactory 1.13 or higher version.

5.3.4. S/H - Sample and Hold

The sample and hold module will take the value of the **In** input on each low->high transition of **Trig** and will hold this value until the next. It will generate stepped control signals from continuous signals.

Inputs:
In - Signal input, this signal is sampled on each trig transition
Trig - Trigger signal.

Outputs:
Out - Stepped signal output

Technical details:
This module can be used for a lot of different purposes. In combination with a RND as source it generates a new random value on each trigger point. Unlike its analog counterpart it's use is not restricted to control signals, it works also on audio signals, generating all sorts of artifacts when both **Trig** and **In** are connected to two different audio signal sources, in this mode it functions as a distortion unit.

Available:
SynFactory 0.99 or higher version.

5.3.5. GLI - Glide/Portamento

The output of this module follows the input, but it can be slowed down with the speed setting. It find its use after Sample&Hold gates or sequencers to 'glide' the sound. In combination with a 'splitter' module it can function as an envelope follower. This module is not very useful for processing audio signals (output doesn't follow the input fast enough).

Controls:
Speed - Sets the follow speed 0 slowest and at 32767 the output will follow input directly.

Inputs:
In - Input signal which is filtered and send to the output.
Spd - Control input for the speed setting.

Outputs:
Single output providing the filtered/followed input signal.

Available:
SynFactory 0.99 or higher version.

5.3.6. TRIG - Delayed gate/trigger/one-shot

This module delays a trigger signal or stretches a gate signal. Both modes can be used at the same time, delaying both the trigger moment and the gate release times.

Controls:
T-On - Sets the delay time between the activation of the gate input and the outputs becoming active (32767).
T-Off - Sets the delay time between the deactivation of the gate input and the gate output becoming inactive (0) and it also sets the length of the one shot pulse.

Inputs:
T-on - Control input for the on time delay setting.
T-off - Control input for the off time delay setting.
Gate - Gate signal input. Defined as ≤0 is inactive and >0 is active.

Outputs:
Gate - Gate signal delayed from the input gate. Length of the pulse depends on the length of the input pulse and the settings of the controls.
1shot - The pulse length is independed on the length of the gate input.

Available:
SynFactory 1.00 or higher version.
SynFactory 1.12 or higher version for module with **1shot** output.

5.3.7. SEQ - 16 steps sequencer

Controls:
Step 1-16 - Value for each step of the sequencer

Inputs:
Clk - On each clock transition from low to high (≤0 to >0) the sequencer steps one step further.
Rst - Restart sequencer to the first step when this input is high (>0). It will stay at step 1 as long as the input is high.

Outputs:
Out - Value of the current active step of the sequencer.
Rst - This output is active when sequencer is on step 1.

Available:
SynFactory 0.99 or higher version.

5.3.8. SEQ - 8 steps sequencer

Controls:
Step 1-8 - Value for each step of the sequencer

Inputs:
Clk - On each clock transition from low to high (≤0 to >0) the sequencer steps one step further.
Rst - Restart sequencer to the first step when this input is high (>0). It will stay at step 1 as long as the input is high.

Outputs:
Out - Value of the current active step of the sequencer.
Rst - This output is active when sequencer is on step 1.

Available:
SynFactory 0.99 or higher version.

5.3.9. BinSeq - Binary input 8 steps sequencer

Controls:
Step 1-8 - Value for each step of the sequencer

Inputs:
S0 - Select the active step (S0 to S2 form a 3 bits value selecting a step). This is bit 0 (step offset 1)
S1 - Select the active step (S0 to S2 form a 3 bits value selecting a step). This is bit 1 (step offset 2)
S2 - Select the active step (S0 to S2 form a 3 bits value selecting a step). This is bit 2 (step offset 4)
-OE - Disables the output (makes it zero) if this input is positive.

Outputs:
Out - Value of the current active step of the sequencer.

Available:
SynFactory ?.?? or higher version.

5.4. Math modules

5.4.1. ADD - 2-8 input adder

Adds the signals on all inputs together and send it to the output. It accepts all types of signals and simply adds them together. Useful if you want to feed multiple outputs into one input. Some modules already have multiple inputs when this is common (like the filters). Adding multiple high volume signals together increases the chance for distortion. Use one of the mixers instead, because these have controls to lower the volume on each input.

Inputs:
2 to 8 signal inputs which will be added together.

Outputs:
Single output providing the summed value of all inputs

Available:
SynFactory 0.99 or higher version.

5.4.2. MUL - Multiplier/Ringmodulator

Calculates the product of the two inputs and scales this down to the normal signal range. If both inputs have maximum amplitude, the resulting product will have the same amplitude. This module can be used for multiple purposes. It can function as a ringmodulator, a amplitude modulator with linear response or a distortion unit (with same signal connected to both inputs).

Inputs:
Two signal inputs.

Outputs:
Single output providing scaled product of the two inputs.

Technical details:
Normal signal range is from -32768 to 32767. Multiply these together and the range becomes much larger. The resulting product is scaled down by dividing by 32768. This is a very fast operation because it can be done by shifting the result 15 bits to the right.

Available:
SynFactory 0.99 or higher version.

5.4.3. SUB - Subtractor

Calculates the difference between two signals. Because a not connected input is zero, it can also be used as an inverter.

Inputs:
inv - Inverted input, this signal is subtracted from zero before added.
noninv - Non inverting input, this signal is added unmodified.

Outputs:
Single output providing the difference between the two inputs.

Technical details:
Output = **noninv** - **inv**

Available:
SynFactory 0.99 or higher version.

5.4.4. SPLIT - Positive and negative signal splitter

This module splits the input in 3 different signals depending on the sign of the input signal.

Inputs:
Single input signal which is splitted on sign.

Outputs:
Pos - Only the positive values of the input signal are send to this output. If the input signal is negative this output is set to zero.
Neg - Only the negative values of the input signal are send to this output. If the input signal is positive this output is set to zero.
Abs - This is the absolute value of the input signal. Negative signals are converted to positive signals, zero or positive signals are unchanged. The effect is a signal with the same amplitude as the input signal, but the signal is always positive (or zero).

Available:
SynFactory 0.99 or higher version.

5.4.5. BETWEEN - Window comparator

This module performs two functions. It checks if a signal is in a range set with two set-points. Two logical outputs provide information about the input signal. The signal is also send out unmodified as long its in the allowed range. Outside the range its clipped to one of the set-points. This module can therefore also be used as a distortion unit.

Controls:
Point1 - Set clipping point 1.
Point2 - Set clipping point 2.

Inputs:
inp - Signal input
pnt1 - Control input for setting first limit point.
pnt2 - Control input for setting second limit point.

Outputs:
out - Output is the same as the input signal but clipped to the set-points when the signal is outside the allowed range.
btwn - This logic output is active (32767) when the signal is within the range (doesn't clip).
clp'd - This logic output is active (32767) when the signal is outside the range (it is clipped).

Available:
SynFactory 1.13 or higher version.

5.5. Logic Modules

5.5.1. OR - 2-8 input logic OR gate

The OR module performs a logic function. The output is active when one or more of the inputs are active.

Inputs:
Two to eight logic inputs. When the input value is ≤0 the input is inactive, when value is >0 the input is active.

Outputs:
Single output providing the result of the logic OR function. This output is active (32767) when one or more inputs are active (>0).

Technical details:

Logic diagram OR								
Input 1	**Input 2**	**Input 3**	**Input 4**	**Input 5**	**Input 6**	**Input 7**	**Input 8**	**Output**
≤0	≤0	≤0	≤0	≤0	≤0	≤0	≤0	0
>0	x	x	x	x	x	x	x	32767
x	>0	x	x	x	x	x	x	32767
x	x	>0	x	x	x	x	x	32767
x	x	x	>0	x	x	x	x	32767
x	x	x	x	>0	x	x	x	32767
x	x	x	x	x	>0	x	x	32767
x	x	x	x	x	x	>0	x	32767
x	x	x	x	x	x	x	>0	32767

Available:
SynFactory 1.00 or higher version.

5.5.2. AND - 2-8 input logic AND gate

The AND module performs a logic function. The output is active when all of the inputs are active.

Inputs:
Two to eight logic inputs. When the input value is ≤0 the input is inactive, when value is >0 the input is active.

Outputs:
Single output providing the result of the logic AND function.

Technical details:

Logic diagram AND								
Input 1	**Input 2**	**Input 3**	**Input 4**	**Input 5**	**Input 6**	**Input 7**	**Input 8**	**Output**
≤0	x	x	x	x	x	x	x	0
x	≤0	x	x	x	x	x	x	0
x	x	≤0	x	x	x	x	x	0
x	x	x	≤0	x	x	x	x	0
x	x	x	x	≤0	x	x	x	0
x	x	x	x	x	≤0	x	x	0
x	x	x	x	x	x	≤0	x	0
x	x	x	x	x	x	x	≤0	0
>0	>0	>0	>0	>0	>0	>0	>0	32767

Available:
SynFactory 1.00 or higher version.

5.5.3. NOT - Logic NOT gate

Inputs:
Single input for NOT gate.

Outputs:
Single output providing the logic NOT function.

Technical details:

Logic diagram NOT	
Input	**Output**
≤0	32767
>0	0

Available:
SynFactory 1.00 or higher version.

5.5.4. XOR - Logic XOR gate

Inputs:
2 inputs for XOR gate.

Outputs:
Single output providing the logic Exclusive OR function.

Technical details:

Logic diagram ExOR		
Input 1	**Input 2**	**Output**
≤0	≤0	0
≤0	>0	32767
>0	≤0	32767
>0	>0	0

Available:
SynFactory 1.00 or higher version.

5.5.5. ADC - Digitize signals (9 bits resolution)

Converts a continuous signal to a 9 bit digital representation.

Inputs:
Single signal input

Outputs:
b7..b0 - 8 bit digital representation of absolute value of input.
neg - negative flag is 32767 when signal is <0 otherwise it is 0.

Available:
StudioFactory 1.00 or higher version.

5.5.6. DAC - Binary to signal (9 bits resolution)

Converts a 9 bit digital representation of a signal to a (511 steps) signal output.

Inputs:
b7..b0 - 8 bit digital representation of absolute value of output.
neg - negative flag is 32767 when signal is <0 otherwise it is 0.

Outputs:
Single output providing the converted signal.

Available:
StudioFactory 1.00 or higher version.

5.5.7. Pulsar - Pulse generator/clock divider

Pulsar acts like a counter but the outputs give only a very short pulse. This module can be used to trigger SyncDelay modules or control counters and other pulsar modules. Triggering envelope generators can be tricky because the pulse is too short for the envelope generator to follow. Use a TRIG module to increase the pulse length.

Inputs:
Clk - Clock input, Pulsar counts on rising edge of clock signal.
Rst - Internal counters are resetted.

Outputs:
:2 - Clock divided by two (a pulse is generated for each 2 clocks).
:3 - Clock divided by three (a pulse is generated for each 3 clocks).
:4 - Clock divided by four (a pulse is generated for each 4 clocks).
:5 - Clock divided by five (a pulse is generated for each 5 clocks).
:6 - Clock divided by six (a pulse is generated for each 6 clocks).
:7 - Clock divided by seven (a pulse is generated for each 7 clocks).
:8 - Clock divided by eight (a pulse is generated for each 8 clocks).
:16 - Clock divided by sixteen (a pulse is generated for each 16 clocks).

Available:
SynFactory 1.01 or higher version. Although it is available in some earlier versions this module doesn't work correctly in any version of SynFactory before 1.01.

5.5.8. BIN - 8 bit Binary counter

Digital counter. Clock signals are counted binary wise. The counter is 8 bits wide so divides the clock signal by 256. The counter triggers on a negative clock input, this makes daisy-chaining multiple counter easy. Simply connect the **:256** output of the first counter with the **-Clk** input of the second. They will act as a 16 bit counter that way dividing the clock by 65536.

Inputs:
-Clk - Clock input for counter. Single step after each positive to zero or negative transition of the clock.
Rst - Making this input high will reset the counter to 0 (all outputs low).

Outputs:
:2 - Counter bit 0, clock divided by 2 output.
:4 - Counter bit 1, clock divided by 4 output.
:8 - Counter bit 2, clock divided by 8 output.
:16 - Counter bit 3, clock divided by 16 output.
:32 - Counter bit 4, clock divided by 32 output.
:64 - Counter bit 5, clock divided by 64 output.
:128 - Counter bit 6, clock divided by 128 output.
:256 - Counter bit 7, clock divided by 256 output.

Available:
SynFactory 1.00 or higher version.

5.5.9. DeMux - 1 to 2 demultiplexer

A demultiplexer makes one of its outputs high (>0) and the rest low (≤0). Which one depends on its inputs. The inputs represent a binary number.

Inputs:
S0 - Binary input to select one of the two outputs.

Outputs:
Gt0-1 - Only one of these outputs is active.

Technical details:

Logic diagram 1 to 2 demultiplexer		
S0	**Gt0**	**Gt1**
≤0	32767	0
>0	0	32767

Available:
SynFactory 1.00 or higher version.

5.5.10. DeMux - 2 to 4 demultiplexer

A demultiplexer makes one of its outputs high (>0) and the rest low (≤0). Which one depends on its inputs. The inputs represent a binary number.

Inputs:
S0 - Binary input to select one of the four outputs (weight of S0 is 1).
S1 - Binary input to select one of the four outputs (weight of S1 is 2).

Outputs:
Gt0-3 - Only one of these outputs is active (active output calculate with S1*2+S0).

Technical details:

Logic diagram 2 to 4 demultiplexer					
S1	**S0**	**Gt0**	**Gt1**	**Gt2**	**Gt3**
≤0	≤0	32767	0	0	0
≤0	>0	0	32767	0	0
>0	≤0	0	0	32767	0
>0	>0	0	0	0	32767

Available:
SynFactory 1.00 or higher version.

5.5.11. DeMux - 3 to 8 demultiplexer

A demultiplexer makes one of its outputs high (>0) and the rest low (≤0). Which one depends on its inputs. The inputs represent a binary number.

Inputs:
S0 - Binary input to select one of the eight outputs (weight of S0 is 1).
S1 - Binary input to select one of the eight outputs (weight of S1 is 2).
S2 - Binary input to select one of the eight outputs (weight of S2 is 4).

Outputs:
Gt0-7 - Only one of these outputs is active (active output calculate with S2*4+S1*2+S0).

Technical details:

Logic diagram 3 to 8 demultiplexer										
S2	**S1**	**S0**	**Gt0**	**Gt1**	**Gt2**	**Gt3**	**Gt4**	**Gt5**	**Gt6**	**Gt7**
≤0	≤0	≤0	32767	0	0	0	0	0	0	0
≤0	≤0	>0	0	32767	0	0	0	0	0	0
≤0	>0	≤0	0	0	32767	0	0	0	0	0
≤0	>0	>0	0	0	0	32767	0	0	0	0
>0	≤0	≤0	0	0	0	0	32767	0	0	0
>0	≤0	>0	0	0	0	0	0	32767	0	0
>0	>0	≤0	0	0	0	0	0	0	32767	0
>0	>0	>0	0	0	0	0	0	0	0	32767

Available:
SynFactory 1.00 or higher version.

5.5.12. DeMux - 4 to 16 demultiplexer

A demultiplexer makes one of its outputs high (>0) and the rest low (≤0). Which one depends on its inputs. The inputs represent a binary number.

Inputs:
S0 - Binary input to select one of the sixteen outputs (weight of S0 is 1).
S1 - Binary input to select one of the sixteen outputs (weight of S1 is 2).
S2 - Binary input to select one of the sixteen outputs (weight of S2 is 4).
S3 - Binary input to select one of the sixteen outputs (weight of S3 is 8).

Outputs:
Gt0-15 - Only one of these outputs is active (active output calculate with S3*8+S2*4+S1*2+S0).

Technical details:

Logic diagram 4 to 16 demultiplexer

S3	**S2**	**S1**	**S0**	**Gt0**	**Gt1**	**Gt2**	**Gt3**	**Gt4**	**Gt5**	**Gt6**	**Gt7**
≤0	≤0	≤0	≤0	32767	0	0	0	0	0	0	0
≤0	≤0	≤0	>0	0	32767	0	0	0	0	0	0
≤0	≤0	>0	≤0	0	0	32767	0	0	0	0	0
≤0	≤0	>0	>0	0	0	0	32767	0	0	0	0
≤0	>0	≤0	≤0	0	0	0	0	32767	0	0	0
≤0	>0	≤0	>0	0	0	0	0	0	32767	0	0
≤0	>0	>0	≤0	0	0	0	0	0	0	32767	0
≤0	>0	>0	>0	0	0	0	0	0	0	0	32767
>0	x	x	x	0	0	0	0	0	0	0	0

S3	**S2**	**S1**	**S0**	**Gt8**	**Gt9**	**Gt10**	**Gt11**	**Gt12**	**Gt13**	**Gt14**	**Gt15**
≤0	x	x	x	0	0	0	0	0	0	0	0
>0	≤0	≤0	≤0	32767	0	0	0	0	0	0	0
>0	≤0	≤0	>0	0	32767	0	0	0	0	0	0
>0	≤0	>0	≤0	0	0	32767	0	0	0	0	0
>0	≤0	>0	>0	0	0	0	32767	0	0	0	0
>0	>0	≤0	≤0	0	0	0	0	32767	0	0	0
>0	>0	≤0	>0	0	0	0	0	0	32767	0	0
>0	>0	>0	≤0	0	0	0	0	0	0	32767	0
>0	>0	>0	>0	0	0	0	0	0	0	0	32767

Available:
SynFactory 1.00 or higher version.

5.6. Song Modules

5.6.1. SCRIPT - Script controlled note player

This module is a note sequencer with a buildin scripting engine. It can perform multiple functions depending on the script. Main output is a note with gate signal, but six additional control outputs are available. The outputs can be used for example to set note volume (velocity) or change the filter cutoff and resonance.

Double click on the script module with the left mouse button to open the script editor. After required changes are made, close the editor window with the close icon in the right corner of the window. If the patch is running, the scripting module will react as if the **Rst** input is activated (the script will start from the beginning). Take note: Errors in the script will be skipped without any visual feedback!

Inputs:
-Clk - Clock input. With the **P*count*** command the script can be paused for one or more clock ticks (trigger on falling edge).
Rst - If >0 reset the module, script will restart from beginning (Note: outputs are *not* resetted).
Inp1 - Inp6 - 6 extra inputs which can be used to control the flow of the running script.

Outputs:
Freq - Frequency output (use commands 'C', 'C#', 'D', 'D#', 'E', 'F', 'F#', 'G', 'G#', 'A', 'A#' or 'B' to control this output).
Gate - Gate signal (use commands **[** and **]** to control this output).
u-z - Six extra control outputs (use commands **u**-**z** to control these outputs). Outputs can function as control signal or extra note outputs.

Scripting language:
{ comment } - Place comment in the script, this will be skipped by the scripting engine. Use it to make the scripts more readable.
C4 - Play note C from 4th octave. Last octave is remembered so if multiple notes from the same octave are played only the first one needs the octave number.
C - Play note C from current octave.
C# - Play note C-sharp from current octave
D D# E F F# G G# A A# B - Play one of the other notes from the octave.
[- Turn gate signal on (32767)
] - Turn gate signal off (0)
:*label* - Define subroutine label. The **:** command will only set a label, executing the command will *not* skip the subroutine behind it. Therefore place subroutines at the end of the script, so the normal script flow is not disturbed.
; - Return from subroutine, back to the point just behind the **M*label*** command. If there are no return points, it will behave as the **R** command.
J*label* - Jump to label, its like a 'goto' command in basic. The **;** command can *not* return after a jump, use **M*label*** if the return point is needed.
M*label* - Call subroutine with specified label.
P*count* - Wait for *count* number of clock cycles. **P0** doesn't wait on clock but waits only one sample, this is usefull for generating trigger signals. The sequence **W32767 P0 W0 P0** will generate a short pulse on the **w** output.
R - Reset module, script will restart from beginning (Note: outputs are *not* resetted, use the sequence **U0 V0 W0 X0 Y0 Z0] P0** to reset all outputs).
U*value* - Set **u** output to specified value.
U*note* - Set **u** output to specified note (for example UC#2).
V*value* - Set **v** output to specified value.
V*note* - Set **v** output to specified note (for example VC#2).
W*value* - Set **w** output to specified value.
W*note* - Set **w** output to specified note (for example WC#2).

X*value* - Set **x** output to specified value.
X*note* - Set **x** output to specified note (for example XC#2).
Y*value* - Set **y** output to specified value.
Y*note* - Set **y** output to specified note (for example YC#2).
Z*value* - Set **z** output to specified value.
Z*note* - Set **z** output to specified note (for example ZC#2).

Example script:

```
{ This script will loop fast through multiple notes, use W output to
trigger base drum sound }
C5 W1 P0 W0 P2 D# P2 E P2 D P2
C5 W1 P0 W0 P2 D# P2 E P2 D P2
C5 P2 D# P2 E P2 D P2
C5 P2 D# P2 E P2 D P2
R
```

Available:
SynFactory 1.13 or higher version.

5.7. Effect Modules

5.7.1. FLA - Flanger

Strictly speaking a flanger/chorus is nothing more as a variable delayline. This delayline has filters around it, so it's possible to modulate the delayline length without introducing noise. When combining the input and delayed signal, phase differences will generate the flanger/chorus effect. The exact effect depends on modulation speed, modulation amplitude and the waveform that is used (best use triangle or sine waves as modulator). The delayline is very short, use a normal delay module if longer delaytimes are needed (but the length of the normal delayline is more difficult to modulate without artifacts).

Controls:
InpLev - Sets the gain of the input signal. The delayline can clip if the sum of the feedback and input signal is too high.
FdBack - Part of the delayline output can be send back to the input.
Mix - Sets the mixing level between the input signal and delayed signal.

Inputs:
Inp - Audio input signal
Pos - Controls the position of tap in the delayline. This changes the effective length of the delayline. Modulate with a low-frequency triangle or sine wave.
Fbd - Control input for the feedback setting.
Mix - Control input for the mix setting.

Outputs:
mix - This output provides the sum of input signal with the delayed signal (depending on the setting of the mix control).
dly - Provides the output of the delayline without mixed input (this is also the internal signal used as feedback signal).

Technical details:
The flanger is a delayline with a interpolation filter at the output. The lower 4 bits are used to interpolate between the nearest samples in the delayline. This gives a 16 times higher modulation precision as the samplerate normally permits, but it sacrifices the maximum available delayline length to get these four extra bits.

Available:
SynFactory 0.99 or higher version.

5.7.2. DLY - Delay line

Delayline with single input and ouput (single tap). For convience there is buildin support for a feedback signal. Use it as a simple reverb or connect multiple together to build a multi-tab delay effect. Although the length of delayline can be modulated, there is a high chance for clicking noise. Use a Flanger module instead because it has better suppression of transition noise (but also shorter delay times).

Controls:
InpLev - Sets the gain of the input signal. The delayline can clip if the sum of the feedback and input signal is too high.
Length - Sets the length for the delayline (in samples). Maximum length is 32767/44100 = 0.74 seconds.
FdBack - Part of the delayline output can be send back to the input.

Inputs:
Inp - Audio input signal
Len - Control input for the delayline length setting.
Fbd - Control input for the feedback setting.

Outputs:
mix - This output provides the sum of input signal with the delayed signal.
dly - Provides the output of the delayline without mixed input (this is also the internal signal as used feedback signal).

Available:
SynFactory 0.99 or higher version.

5.7.3. SyncDly - Syncable Delay line

Delayline with single input and ouput (single tap). For convience there is buildin support for a feedback signal. The delay length is derived from a clock source. Maximum delay length is little over 1 second, it can take a few seconds before the delay 'locks' to the input clock. Use it as a rithmic delay or connect multiple together to build a multi-tab delay effect.

Controls:
InpLev - Sets the gain of the input signal. The delayline can clip if the sum of the feedback and input signal is too high.
FdBack - Part of the delayline output can be send back to the input.

Inputs:
Inp - Audio input signal
Clk - Input for clock signal, the frequency of the input clock determines delayline length.
Fbd - Control input for the feedback setting.

Outputs:
mix - This output provides the sum of input signal with the delayed signal.
dly - Provides the output of the delayline without mixed input (this is also the internal signal as used feedback signal).

Available:
SynFactory: 1.00 or higher.
StudioFactory: All versions

5.7.4. BIT - Bit reducer

This module is also known as a quantizer. It reduces the possible values a signal can be. All other values are rounded down to the nearest allowed value. High settings will generate extreme quantization noise, which might be useful for special sound effects. It can also process control signals to make 'stair case' waveforms. Not unlike a Sample&Hold gate, but without the need for a trigger signal.

Controls:
Bits - Resolution of the quantizing steps. Higher values give bigger steps and more noticable effect.

Inputs:
Inp - Signal input which will be quantized.
Bits - Resolution control

Outputs:
Single output providing the quantized output.

Technical details:
If this module would really do a bit-reduction only 15 different control settings would be available. To make a finer control range, a rounding function is performed. The signal is divided, rounded to the nearest integer and then multiplied again by the same value. The result is the same as a bit-reduce but with much finer control.

Available:
SynFactory 0.99 or higher.
StudioFactory: All versions.

5.7.5. Clippy - NoiseGate / Clipper / Distortion

This module does multiple sound effects at the same time. Its a weird combination of a limiter, distortion unit and a noise-gate. Unlike normal noise-gates it doesn't remove small signals by opening and closing a (virtual) switch, but it subtracts them from the signal. The result is a crossover distortion generating high-frequency sounds at zero crossings. After that comes an amplifier with a hard limiter. When the sound hits the limiter threshold rich overtones are generated (like a pulse wave).

Controls:
Lev - Initial amplitude level. Higher settings will increase the limiter effect. Lower settings will increase the noise-gate effect.
Gate - Sets the minimum level of the signals which are let through. Higher settings (1024+) give huge distortion.
Drive - Boosts the signal to get the amplitude needed to activate the limiter. Works together with the Lev and Gate controls. Because these can lower the amplitude of the signal. Drive can restore of even increase the level of the signal.

Inputs:
Inp - Audio signal input.
lev - External control input for the Lev setting.
gate - External control input for the Gate setting.
drv - External control input for the Drive setting.

Outputs:
Single audio output providing the resulting audio signal after the effects.

Available:
SynFactory: 1.00 or higher.
StudioFactory: All versions

5.7.6. PAN - Signal controlled panner

Give an audio source a position within the stereo signal.

Controls:
Pan - Manual panning (balance), sets the centre of the sound.
CtrDly - Delays the 'Ctr' input. Fast changes can cause clicks, this can be prevented by slowing down fast transitions. If this control is at 32767 the 'Ctr' input is directly setting the panning position, lower values will filter the signal, at 0 there is no change at all.

Inputs:
In - Audio input.
Ctr - Panning control. -32768 is left, 0 is center and 32767 is right.
Dly - This input is added to the value of the CtrDly control.

Outputs:
Left - Left channel audio output.
Right - Right channel audio output.

Available:
SynFactory: 1.10 or higher.
StudioFactory: All versions

5.8. Mixer modules

5.8.1. MIX - 3 channel Mixer

Module to mix 3 input signals to one. Level for each input can be set independently. The level controls are logarithmic. This means like a real mixing desk, two times higher level setting means two times preceived higher volume. This module can also be used to mix control signals, but because of the logarithmic level controls it can be tricky to get the correct amplitude for the resulting sum signal.

Controls:
Lev 1 - Control the mixing level of the **In 1** input (logarithmic).
Lev 2 - Control the mixing level of the **In 2** input (logarithmic).
Lev 3 - Control the mixing level of the **In 3** input (logarithmic).

Inputs:
In 1 - Signal input 1.
In 2 - Signal input 2.
In 3 - Signal input 3.

Outputs:
Single output providing the mixed signal.

Available:
SynFactory 0.99 or higher version.

5.8.2. MIX - 4 channel Mixer

Module to mix 4 input signals to one. Level for each input can be set independently. The level controls are logarithmic. This means like a real mixing desk, two times higher level setting means two times preceived higher volume. This module can also be used to mix control signals, but because of the logarithmic level controls it can be tricky to get the correct amplitude for the resulting sum signal.

Controls:
Lev 1 - Control the mixing level of the **In 1** input (logarithmic).
Lev 2 - Control the mixing level of the **In 2** input (logarithmic).
Lev 3 - Control the mixing level of the **In 3** input (logarithmic).
Lev 4 - Control the mixing level of the **In 4** input (logarithmic).

Inputs:
In 1 - Signal input 1.
In 2 - Signal input 2.
In 3 - Signal input 3.
In 4 - Signal input 4.

Outputs:
Single output providing the mixed signal.

Available:
SynFactory 0.99 or higher version.
StudioFactory: All versions

5.8.3. MIX - 8 channel Mixer

Module to mix 8 input signals to one. Level for each input can be set independently. The level controls are logarithmic. This means like a real mixing desk, two times higher level setting means two times preceived higher volume. This module can also be used to mix control signals, but because of the logarithmic level controls it can be tricky to get the correct amplitude for the resulting sum signal.

Controls:
Lev 1 - Control the mixing level of the **In 1** input (logarithmic).
Lev 2 - Control the mixing level of the **In 2** input (logarithmic).
Lev 3 - Control the mixing level of the **In 3** input (logarithmic).
Lev 4 - Control the mixing level of the **In 4** input (logarithmic).
Lev 5 - Control the mixing level of the **In 5** input (logarithmic).
Lev 6 - Control the mixing level of the **In 6** input (logarithmic).
Lev 7 - Control the mixing level of the **In 7** input (logarithmic).
Lev 8 - Control the mixing level of the **In 8** input (logarithmic).

Inputs:
In 1 - Signal input 1.
In 2 - Signal input 2.
In 3 - Signal input 3.
In 4 - Signal input 4.
In 5 - Signal input 5.
In 6 - Signal input 6.
In 7 - Signal input 7.
In 8 - Signal input 8.

Outputs:
Single output providing the mixed signal.

Available:
SynFactory 0.99 or higher version.
StudioFactory: All versions

5.8.4. CROSS - Cross fade

Mixes two signals together. The cross fade control and cross input control the balance between the two signals. Setting cross fade at 0 will mix both inputs at 50% each. Making the cross input higher as 0 or rotating the cross control clockwise increases the amplitude of the **inp H** input and decreases the amplitude of **inp L**. When this input or control is maximum only **inp H** is send to the output at 100%. Making the cross input lower as 0 reverses the process and increases the amplitude of the **inp L** input until it is 100% at fully anti-clockwise setting of the control (or -32768 at the cross input) .

Controls:
Cross - Sets mix between **inp H** and **inp L**. Clockwise increases **inp H** input, anticlockwise decreases **inp H** and increases the amplitude of **inp L**.

Inputs:
inp H - Input that is mixed with **inp L** will become louder when cross fade setting is higher as 0
cross - Control input for the cross fade
inp L - Input that is mixed with **inp H** and will become louder when cross fade setting is less as 0

Outputs:
Single output providing a mix between inp L and inp H.

Available:
SynFactory: not available
StudioFactory: All versions

5.8.5. MXO - Output with mixer control

5.8.6. OUT - Output

This module mixes its inputs together and sends the result directly to the soundcard. The mono (mid) inputs are mixed both to the left and right channel. The signal is reduced to 50% of the original amplitude before send to the soundcard. This allows some headroom if multiple signals are added. There can be multiple OUT modules in the patch, the signals from the various OUT modules are simply added together.

Inputs:
Left (2x) - Signals on these inputs are send only to the left speaker.
Mid (4x) - Signals on these inputs are send both to the left and right speaker (mono).
Right (2x) - Signals on these inputs are send only to the right speaker.

Available:
SynFactory All versions.
StudioFactory: All versions

5.8.7. OUT - Output with surround

This module mixes its inputs together and sends the result directly to the soundcard. The mono (mid) inputs are mixed both to the left and right channel. The signal is reduced to 50% of the original amplitude before send to the soundcard. This allows some headroom if multiple signals are added. There can be multiple OUT modules in the patch, the signals from the various OUT modules are simply added together.

Inputs:
Left (2x) - Signals on these inputs are send only to the left speaker.
Mid (4x) - Signals on these inputs are send both to the left and right speaker (mono).
Right (2x) - Signals on these inputs are send only to the right speaker.
Surrnd (2x) - Signals on these inputs are send both to the left and right audio channels, but are send in anti-phase. A dolby decoder will put these signals onto the rear speakers.

Available:
SynFactory: 1.10 or higher.
StudioFactory: All versions

5.8.8. PANOUT - Output with panning control

This module mixes its inputs together and sends the result directly to the soundcard. The mono (mid) inputs are mixed both to the left and right channel. In addition this module has both a panning and volume knob (and a control input for each) to set volume and balance of the left and right channel.

Controls:
Pan - Set difference between the amount of signal send to the left and right channels.
Volume - Total amount of signal send to the output.

Inputs:
Left - Signals on this input are send only to the left speaker.
Mid - Signals on this input are send both to the left and right speaker (mono).
Right - Signals on this input are send only to the right speaker.
Pan - Control input for panning.
Vol - Control input for setting volume.

Available:
SynFactory ?.?? or higher version.

5.8.9. INPUT - Audio Input

This module takes audio samples from a microphone or line-in and makes them available in the patch. StudioFactory can be used in this way as a powerful reverb or echo chamber. In combination with other modules more complex effects can be build like a vocoder.

Outputs:
Left - Left channel of microphone or line input
Right - Right channel of microphone or line input

Available:
SynFactory: not available
StudioFactory: All versions.

5.9. Interface Modules

5.9.1. Joystick - Joystick controlled module

If an (analog) joystick is connected to the machine, this module can be used to extract position information from the joystick to control various parameters. Joysticks with upto 6 axis and 4 buttons are supported.

Outputs:
X - Returns position on the horizontal axis (range -32767 to 32767).
Y - Returns position on the vertical axis (range -32767 to 32767).
Z - Returns position on the third axis, this is often the throttle control (range -32767 to 32767).
R - Returns position on the fourth axis (range -32767 to 32767).
U - Returns position on the fifth axis (range -32767 to 32767).
V - Returns position on the sixth axis (range -32767 to 32767).
B1 - Returns state of button 1 (32767 if held down, 0 if not pressed).
B2 - Returns state of button 2 (32767 if held down, 0 if not pressed).
B3 - Returns state of button 3 (32767 if held down, 0 if not pressed).
B4 - Returns state of button 4 (32767 if held down, 0 if not pressed).

Available:
SynFactory 1.15 or higher version.

5.9.2. Scope - 4 channel scope

This is a seperate scope, use it to debug the patch or visualize one or more parameters. Double click on the module to open the scope Window. It can display upto 4 channels at the same time. The 3 numbers represent the running average and the lowest and highest peak value seen in the current timeslot.

Inputs:
Ch 1 - First signal input. Data will be shown in left-top corner of scope window.
Ch 2 - Second signal input. Data will be shown in right-top corner of scope window.
Ch 3 - Third signal input. Data will be shown in left-bottom corner of scope window.
Ch 4 - Fourth signal input. Data will be shown in right-bottom corner of scope window.

Available:
SynFactory 1.15 or higher version.

6. Midi implementation chart (SynFactory patch)

Function		Transmitted	Recognised	Remarks
Basic	Default	X	1-16	Memorized
Channel	Changed	X	1-16	
Mode	Default	X	2, 4	Memorized
	Messages	X	X	
	Altered	********	X	
Note		X	0-127	
Number	True Voice	X	0-112	
Velocity	Note On	X	1-127	Scaled to range 0 to 32767
	Note Off	X	0-127	
After	Key's	X	X	
Touch	Ch's	X	O	
Pitch Bender		X	O	14 bits resolution, scaled to range -32768 to 32767
Control	1	X	*	Modulation
Change	2	X	*	Breath
	4	X	*	FootPedal
	5	X	*	Portamento Time
	7	X	*	Volume
	8	X	*	Balance
	10	X	*	Pan
	11	X	*	Expression
	12	X	*	Efx Control 1
	13	X	*	Efx Control 2
	14	X	*	Efx Control 3
	15	X	*	Efx Control 4
	16 - 19	X	*	Slider 1 - 4
	41 - 48	X	*	Knob 1 – 8 (eg AN1x)
	70	X	*	Sound Variation
	71	X	*	Sound Timbre
	72	X	*	Sound Release Time
	73	X	*	Sound Attack Time
	74	X	*	Sound Brightness
	75	X	*	Sound Control 6
	76	X	*	Sound Control 7
	77	X	*	Sound Control 8
	78	X	*	Sound Control 9
	79	X	*	Sound Control 10
Prog		X	X	
Change	True	X	X	
System Exclusive		X	X	Patch storage is done through files on disk.
System	Song Pos	X	X	
Common	Song Sel	X	X	
	Tune	X	X	
System	Clock	X	O	
Realtime	Commands	X	O	
Aux	Local On/Off	X	X	
	All Notes Off	X	X	
	Active Sense	X	X	
	Reset	X	X	
Notes	* Control signals can be wired to any desired function within the patch.			

7. Tuning Charts

The oscillators within SynFactory have a continuous range. The following tables help you tuning your patches and sequencer steps. There is a lot of information about tuning and scales available on the internet. It is impossible to include information and help on all scales and tunings in this document, but the tables should give an idea how to create your own tuning tables by using these as an example.

7.1. Equally tempered scale

Tuning Chart, Diatonic Scale, Equally Tempered. Numeric values for pitch are approximate. The scale is based on standard tuning of 440Hz, and derives the 12 tone scale from the 12th root of 2: 1.0594630943592952645618252949463.

Note	Freq. (Hz)	Value	Osc. Freq.		Note	Freq. (Hz)	Value	Osc. Freq.
C	32.703	18801	32Hz70		C	261.625	25347	261Hz6
C#	34.648	18983	34Hz65		C#	277.183	25530	277Hz2
D	36.708	19165	36Hz71		D	293.665	25712	293Hz7
D#	38.891	19346	38Hz89		D#	311.127	25893	311Hz1
E	41.203	19528	41Hz21		E	329.628	26075	329Hz6
F	43.654	19709	43Hz65		F	349.228	26257	349Hz2
F#	46.249	19891	46Hz25		F#	369.994	26439	369Hz9
G	48.999	20073	49Hz00		G	391.995	26621	391Hz9
G#	51.913	20254	51Hz91		G#	415.305	26804	415Hz4
A	55.000	20436	55Hz00		A	440.000	26986	440Hz1
A#	58.270	20618	58Hz27		A#	466.163	27167	466Hz1
B	61.735	20800	61Hz74		B	493.883	27350	494Hz0
C	65.406	20981	65Hz40		C	523.251	27531	523Hz2
C#	69.296	21163	69Hz29		C#	554.365	27713	554Hz3
D	73.416	21345	73Hz41		D	587.330	27895	587Hz3
D#	77.781	21527	77Hz78		D#	622.254	28077	622Hz2
E	82.407	21709	82Hz41		E	659.255	28259	659Hz2
F	87.307	21890	87Hz29		F	698.456	28441	698Hz4
F#	92.499	22072	92Hz49		F#	739.989	28623	739Hz9
G	97.999	22254	97Hz99		G	783.991	28805	783Hz9
G#	103.826	22437	103Hz8		G#	830.609	28988	830Hz8
A	110.000	22618	110Hz0		A	880.000	29169	879Hz9
A#	116.541	22800	116Hz5		A#	932.328	29351	932Hz2
B	123.471	22982	123Hz4		B	987.767	29533	987Hz6
C	130.813	23165	130Hz8		C	1046.50	29716	1046Hz
C#	138.591	23346	138Hz6		C#	1108.73	29898	1108Hz
D	146.832	23527	146Hz8		D	1174.66	30080	1174Hz
D#	155.563	23710	155Hz5		D#	1244.51	30262	1244Hz
E	164.814	23892	164Hz8		E	1318.51	30444	1318Hz
F	174.614	24074	174Hz6		F	1396.91	30626	1397Hz
F#	184.997	24256	185Hz0		F#	1479.98	30808	1480Hz
G	195.998	24438	196Hz0		G	1567.98	30990	1568Hz
G#	207.652	24620	207Hz7		G#	1661.22	31172	1661Hz
A	220.000	24802	220Hz0		A	1760.00	31354	1760Hz
A#	233.081	24984	233Hz1		A#	1864.66	31536	1864Hz
B	246.942	25165	246Hz9		B	1975.53	31718	1975Hz
C	261.625	25347	261Hz6		C	2093.00	31900	2093Hz

To a maximum frequency of about 76 cents short of F#. The oscillator response is exponential, like the Minimoog and Arp Odyssey. Thus, a linear input results in exponential output. In the case of SynFactory oscillators, frequency doubles everytime you add 2183 to the frequency (FM) input.

The neat thing here is that offsets are easy. There is no need to constantly recalculate from octave to actave. The following is a chart of offsets. Given the inherent minor inaccuracies, the offsets are based on averages.

Interval	Offset
One-half step	182
Whole step	364
m3	544
M3	727
4	909
Aug4 (tritone)	1092
5	1273
m6	1456
M6	1638
m7	1820
M7	2002
Octave	2183

7.2. Cents Tuning

The method for tuning calculations is the use of cents. One half step equals 100 cents, one octave equals 1200 cents. Again, this is a linear scale, and so easily used with SynFactory oscillators. A cent is worth about 1.82 on the frequency scale, or 182 (one half step) /100 or 2183/1200. If you want to create an offset of one Pythagorean half step, 90.225 cents, use INT(90.225*1.82). This would be an offset of 164.

8. File Formats

The file format specifications are provided for those who like to make utilities for StudioFactory and SynFactory, or want to provide file loading support in their software and need detailed information about the file formats. Some none native file formats are also described, both to give details how StudioFactory handles the loading of these formats and because some technical information about these files is difficult to acquire.

8.1. SYN file format (SynFactory 1.x)

8.1.1. Introduction

There is only a single file format for all versions of SynFactory. This makes it easy to transfer files between different versions of the program. Although the file format is the same, there are some subtle difference in the files generated by the different version of SynFactory. The only format differences between 1.x and 2.0beta versions of SynFactory is an extra section and the possibility to have multiple patches in one file. Although the beta versions are not officially supported, StudioFactory can load both the SYN (1.x) and SYF (2.0) files.

The file format is designed to provide full compatibility between different versions, newer versions can always load older syn-files, but the reverse isn't always true. Because new modules will be added, using these modules in patches can make it impossible to load these files in older versions of SynFactory. A module with three questions marks will appear in the patch or the file is refused on load.

The patch files are saved in ASCII format. The files can contain information not understood by all versions of SynFactory. Most information is identified by a ASCII based name token. All tokens not supported are simply skipped on load. The end of a command or piece of information can be determined by a line-break (CR+LF on windows machines).

During parsing of .syn files be prepared to deal with very long lines (>1000 chars). Don't assume 80 or so characters, because some commands can have many parameters and would overflow your storage buffers (this is one of the most common bugs in many programs). You have been warned!

8.1.2. Layout

Patch files contain multiple sections. A section is identified by the special sequence {{{ and the end with }}}. Sections can be nested inside each other and are identified with a name placed behind the {{{ and the }}} tokens.

The order of the sections in the file is not defined and the same type of section can occur multiple times. Which sections are present in the file depends on the patch saved and the way it is saved. The 'autoload.syn' file for example has a number of extra sections for storing configuration and settings, these are normally not found in other patch files.

All files begin with a fixed header to indentify it's a .syn-file (this headeris NOT stored in a section). After the header come zero or more sections each identified with special section token. Currently the following section tokens are in use:

{{{FILEPATHS Names of loaded files and other filesystem related information.
{{{SETTINGS Section to store user setting for the operation of SynFactory.
{{{WINDOWS Section which contains all window locations to reposition them on restart.
{{{SAMPLEBANK This is a container for sections dealing with samples and sampling.
{{{SAMPLES Alias for SAMPLEBANK (2.0+ only)
{{{SAMPLE Description for a single sample.
{{{PATCHES Section which contains zero or more PATCH sections (2.0+ only).
{{{PATCH This is a container for other sections specifing details about the complete patch.
{{{MODULE Description for a single synth module. Describes position, layout and settings of the module.

8.1.3. Header

The header consists of 3 lines which have a fixed layout. Changing only a single character in this header will result in a reject by SynFactory to load your file.

```
FILETYPE SYN
PROGRAM SynFactory
VERSION 1.00
```

Or for SynFactory 2.0 and above

```
FILETYPE SYN
PROGRAM SynFactory
VERSION 2.00
```

After the header is the path used to store this file

```
NAME C:\SynFactory\Shepard_01.syn
```

While this is not used by SynFactory and is not an official part of the header, most files saved by SynFactory will have this as the 4th line in the file. After these four lines come the sections. There is no footer or other file terminating sequence. The loading ends when EOF (End Of File) is detected.

8.1.4. Filepath section

On startup SynFactory will redisplay the patch which was active while SynFactory was closed. From SynFactory 1.12 onward the filename of the patch is also restored. The following setting is used to save this filename:

```
CURRENTFILE C:\SynFactory\Shepard_01.syn,Shepard_01.syn
```

8.1.5. Settings section

All flags and settings in this section can be changed from within synfactory so it is not recommended to change these values from within another tool. Noted here for reference only.

TOOLBAR <flag>
<flag> can be 0 or 1. If 0 then toolbar is off, when 1 then toolbar is visible. The default value is 1.

MAINMENU <flag>
<flag> can be 0 or 1. If 0 then main menu is invisible. The default is 1 and is recommended setting.

PATCHCABLES <type>
<type> can be 0, 1 or 2.

BUFFERSIZE <size>
<size> is one of 256, 512, 1024, 2048, 4096, 8192 or 16384.
This controls the buffer size for the DSP engine. I recommend to change this value by use of SynFactory only. Incorrectly setting of this value can cause undesired misbehavior of SynFactory or your system sound drivers (blue screen bye bye windows :-).

NROFBUFFERS <count>
Number of buffers used to drive the audio output. Only used for some audio drivers. Valid range depends on SynFactory version but is normally 3 to 10.

SCOPEMODE <mode>
<mode> can be 0 or 1. This setting controls the way the Output Scope displays its waveforms. 0 will display the channels are above each other. 1 will display the channels next to each other.

JOYSTICKMODE <mode>

<mode> selects which joystick input is used.

8.1.6. Windows section

Stores location and size of the tool windows. There are two possible commands for the scope-window. Only one is present in the file. From version 1.13 the scope window is resizable, so 2 extra parameters need to be stored. The SCOPEWINDOW2 token is added to not break backwards compatibility. Only problem is when loading a 1.13+ autoload.syn file in an older version the scope window will not be displayed and the stored location and size will be lost (because the SCOPEWINDOW command is not present).

SCOPEWINDOW <flag>,<x>,<y>
<flag> can be 0 or 1. If 0 then the scope window is not visible, when 1 the scope window is visible. <x> is the horizontal location of the window. <y> is the vertical location of the window.

SCOPEWINDOW2 <flag>,<x>,<y>,<xs>,<ys>
<flag> can be 0 or 1. If 0 then the scope window is not visible, when 1 the scope window is visible. <x> is the horizontal location of the window. <y> is the vertical location of the window. <xs> is the width of the window in pixels. <ys> is the height of the window in pixels.

TRANSPORTWINDOW <flag>,<x>,<y>
<flag> can be 0 or 1. If 0 then the transport window is not visible, when 1 the transport window is visible. <x> is the horizontal location of the window. <y> is the vertical location of the window.

MIXERWINDOW <flag>,<x>,<y>,<xs>,<ys>
<flag> can be 0 or 1. If 0 then the mixingdesk window is not visible, when 1 the mixingdesk window is visible. <x> is the horizontal location of the window. <y> is the vertical location of the window. <xs> is the width of the window in pixels. <ys> is the height of the window in pixels.

8.1.7. Samplebank section

Container section for storing SAMPLE sections.

8.1.8. Samples section

Container section for storing SAMPLE sections.

8.1.9. Sample section

This section stores information for a single sample. These samples are used in the Tracker-sequencer. Because sample data can contain any character they are encoded to remove any ASCII control characters which might give cross platform inconsistency.

8.1.10. Sampledata encoding

The sample data is coded in a 'base-85' encoding. 4 bytes are packed to 5. If the file is not a multiple of 4, extra zero's are added during encoding phase but are not counted in the length fields. These always give the real length of the sample. Four bytes are taken as an unsigned 32bits long (filling from MSB to LSB) and are 5 times divided by 85. The modulus (% operator in C) is used to get the remainder of the division and with 33 added this is written to the file. Two small improvements are made to save some of the space, because this code gives 25% overhead. If the 32 bits integer is 0 we do not write '!!!!!' but 'z'. This saves 4 chars on each 32 bits integer which is zero (and zero is very common in samples because it is silence!). And if current 32 bits integer is same as previous 'x' is written instead of the full encoding. The 'z' does NOT reset the state of the previous storage value! So multiple zero's are written as 'zzzzz' and not as 'zxxxx'!

8.2. STF file format (StudioFactory)

8.2.1. Introduction

This is the StudioFactory native file format. It follows basically the same logic as the .SYN file format, but is binary format instead of an ASCII format. Because of it's binary format, it can store samples and other binary data much more efficiently.

8.2.2. Layout

The file consist of a header followed by one or more chunks with data. Each chunk is identified with a name which determines the type. Each chunk also contains a field that specifies the length of the chunk. This way the file format can be extended without breaking older software. The new chunks or extra data fields are simply ignored by older software. The rule is only adding new fields after the old ones. The software should always use the length given in the chunk and never assume anything on the chunk name.

There is no predefined contents of the files, all depends on the specific data stored. The order of the chunks however might be important for the application, so external tools should try to preserve the chunk order if possible.

8.2.3. Encoding

Integers are stored as 4 bytes with the MSB first (big endian).
Strings start with an integer (4 bytes, MSB first) with the length of the string counted in characters, followed by the characters themselves. No terminating 0, padding or aligning characters are added. The next field can therefore start on an odd offset in the file. Text strings have a length field at front and no embedded terminate characters and can therefore also used to store binary data like samples and bitmaps.

Each data chunk starts with the name of the chunk (stored as STF string with 4 bytes for the length followed by the characters of the name). The minimum chunk name length which should be supported by applications is 31 characters. The name is followed by an integer that tells the length of the data in the chunk (excluding chunk name and this integer). So for an empty chunk this integer is zero.

The data inside each chunk is application depended. For chunks not recognized by a particular application the length field can be used to skip to the next chunk.

8.2.4. Header

The header is an empty chunk (24 bytes total length) with the name "STUDIOFACTORY100" (hex 00 00 00 10 53 54 55 44 49 4F 46 41 43 54 4F 52 59 31 30 30 00 00 00 00). This header must be the first chunk in the file starting at offset 0, for the file to be recognized as a StudioFactory file.

8.2.5. StudioFactory configuration data

ProgramLanguage
    menu and help language (string: DE | EN | FR | IT | LT | NL)
PatchCableType
    cable type (integer 0 blacklines | 1 colored lines | 2 virtual patch cables)
MAINWINDOW
HELPWINDOW
COLORSELECTWINDOW
TRANSPORTWINDOW
SCOPEWINDOW2
AudioMixerWindow
MIDIACTIVITYWINDOW
MIDISCOPEWINDOW
PROJECTWINDOW
CONFIGWINDOW
MidiInDevice

device (integer 1 to maximum devices in system)
port (integer 0 to 25 for port A-Z)
MidiOutDevice
device (integer 1 to maximum devices in system)
port (integer 0 to 25 for port A-Z)

8.2.6. Project data

ProjectBegin
projectname (string)
ProjectPath
ProjectModified (empty chunk only used in autoload.stf, because this file can contain unsaved projects)
Samples (see 8.2.7)
SynFactory patches (see 8.2.8)
Sequencer data (see 8.2.10)
ProjectEnd (empty chunk)

8.2.7. Sample and instrument data

SampleBegin (chunk)
sample id (integer)
sample name (string)
SampleRate
SampleEncoding
SampleData
SampleEnd (empty chunk)

8.2.8. SynFactory patch data

PatchBegin (chunk)
patch id (integer)
patch name (string)
PatchMidi (chunk)
MIDI port (integer 0 off, 1 .. 26 for port A .. Z)
MIDI channel (integer 0 all, 1 .. 16 single channel)
ModuleBegin (chunk)
module id (integer 1..n. It must be unique for a patch. Gaps in the numbering are allowed.)
module type (string, refer to the source code for possible values)
ModulePosition (chunk)
x position (integer)
y position (integer)
ModuleLabel (chunk)
label active (integer 0: label is not visible, 1: label is visible)
ModuleCable (chunk)
input number (integer 0..31)
module where cable comes from (integer 1..n)
output on module where cable comes from (integer 1..32)
cable color index (integer 0..7)
ModuleKnob (chunk)
knob id (0..31)
value (-32768..32767)
ModuleMode (chunk)
mode (integer 0..5 for OSC, not used for other modules)
ModuleScript (chunk)

script (string)
ModuleBuffer (chunk)
buffer (binary string)
ModuleSize (chunk)
x size (integer)
y size (integer)
ModuleColor (chunk)
foreground color (integer 24 bit RGB)
background color (integer 24 bit RGB)
ModuleEnd (empty chunk)
PatchEnd (empty chunk)

8.2.9. Bitmap data

BitmapBegin
bitmap id (integer)
bitmap name (string)
BitmapSize
x,y,colors,aspect x,y
BitmapPalette
BitmapEncoding
BitmapPlanes
BitmapEnd

8.2.10. Sequencer data

This feature is still in development

8.2.11. Embedded file data

ObjectBegin
ObjectName
ObjectPath
ObjectEncoding
ObjectData
ObjectEnd

8.3. BMP file format (bitmap)

This file format is not yet supported.

8.4. MOD file format (SoundTracker, Protracker etc)

This file format is not yet supported.

8.5. S3M file format (ScreamTracker v3)

This file format is not yet supported.

8.6. OKT file format (Oktalyser)

This file format is not yet supported.

8.7. WAV file format (wave/riff)

This file format is not yet supported.

Alphabetical Index