Modul

A module is a component for signal generation or processing. A library of elementary modules is built into GENERATOR. It provides the basic building blocks for MIDI and audio signal processing. A module is displayed as a graphic object with inputs on the left and outputs on the right hand side. Each module is marked with a label and an icon for graphical identification.

Port

The inputs and outputs of a module are called ports. They serve as terminals for interconnections to other modules. Ports are marked with a port label. Individual ports as well as complete modules can be deactivated with the mute function.

Wire

The connections between the ports of modules which are displayed as lines, are called wires.

Signal

The wires carry signals from one module to another. Here GENERATOR distinguishes between event and audio signals.

Audio
Audio signals are comparable to sound signals and control voltages in the analogue world. These signals are processed by GENERATOR in a quasi-continuous way, as a sequence of sample values at the sample rate set for the system. The processing of such a signal constitutes a permanent load on the CPU.

Event
An event is a singular occurrence that only happens when a conrol message for changing some value arrives. After the event the value stays constant until another event arrives. Typical signal sources for events are MIDI and fader source modules. Event processing allows complex manipulation of control messages without continuous calculations and thus serves to reduce the load on the CPU.

Mixed Connections
A port that outputs an event signal (red label) can also be simply connected to a port expecting an audio signal (black label), i.e. audio input ports can take any kind of signal. But to connect an audio signal to an event in port (red label) a converter (A to E) has to be inserted between the two.

Properties

For each module a properties dialog box can be opened with a mouse click to get information about the module and to change those properties that can be edited, such as the label. The ports of a module also have their own properties dialog boxes.

Structure

A window in which modules are placed and interconnected is called a structure.

Panel

The fader source modules in a structure have their corresponding graphical controls in the panel window. This is comparable to the front panel of a hardware synthesizer on which the controls for setting the parameters are located. In GENERATOR the panel window contains the fader controls which are used to set the parameter values used by the structure.There is exactly one panel window for each instrument and one for the ensemble.

Macro-Module

Common functional blocks can be encapsulated as macro modules for reuse. Macro modules are also useful to give complex arrangements a hierarchical structure to make their functionality more clear to the eye. Very large structures have to be realized using macro modules because the number of modules in one structrue window is limited (80). Also it soon becomes difficult to work on a structure when it becomes to large to fit onto the screen completely.

With a double-click a macro module can be opened, i.e. its inner structure appears in a separate window in which it can be edited.

Module Port
A port to a macro module is created by inserting an in terminal or out terminal in its internal structure.

Saving
After creating or modifying a macro module you can save it in a *.mdl file. The file contains all data about the type of the module, the internal structure, the labels, infos and current settings .

Instrument

Instruments are macro modules that have their own MIDI processing, a separate panel window and separate snapshots. The MIDI events received by GENERATOR are administered by instruments before being passed to the appropriate MIDI sources. Instrument modules can be recognized by their dark blue label and have an icon symbolising a control panel. Double-clicking on an instrument module opens its panel. Each instrument has exactly one panel which contains the faders for all structures that belong to the instrument.

Instrument Properties
The properties dialog box of an instrument module shows the settings of the instrument's parameters for controlling the MIDI management. The settings can be edited there.

MIDI Filter
Each instrument has its own polyphonic voice allocation for which the number of voices can be set. In its function as a MIDI filter the instrument only passes on MIDI events which are in the selected channels and in a set range of note values (useful for keyboard splits). The instrument can also transpose note values and the number of the MIDI controllers which control the hold and sustain functions can be set.

Number of Voices
The number of voices in which a polyphonic module processes its signals is determined by the instrument to which the module belongs (a module always belongs to an instrument, the ensemble being the first instrument). A module can be switched to mono mode if polyphonic processing is not needed.

Multitimbral
By using several instruments assigned to differend MIDI channels or note ranges, multitimbral operation is possible – even using completely different methods of synthesis.

Ensemble

The highest organisational level in GENERATOR is the ensemble. It has the functionality of an instrument and it contains all other instruments and all their structures and panels. All this can be stored together with all settings and snapshots in an *.ens file. Later the file can be opened to restore everything to the saved state.

Source

The modules which are used as sources for control signals in a structure are called source modules.

Fader
Faders are source modules that have a corresponding graphical controller in the panel window. The position of the fader's knob determines the value of the signal at the onput of the module

Remote
Faders can be remote controlled by any MIDI controller (or the poly aftertouch of a note). The number of the controller can be selected freely. With the soft takeover feature sudden jumps in the fader value when remote control takes over are avoided.

MIDI
The MIDI source modules are used for direct control of the audio signal processing with MIDI events. For each type of MIDI event there is a separate kind of source module. The output signal of such a source corresponds to the values transmitted by the particular MIDI events. The OnVelocity source for example outputs a control signal that corresponds to the velocity of the last received note on event.

Value Range
The range of values for the output signal of a source can be set in its properties dialog box. It is also possible to reduce the range for the received MIDI values. The received values in this range are scaled linearly to the range of the output signal.

Snapshots

Snapshots correspond to the memories of conventional synthesizers. Each instrument can store 128 snapshots. A snapshot can record the current setting of all the instrument's faders and MIDI controllers. By recalling a snapshot all the settings are restored to the stored state. Snapshots can also be recalled using MIDI program change messages.

Control Box

The Control Box is a small window that always stays on top, containing controls and indicators for the current operational state of the GENERATOR system.

1.1 Configuring MIDI Keyboard

Select the menu item *Options/MIDI*. A dialog window appears with a list of "Available Ports" showing the MIDI inputs installed on your PC.

Select the MIDI input port that you want to use with GENERATOR by clicking on it. Click on *Insert* to add this port to the list of "Installed Ports". All MIDI inputs listed under "Installed Ports" can be used to send control signals to GENERATOR. (You can use *Delete* to remove from the list any MIDI ports that are not required.)

When you have configured the MIDI input correctly, the MIDI lamp in the control box window will light up blue with every arriving MIDI signal.

1.2 Configuring MIDI Sequencer

If you want to control GENERATOR from a MIDI sequencer running on the same PC, you can make the connection using the driver GENMIDI.DLL (the installation is explained under GENMIDI.DLL). Instead you can also use any other virtual MIDI loopback device.

In the sequencer please set the MIDI output port for the relevant tracks to "Generator Synthesizer". In GENERATOR under *Options/MIDI* add the "Generator internal MIDI-Port" to the list of Installed Ports. Unfortunately under Windows 95 / NT only one application at a time can access any one MIDI port. This means that only either GENERATOR or the Sequencer can use a MIDI input port. We recommend that when working with a sequencer, always to control GENERATOR through the sequencer.

1.21 GENMIDI.DLL

What is GENMIDI.DLL ?

The "genmidi.dll" driver can be used to couple GENERATOR to other MIDIapplications like sequencers. It provides an MIDI outport named "Generator Synthesizer", from where MIDI events are internally routed to the GENERATOR MIDI inport "Generator internal Midiport".

Installation of GENMIDI.DLL :

With the installation of the GENERATOR software the file "genmidi.dll" is automatically copied into the folder \ Windows\System\ .

The driver can be activated by an entry in the "System.ini". Please open an editor for "System.ini" and insert in the section "[drivers]" the line

    midiX=genmidi.dll

where "X" in "midiX" stands for the smallest number, that is not used by a MIDI driver. Example given:

    midi=mmsystem.dll
    midi1=tpc.drv
    midi2=genmidi.dll

Windows has to be restartet to activate the driver.

2.1 Configuring a Windows Multimedia Soundcard

In the menu *Options/Audio-Port* choose the **MME** soundcard (this is normally the default setting). Open the Audio dialog window (*Options/Audio*) and under *Out Port* select the sound card to be used by GENERATOR for audio output. Use the Play Ahead slider underneath to set latency, i.e. the time delay between a MIDI input signal and the resulting sound. The shorter this value the faster GENERATOR reacts to control inputs. If Play Ahead is set too short, disturbance to the audio signal and breaks in the sound may result. How low this value can be set while maintaining proper operation depends on the hardware you use.

When you have configured your sound card correctly the In and Out lamps in the control box will light up

2.2 Configuring EMAGIC AudioWerk8 Card

To use GENERATOR with the AudioWerk8 card you first need to install the Native Instruments AudioWerk8 driver as explained under AudioWerk8. Once you have done this you can choose AudioWerk8 in the menu *Options/Audio-Port*. Just as for Windows **MME** sound cards you can set the latency using the Play Ahead slider in *Options/Audio*.

When you have configured the AudioWerk8 correctly the In and Out lamps in the control box will light up green. The **DAC** module in the ensemble window now offers eight outputs.

2.21 AudioWerk8

GENERATOR supports the two inputs and eight outputs of the Audiowerk8 and is   digital I/Os. The MIDI-to-Audio delay is much shorter than with standard sound cards. If an Audiowerk8 and the extended driver is installed, you can select the card in by the entry Audio-Port in the Options menu.

Installation of the Audiowerk8 driver:

An extended version of the hardware driver (Vaw8D.vxd) has to be installed to run GENERATOR on a Audiowerk8. This driver also supports other applications like LOGIC AUDIO, LOGIC AUDIO Discovery and VMR.

The Native Instruments driver files can be found on the floppy disk or can be downloaded from the download page of our website.

If an Audiowerk8 driver is already installed:

In order to replace the original driver by the NI driver please open the Device Manager (Start->Settings->Control Panel->System->Device Manager) and open the section "sound, video and game controllers".

Doubleclick on the "Audiowerk 8" entry to get its Properties sheet.

Open the "Driver" page and click on "Change driver...".

Click on "Have disk..."

Click on   "Browse..." to select the disk drive with the demo installation disk.

If you have downloaded the driver, please open the folder with the downloaded files   instead of the disk drive.

Select the configuration file "aw8.inf".

The entry "Audiowerk 8" is shown. Click "OK".

Restart the computer to load the new driver.

If no Audiowerk8 driver has been installed before:

When you start the computer, Plug and Play will display the message, that a new hardware has been found. Please insert the GENERATOR demo disk instead of the original Audiowerk8 CD ROM. (If you have downloaded the driver, please select the folder with the downloaded files.)

3. Loading an Example Ensemble

You can use the menu item *File/Open* to load the included example instruments. Select **Synth1** and click on *Open*. In the foreground you will see the panel window and in the background the ensemble window. The control elements in the panel window function like the controllers on ordinary synthesizers. Use them to adjust the sound parameters of **Synth1**. In the ensemble window you can see how **Synth1**'s instrument module is connected to the **DAC** module which represents the sound card.

To open the structure window of **Synth1** click the right mouse button on **Synth1**'s instrument module in the ensemble window and select *Structure* in the pop-up menu that appears. The structure window shows the modules that make up the instrument.

4. Playing an Example Instrument

Make sure that GENERATOR is switched on by checking that the Out lamp in the control box window is showing green light. If necessary switch on by clicking on the button in the control box. You can also use the control box to set the internal sample rate and the number of voices. The resulting CPU load in percent is indicated. If the status lamps light up yellow, this indicates that the CPU is overloaded. Reduce the load by selecting a lower sample rate and/or number of voices.

Now you can try out Synth1. Play some notes on your MIDI keyboard and explore how the controllers in the panel change the sound. Try some of the snapshots. Snapshots are stored settings of the panel window. They correspond to the presets of ordinary synthesizers. To select a snapshot use the drop down list in the toolbar of the panel window. The currently selected snapshot is shown in the text box in the tool bar. Clicking on the button with the camera icon opens a dialog window in which you can define your own snapshots.

Also try out the other included example ensembles. Visit our web site www.native-instruments.de where you can find more examples and up-to-date information about GENERATOR.

Tutorial 1:   A Simple Synthesizer

1.0 Getting Started

Start GENERATOR by selecting the menu *Start/Programs/Native Instruments*. First you see GENERATOR's ensemble window which is used for connecting up the instruments. Choose the menu item *File/New* and you will see an empty instrument module, the **DAC** (digital to analog converter) module and the **ADC** (analog to digital converter). Through the **DAC** module an audio signal can be output to the sound card and with the **ADC** module and audio signal can be read from the sound card input. We will now build a simple synthesizer structure in the instrument module.

2.0 Selecting an Oscillator

Click the right mouse button on the instrument module and choose *Structure* in the pop-up menu. The structure window for the instrument appears. Open the context sensitive pop-up menu for the structure (click the right mouse button ...) and select *New/Oscillator/Sawtooth*. The module appears and you can drag it to where you want it by clicking the left mouse button in the middle of the module. Move it to the left of the voice combiner module (**}**).

The **sawtooth** oscillator module has control signal inputs on the left and an audio output on the right hand side. The input **P** is for connecting a control signal for setting the pitch of the oscillator. Input **A** controls the amplitude (volume). By double-clicking on a port you can get a description of its function. All modules in GENERATOR have their inputs on the left and outputs on the right.

3.0 Selecting Controllers

From the menu *New/MIDI Source* select the **Note Pitch** module and move it next to the **P** input of the **sawtooth** module. When you press a key on a MIDI keyboard the **Note Pitch** module provides the pitch (note number) of this key as a control signal. We want to use this to control the pitch of the **sawtooth** oscillator. Connect the output of **Note Pitch** to the **P** input by clicking on one of the two ports, holding the mouse button down, moving to the other and releasing. A wire appears which connects the two ports.

Next place a **Gate** module (*New/MIDI Source/Gate*) below the **Note Pitch** module. When you press a key on the MIDI keyboard the **Gate** module provides a control signal corresponding to how hard the key was pressed (velocity). Connect it to the **A** input of the **sawtooth** module. Finally connect the output of the **sawtooth** oscillator to the voice combiner module (**}**) which is already connected to the output terminal.

You have now completed the instrument structure and can close the structure window if you wish.

4.0 Connecting Instrument to DAC

In the ensemble window connect the output of the instrument module to the input **L** of the **DAC** module. Play some notes on your MIDI keyboard and you should hear some sound from the left loudspeaker. (If not make sure that GENERATOR is properly configured and switched on and that your soundcard is correctly connected to speakers.) Also connect the instrument to the input **R** of the **DAC**. Now you can hear GENERATOR through both speakers in the central stereo position.
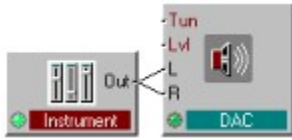
5.0 Master Volume Fader

Click the right mouse button on the **Lvl** input of the **DAC** module and select *Create Control* in the pop-up menu.
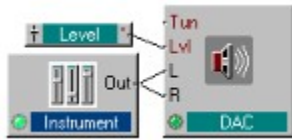
With the Create Control function GENERATOR automatically makes a virtual fader for adjusting the control signal at the selected input. To be able to operate the fader, click the right mouse button on the background of the ensemble window and select the menu item **Panel**. The panel window appears containing the Level fader you just created. To operate the fader just click somewhere in its scale and move the mouse up or down while holding the mouse button. You can move the fader around in the panel by and dragging it by its edge.

Play some more notes and try out what effect the master level fader has.

6.0 Variations

Replace the **sawtooth** module with **triangle**, **parabolic** or **pulse** wave oscillators.

Use Create Control to make a fader for the master tuning (input **Tun** of the **DAC** module).

Tutorial 2: The First Useful Synthesizer

1.0 Building the Basic Structure

If GENERATOR is not already running start it from *Start/Programs/Native Instruments*. Choose the menu item *File/New*. The default ensemble window appears with an empty instrument module, an **ADC** and a **DAC** module. Open the instrument's structure window and using the pop-up context menu add the following modules: **triangle** oscillator (*New/Oscillator/Triangle*), **Note Pitch** (*New/MIDI Source/Note Pitch*), **Gate** (*New/MIDI Source/Gate*) and an **ADSR** envelope (*New/Envelope/ADSR*). Position and interconnect the modules as shown in the picture. Use the Create Control function (right mouse click on the respective input ports ...) to create the controllers for the four inputs **A**, **D**, **S** and **R** of the envelope module.
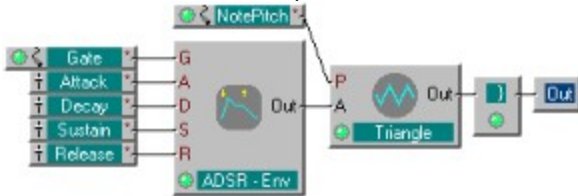
In the ensemble window, connect the output of the instrument module with the inputs **L** and **R** of the **DAC** module.

2.0 Function of the ADSR Envelope Module

The **ADSR** module generates an envelope that is used to change the sound with time. The shape of the envelope is set with the **Attack**, **Decay**, **Sustain** an **Release** control knobs in the instrument's panel window. The panel window can be opened by selecting *Panel* in the pop-up menu of the structure window or of the instrument module in the ensemble window. The envelope starts when an event arrives at the gate input **G**. In this case a key press triggers the envelope.

Play some notes and change the envelope parameter settings...

3.0 Adding a Resonant Filter

Now we want to include a filter module to change the sound by removing some frequencies from the signal of the **triangle** oszillator. Choose a **Multi 2-Pole** Filter from the menu (*New/Filter/Multi 2-Pole*). Wire the output of the **triangle** module to the input of the filter and the output of the filter to the voice combiner (**}**). Make controllers for the filter's resonance input **Res** and the cutoff frequency input **F** using the Create Control function.
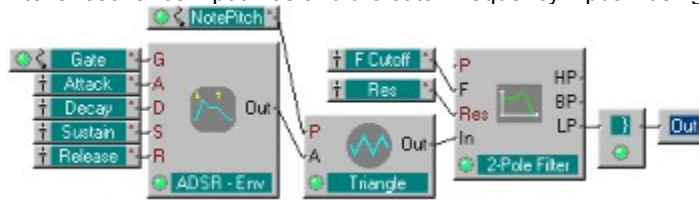
4.0 Function of the Resonant Filter

Play some notes on your keyboard while changing the filter settings **F Cutoff** and **Res** using the control knobs in the panel. **F Cutoff** sets the filter's cutoff frequency. If you are using the **LP** (low pass) output of the **2-Pole Filter** module as shown, all frequencies above the cutoff frequency will be suppressed. The same module can also be used as a high pass (**HP**) or band pass (**BP**) filter by taking the ouput signal from the respective ports.

The filter's resonance is adjusted using the **Res** input. The higher the resonance value, the more the frequencies near the cutoff frequency will be boosted up. At a resonance value of 1 the filter will go into undamped self-oscillation.

5.0 Adding Keyboard Tracking

Play some low and some high notes on your keyboard and you will notice that the high notes sound very dull. This is because the filter always uses the same fixed cutoff frequency regardless of the pitch of the note you are playing. So if you play a note whose fundamental frequency is above this cutoff, you will hear very little. We will now change this by matching the filter frequency to the note pitch.

Connect the **Note Pitch** module to the input **P** of the **2-Pole Filter** module (the **Note Pitch** module is now connected to two modules: the **triangle** oscillator and the filter). The frequency corresponding to the MIDI pitch signal at the filter's **P** input is added to the frequency set at the **F** input. The sum of the two determines the cutoff frequency. If you now play high notes they will sound 'normal'.

6.0 Adding a Filter Envelope

Finally we want to have the filter frequency modulated by an envelope. For this we will use the existing **ADSR** module (of course you can add a new envelope module just for the filter if you prefer). Choose a **2 input audio multiplier** module from the module library (*New/ +,-,*,/ /Audio Mult 2*) and connect it to the output of the **ADSR** envelope, the **F Cutoff** controller and the input **F** of the **2-Pole Filter**. You will notice that the existing wire from the controller to the **F** input disappears as you make a new connection to the input because an audio signal input can only ever have one wire attached to it.
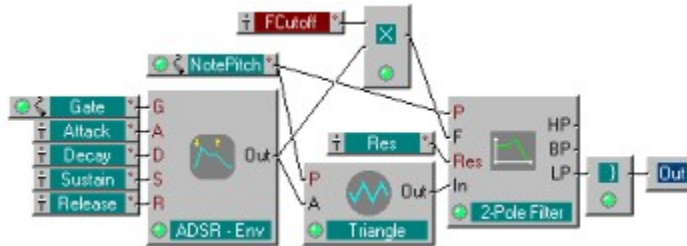
If you play some notes now you will hear that the envelope now also controls the filter's cutoff frequency. The **ADSR** module outputs a control signal whose value moves between 0 and 1. This control signal is multiplied with the value of the controller so that when the envelope is at its peak (=1), the filter's **F** input receives the value set by the controller. When the envelope signal returns to 0 the value at the filter's **F** input is also 0.

The function of this controller is usually called Filter Envelope Modulation Depth. Open the controller's properties window by double-clicking on the module and change its label from **F Cutoff** to **Env Mod**.

7.0 Variations

Try the **HP** and **BP** outputs of the **2-Pole Filter** module.

Replace the **2-Pole filter** with a **4-Pole-Filter**.

Try out different envelopes.

Use a second envelope just for the filter.

Context Menus

As is common practice in Windows 95 programs, the right mouse button has an important function. It is used for opening the context dependent popup menus. Whenever you want to work on an object or need information about the object, click on it with the right mouse button. A Menu appears whose entries relate to the selected object. With a click of the left mouse button you activate the desired menu item. The menu disappears and the operation is carried out. For example, you can delete a module by selecting the entry Delete in its context menu.

Objects which have context menus are:
Modules
Input and output ports of modules
Structure windows
Panel windows
Faders

The context menus of structure and panel windows refer to the macro module or instrument to which they belong. The context menu of a fader is the same as that of the corresponding source module.

Windows

Working with GENERATOR takes place with various kinds of windows: structure, panel, snapshot and properties dialog. All windows can be placed anywhere on the screen independent of the main window. They can be resized in width and height, they can be maximized, minimized, restored and closed.

Structure
In structure windows modules are placed and interconnected. GENERATOR's main window which appears on startup is a special structure window because it represents the highest hierarchical level, the ensemble. It is the only window which has a menu bar at the top. In this menu bar you find the functions that affect the whole program of the ensemble. All other functions of GENERATOR are located the various context menus that are opened with the right mouse button.

Each macro module also has its corresponding structure window in which its inner structure can be edited. It can be opened with a double-click on the macro module. If a macro module contains other macro modules a hierarchical, tree-like arrangement of the structures results. With a double-click on a macro module you step down to the next lower level and the menu entry Parent in the context menu of the structure window returns you to the next higher level.

Panel
For each instrument there is a corresponding panel window as its user interface. It contains the controllers for setting the values of the signals output by the instrument's source modules which serve as the structure's parameters. In its function the panel window corresponds to the front panel of a conventional synthesizer on which the buttons and knobs are located.

Properties
Each object has a properties dialog box that informs about the properties and current settings of the object and allows editing its changeable attributes. The last line of every context menu contains the entry Properties with which the dialog box is opened. By clicking on OK or with the Return key the changed settings become active and the dialog box is closed. Cancel or the Esc key close the dialog, discarding any changes made.

Changing the Active Window

Context Menu
The context menus can be used to open windows or change to another window. The entry Structure opens the window showing the internal wiring of the concerned module. Parent shows the structure window which represents the next higher level in the hierarchy, Panel opens the window with the faders for the instrument to which the module belongs and Snapshots opens the window with the corresponding list of snapshots.

Double-Click
A double-click with the left mouse button on an object also opens a connected window (exception snapshot):

Double-Click on: Function:
Elementary Module   Open Module Properties Dialog
Module Port   Open Port Properties Dialog
Macro Module   Open Structure Window
Instrument Module   Open Instrument's Panel
Background of a Stucture Window   Open Corresponding Panel
Background of a Panel Window   Open Corresponding Structure

Key: Window:

Strg-P   Panel
Strg-S   Structure
Strg-R   Parent-Structure
Strg-O   Instrument-Properties

Task Bar

The Windows 95 Task Bar at the bottom of the screen which is normally used to switch between active programs can also be used to switch between GENERATOR's windows. Each window has an entry in the Task Bar and can be made visible or moved to the front by selecting its button. The key combination Alt-Tab is also convenient for changing windows.

Modules

Modules are the basic building blocks of the sound generation in GENERATOR. All those complex sound processing structure consist just of interconnected modules that each carry out a relatively simple task.

Mono/Poly

Modules can be either monophonic (i.e. single voice) or polyphonic (multi voice), carrying out the same operation for several voices in parallel. The number of voices of a polyphonic module is that of the instrument to which it belongs. Polyphonic modules can be recognized by their bright green lamp, monophonic modules have a dark green lamp. Many modules can be operated in both poly and mono modes. To change the mode you use the switch in the modules properties dialog box. Unless a module is really needed in poly mode it should definitely be used in mono mode because that way the computational load is greatly reduced (CPU load is multiplied by the number of voices in poly mode).
Some modules are always monophonic (e.g. fader, const., pitchbend), others always polyphonic (e.g. voice combiner).
Mono signals can be simply fed into poly input ports (the same signal is applied to all voices) but poly signals can only be connected to mono input ports via a voice combiner module. The audio voice combiner mixes all the voices to one mono signal.

Mute

Modules or single ports can be deactivated by selecting Mute in the context menu of the module of the port. The mute state for selected modules can also be toggled using the key combination Ctrl-M.
When a module is muted a red cross appears over its green lamp. Muted ports have a little red cross at their connection point. An input port will also automatically be marked with a red cross when there is an invalid connection, e.g. if the input is mono and has been connected to a poly output.
A muted module no longer causes any computational load, so if a module is not needed temporarily it should be deactivated (if it is never used it should be deleted, of course). A muted port on the other hand does not have any effect on the load, it just changes the signal flow.

Creation

To insert a new module use the context menu of the structure window. New Module creates an elementary module from GENERATOR's built in library. A multi-step popup menu appears:
In the first step one of a number of functional groupings of modules is chosen and in the second step the actual module is selected. The module will be placed at the point in the window where you opened the context menu.
When inserting a fader source module in a structure, the corresponding fader is automatically inserted at a vacant spot in the panel window. Instead of New Module the context menu of the panel window has the entry New Fader. This can be used to create a new fader for which a fader source module automatically appears in the structure.

Selection

A module can be selected by simply clicking on it, which turns its label red (unselected it is blue-green). You can also select several modules by dragging a frame over them with the mouse. Single modules can be added to or removed from the selected group by clicking on them while holding down the Ctrl key.

Moving

The modules in a structure window can be moved individually or in groups. To do this, click on a module (or one of a group of selected modules), but not in one of its ports, and hold the mouse button down while moving to the desired location. All the wiring remains and follows like rubber bands. On releasing the mouse button the modules are aligned on an (invisible) grid and then remain at the new position. The grid (8x8 pixels) helps to ensures a tidy appearance. The faders in the panel window can be moved in the same way. To prevent accidentally moving the faders while operating them, the Lock function in the panel can be activated.

Cut, Copy, Paste and Delete

Modules or faders can also be created by copying existing modules or faders using the entry Copy in the module's or fader's context menu. An exact copy of all selected objects, including settings, labels and, in the case of macro modules, inner structure, is put into a clipboard from where it can be pasted to other locations any number of times.
Use Cut to remove the selected modules from the structure and place them in the clipboard for moving them to another place with Paste. Finally, Delete removes the modules without putting them in the clipboard. The clipboard contents is not altered.
You can also use the key combinations Ctrl-X (Cut), Ctrl-C (Copy), Ctrl-V (Paste) und Del (Delete) after selecting modules with the mouse.

Save and Open

If you want to store an elementary module or a macro module with its current settings for later reuse, you can save it to a module file. This file (name: *.mdl) can then be opened to insert the module in another structure. To save the module use the entry Save as... in its context menu (or in the macro module's structure window). A dialog box appears in which you select the folder and enter the file name under which it is to be stored.

If you use Save as... for the main window which shows the structure of the ensemble, then the whole ensemble will be stored as a module file and as such can be inserted into another ensemble.

For inserting a module stored in a file, use the entry Open *.mdl in the context menu of the structure into which it is to be placed. A dialog box appears in which you select the folder and file to be opened.

Wiring

Creating Wires
Connecting two ports with a wire is simplicity itself: click with the left mouse button on one port and keep it pressed which moving the mouse pointer to the other ports. A "rubber band" appears between the port and the mouse pointer. When you release the mouse button over the second port the connection is complete and the result can be heard immediately. The wire disappears if you release the mouse button elsewhere than over a port.
You can also click on a port and let go of the button. The wire then remains attached to the mouse pointer. The connection is completed by clicking on the second port, but if you click somewhere else the wire disappears.
Equally, you can use the entry Wire/Unwire in the context menu of a port to start a wire. Click on the second port to complete the connection.
When attempting to wire together two ports whose connection is not permitted, such as an audio output and an event input, the wire disappears.

Deleting Wires
Removing a connection is carried out in the same way as creating a wire: by repeating the wiring process described above the existing wire is removed.
You can also mark a wire by clicking on it or selecting it with a frame (the wire will become red) and then deleting it with the Del key.

Multiple Connections
If you connect an audio input that already has a wire to it with a second output, the first wire disappears because an audio input can only have one connection. Event inputs on the other hand can be connected to several event outputs.

Rules for Wiring

General:
A wire can only be connected between an input and an output.
An output port can be connected to up to 16 different input ports.

Event/Audio
Event ports can be recognized by their red labels. Audio port labels are black.
An audio input can only be connected to one input while event intputs can be fed from up to 16 different event outputs. With multiple event sources, effective is always the last event received by a voice.
An event input cannot process audio signals. For conversion an "A to E" module has to be inserted.
An event output delivers events as well as a stepped audio signal and can thus be connected to both types of inputs.

Mono/Poly:
Monophonic outputs can also be connected to polyphonic inputs where all voices are fed with the same monophonic signal.
Polyphonic outputs can only be connected to polyphonic inputs belonging to the same instrument because the number of voices must match. For connection to a monophonic input a "voice combiner" module has to be inserted.

Source

In those modules that represent sources for control signals, i.e. faders and MIDI sources, the range is limited and the signal scaled before output. This is achieved with the parameter in the top right of the properties dialog box.
The output value of the source is limited to Lower Limit for MIDI values below Min and to Upper Limit for those above Max. The interval between the limits is scaled linearly to the range between Min and Max.
The range for Lower Limit and Upper Limit lies between 0 and 127 where Upper Limit must have a value greater that Lower Limit. On the other hand Max can be smaller than Min to achieve an inverse effect. By setting opposite characteristics for two sources a cross-fade effect with an adjustable transition region can be achieved.
A switch effect with settable threshold position is possible by setting Lower Limit and Upper Limit to consecutive MIDI values like 63 and 64. For a source with these settings, an input value less than 64 sets the the output to Min, otherwise the output value is Max.

Faders

Mouse
A fader is operated most easily with the mouse: point at the fader's knob and while holding down the left mouse button slide the fader by moving the mouse forward and back. When clicking in the fader next to the knob, it jumps by ten steps in the appropriate direction.

Keys
It is also possible to move a fader with keys. When a fader is selected (label appears in red) use:

Key:	Change of Value:
Cursor up	+ 1
Cursor down	− 1
Page up	+ 10
Page down	− 10
Pos 1	= 127
End	= 0

Especially the +/−1 effect of the é/ê keys is very useful for small changes in value.

MIDI Remote
When the Remote switch in a fader's properties dialog box is activated, the fader will follow the MIDI controller with the number set for Controller Nr. If Poly Aftertouch is selected, the fader instead follows the MIDI poly aftertouch value if the appropriate key number. Since poly aftertouch is almost never used for its designed purpose, utilising it in this way gives access to a further 128 controllers.

Soft Takeover
When a fader gets operated by remote controller after having been moved with the mouse or keys it will jump suddenly to the received controller value. By activating Soft Takeover the jump will be prevented and the fader will only start moving when the remote controll value reaches and goes past the current position. The fader first has to be collected, as it were, before it can be taken along.
When controlling faders from a sequencer it is normally best to switch of soft takeover because otherwise desired jumps are not always carried out.

Association
The association between a fader module in the structure and its fader in the panel can be seen, apart from the identical label, by the fact that both labels become red at the same time when one of the two is selected.

Instruments

In an ensemble sounds of very different natures can by generated side by side (multitimbral). For this you group the sound generating structures in instruments which can be assigned to different MIDI channels or note ranges with the settings in their properties dialogs. To be precise, an instrument is a macro module with its own MIDI management. An instrument can contain other instruments and macro modules in such a way that they form a hierarchical structure. The highest level in this hierarchy, the instrument that contains everything else, is the ensemble.
A new instrument is created by selecting New Instrument in the menu of a structure window. It is deleted just like any other module by selecting Delete from its context menu.

Properties:

Number of Voices
The polyphony can be set separately for each instrument. All modules contained in the instrument that are set to mono, operate with the set number of voices.

MIDI Receive Channels
The MIDI source modules of the instrument only receive MIDI events on those channels which are activated in the instrument.

Upper Note Limit / Lower Note Limit
The gate and note pitch modules of the instrument only receive MIDI events in the note range between the set upper and lower limit.

Note Shift
All MIDI note pitch signals for the instrument are transposed by the set number of semitone steps. To tranpose down one octave, for example, enter the value −12.

Sustain Control
The number of the MIDI controller (foot pedal) which works as sustain pedal (called "hold" or "damper pedal" by some MIDI equipment manufacturers, standard controller no: 64) is set with Sustain Control. As long as sustain is on (controller value 64 or more) any playing note will be held even after its key is released.

Hold Control
The number of the MIDI controller (foot pedal) which works as hold pedal (called "sostenuto" by some MIDI equipment manufacturers, standard controller no: 66) is set with Hold Control. All notes that are already playing when hold is switched on will be held even after their key is released - until hold is switched off. Keys that are pressed when hold is already on are not affected.

Program Change Enable
When this switch is activated, snapshots can be recalled with MIDI program change events. The program number determines which snapshot is recalled.

Inputs / Outputs

Because each instrument can have a different number of voices, connections to the instrument must be monophonic. For this reason the input and output ports of instruments are always mono. An instrument that processes multiple voices inside must have voice combiner module at its output to generate a mono signal. The output signals of several instruments can then be combined in a mixed before being sent to a mono DAC.

Sample Rate

The internal sample rate with which GENERATOR computes its signals can be adjusted to adapt to the given requirements. The higher the sample rate, the cleaner the sound, but the computational load rises proportionately allowing only a smaller number of voices to be generated. The pitch of notes is not affected by changes in sample rate.

The sample rate can be set between 22.050 Hz and 132.300 Hz using the Control Box or the main menu (Optionsð Sample Rate). The selected sample rate is saved together with the ensemble.

Problems at Low Sample Rates
At low sample rates noises or distortions may be present in the audio signal. These arise as interference with the sample frequency (so called aliasing). Especially when generating steep-edged waveforms (sawtooth, pulse) at high frequencies does aliasing become apparent. By choosing a higher sample rate the disturbances can be reduced.

Problems at High Sample Rates
It should be noted that the CPU load rises proportional to the sample rate. When the point is reached at which the speed of your PC is no longer adequate to generate the set number of voices in real time, interruptions in the audio output appear which can be heard in the form of clicks or crackle. Watch the processor load using the System Monitoras well as GENERATOR's Control Box. The total system load should not go above a certain value (around 80%) to ensure proper operation of GENERATOR and other programs running at the same time. If necessary reduce the sample rate, the number of voices of the complexity of the ensemble.

Tuning
The master tuning for all instruments can be adjusted. Normally the pitch of note a1 (MIDI note 69, A3) is set to 440 Hz. Using the Tun input of the DAC module the pitch can be modified: connect a fader and set the desired value. The tuning will be raised by one semitone by setting a value of +1.0, a value of −1.0 lowers the tuning by one semitone.

Control Box

The Control Box appears on program startup as an additional small window that always stays on top. It can be closed by clicking the small button marked with a cross or using the main menu (Optionsð–Hide Control Box). To make the Control Box visible again use the menu entry (Optionsð– Show Control Box).

The Control Box contains the following indicators and controls.

Audio Control Lamp
When audio processing is switched on and running smoothly, the audio control lamp lights up green. It changes to red when interference with the audio process or CPU overload occurs. When the audio processing is switched off the lamp stays dark.

Audio Load Display
This display shows the CPU time (in percent) used by the audio process that generates the sounds. Since the transfer of audio data to the DAC card, MIDI processing and graphic display also takes up some CPU time the display will never reach 100%. Furthermore, enough CPU time must be left over for Windows 95 and possibly other programs (e.g. a sequencer) to function. The value that can be reached in undisturbed operation is normally between 60 and 80. You can find the limit for your PC by raising the number of voices for an ensemble until crackling appears in the sound and the audio control lamp becomes red.

DAC Clipping Lamp
A red light in the lamp labelled Clip indicates that the 16-bit range of the digital to analogue converter has been exceeded and clipping distortion is present in the audio signal. Clipping can be prevented by reducing the signal level at the output, e.g. by applying a lower value to the Lvl input of the DAC module.

Global MIDI Activity
The Midi lamp lights up blue whenever GENERATOR receives a MIDI event from one of the installed MIDI in-ports.

MIDI Activity of the Selected Instrument
The Instr. Lamp lights up blue whenever the currently selected instrument receives a MIDI event on one of its receive channels.

Audio Run/Stop Button
This button is used to start (Run) and end (Stop) operation of the audio process. It can be stopped to reduce the CPU load at times when no sounds are being played.
Switching on and off also causes an initialisation of all audio processes. This may sometimes be necessary when the DAC card or a module develops a disorder.
The operating modes Run, Stop and Calc can also be selected through an entry in the Options menu.

Selector for the Internal Sample Rate
GENERATOR's internal sample rate is displayed here and can be changed by selecting from the list. Which sample rates are available depends on the installed DAC card. The sample rate can also be changed using the main menu (Optionsð–Sample Rate)

Selector for Instrument's Number of Voices
The number of voices of the currently selected instrument is displayed here and can be changed by selecting from the list.The instrument to which the setting applies is selected by selecting its module, its structure window, its panel window or the structure window of a contained macro module.An instrument's number of voices can also be set in its properties dialog box.

MIDI-Ports

GENERATOR is normally controlled by MIDI signals. For this GENERATOR's MIDI input must be connected to the output of a Windows MIDI driver. (In Windows these internal interfaces are called In-Ports, i.e. as seen from the perspective of the programs using them.)

Choosing
In GENERATOR, open the MIDI Port dialog using OptionsðMIDI in the main menu. Choose the appropriate in-port from the list of Available Ports and insert it into the list of Installed Ports. It is possible to select several ports that will be active in parallel. Use Delete to remove a selected port from the list. The changes become valid on clicking OK.

External MIDI Source
If you select the driver of a MIDI interface or of a sound card as an in-port then GENERATOR can be controlled by an external MIDI device, e.g. a master keyboard, connected to that interface.

Internal MIDI Source
If you want to control GENERATOR with a MIDI program (e.g. a sequencer) running on the same computer, choose the Generator internal Midiport.