G2500 Manual

v.1.1
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Contents

1 Quick Start

Congratulations with your new virtual analog synthesizer, the G2500.

1.1 License Activation

You activate your license by dragging the license file, LKey.txt (which you probably got in an email), to the G2500 window, when G2500 is running. The G2500 window can be made smaller by dragging the corner of the window. This will save your license at the correct location on disk, so the G2500 application can find it. On some systems, it is also possible to drag the LKey.txt file to the G2500 application icon.

1.2 Setting up Preferences

After you launch the G2500 application, you see the program window filling the entire screen. Press <Ctrl>-, (that is the <Control> key on the keyboard and the comma key on the keyboard at the same time) to open the Preferences window. It is also possible to use the Command key with comma: <cmd>-, .

In the Preferences you see the different tabs near the top of the Preferences window, the first one is "Devices". Below that you see:

- "Audio Input" showing the audio input devices connected to your computer
- "Audio Output" showing the audio output devices connected to your computer
- "MIDI Input" showing the MIDI input devices connected to your computer, and possible the IAC Driver activated in the MacOS "Audio MIDI Setup" program, and
- "Audio Buffer Size" listing a selection of possible sizes.

Audio Devices

Audio input is coming in at line 1 in the upper matrix of the G2500 synthesizer. If you have a microphone or built-in input, you can choose one of these to capture audio to be processed in the synthesizer. You may also see software devices in the list, if you for example have GVirtualAudio or Soundflower installed.

Audio output is going out at line 20 in the lower matrix of the G2500 synthesizer. For the first test, you probably want to select the "Built-in Output". You may also see software devices in the list, if you for example have GVirtualAudio or Soundflower installed.

Set the Audio Buffer Size to maximum (2048 samples) to start with. Later you want to set the buffer size to as small a value as possible to lower the latency. If the system can't cope with a small buffer size because of CPU load, you will hear dropouts or crackle in the audio output.

MIDI Input

If you have a MIDI keyboard or MIDI controller connected to the computer, it will show up in the "MIDI Input" list. Some MIDI keyboard may show up as more than one device (if they for example support DirectLink), and you have to choose the correct device (typically "... Port 1") to get MIDI inputs.

It is not necessary to connect a MIDI keyboard to use the G2500 synthesizer, as you can use the computer keyboard to play notes. A MIDI keyboard is a benefit and is recommended for the full experience.

You close the Preferences with <Esc>, <Ctrl>-W, or by clicking the close button in the upper left corner of the Preferences window with the mouse.

1.3 Loading a Patch

Press <Ctrl>-O to open the "Load Patch" requester, navigate to the "General/" folder and select one of the pre-defined patches.

Some patches produce audio output right away, and you should hear that in the speakers.

If it is too loud, you can instantly stop the audio. Turn the virtual synthesizer off by pressing <Esc> on the computer keyboard. You will also find a master volume dial knob at the first module in the far left of the synthesizer.

Some patches require you to play notes using the computer keyboard or an external MIDI keyboard to produce audio output.

See a list of keyboard shortcuts in the next page.

2 G2500 Keyboard Shortcuts

For most functions using the Ctrl key, it is also possible to use Command key on Mac or Window logo key under Windows.

<table>
<tr><th>Function</th><th>Keyboard Shortcut</th></tr>
<tr><td>Toggle On/Off</td><td>Esc</td></tr>
<tr><td>Change Zoom</td><td>Tab</td></tr>
<tr><td>Toggle Full Height ex. Keyboard</td><td>Ctrl + Tab</td></tr>
<tr><td>Toggle Full View</td><td>Shift + Tab</td></tr>
<tr><td>Move View Up, Down, Left, Right</td><td>(Arrow Keys)</td></tr>
<tr><td>Move View Up, Down, Left, Right</td><td>Alt + W | S | A | D</td></tr>
<tr><td>Move View Fast Left/Right</td><td>Shift + Left arrow | Right arrow</td></tr>
<tr><td>Drag View</td><td>Mousebutton (away from a control and move mouse)</td></tr>
<tr><td>Zoom In/Out</td><td>Ctrl + Mousebutton (and move mouse)</td></tr>
<tr><td>Reset View</td><td>Home</td></tr>
<tr><td>Read the Manual</td><td>F1</td></tr>
<tr><td>Toggle Tooltips</td><td>F2</td></tr>
<tr><td>Start/Stop Recording</td><td>F9</td></tr>
<tr><td>Select Bank One to Five</td><td>1-5</td></tr>
<tr><td>Store Patch in Bank One</td><td>Shift + S</td></tr>
<tr><td>Even Temperament</td><td>Ctrl + E</td></tr>
<tr><td>Bach-Lehman Temperament</td><td>Ctrl + L</td></tr>
<tr><td>Toggle Bandlimiting</td><td>Ctrl + B</td></tr>
<tr><td>Toggle Postfilter</td><td>Ctrl + F</td></tr>
<tr><td>Toggle Relative MIDI Control</td><td>Ctrl + M</td></tr>
<tr><td>Load Patch</td><td>Ctrl + O</td></tr>
<tr><td>Save Patch</td><td>Ctrl + S</td></tr>
<tr><td>Preferences</td><td>Ctrl + , (Control + Comma)</td></tr>
<tr><td>Close Requester</td><td>Ctrl + W</td></tr>
<tr><td>Close Requester</td><td>Esc</td></tr>
<tr><td>Quit</td><td>Ctrl + Q</td></tr>
<tr><td>Play Notes</td><td>A, W, S, E, D, F, T, ..., O, L, P</td></tr>
<tr><td>Down one Octave</td><td>Z</td></tr>
<tr><td>Up one Octave</td><td>X</td></tr>
<tr><td>Reset Control</td><td>Alt + Mousebutton (on control to reset)</td></tr>
<tr><td>Toggle Follow Mouse when Zoomed In</td><td>Space</td></tr>
<tr><td>Zoom Out Zoom-Dial Control Mode</td><td>, (Comma)</td></tr>
<tr><td>Zoom In Zoom-Dial Control Mode</td><td>. (Period)</td></tr>
<tr><td>Change Tooltip values</td><td>Return or Enter (press Tab for next field)</td></tr>
</table>

3 G2500 Concepts

3.1 Mouse Control of Dial Knobs

G2500 features two different ways of turning dial knobs. When you first launch G2500, dial knob turning works by clicking on a knob with the mouse, keep the mouse button pressed and pull the mouse away from the knob in the direction, you want the dial knob indicator to go. This way you can turn a dial knob by moving the mouse pointer around the knob while keeping the mouse button pressed. It is possible to fine tune in small steps by pressing <shift> on the keyboard and move the mouse back and forth while keeping the mouse button pressed at the same time.

The other way of turning dial knobs is called Zoom-Dial Control Mode and is activated in the preferences. Open preferences (control + comma), click the General section, activate ”Zoom-Dial control”, and close the preferences window (escape).

Now dial knobs can be turned by pressing the knob with the mouse and move the mouse back and forth. It is possible to zoom the amount of turning with the scroll-wheel on the mouse, or by using the comma and period keys on the keyboard. Zooming all in, and it is possible to turn a dial knob in the smallest possible steps with more than four billion positions for each dial knob. If you experience, that a dial knob isn't really turning as you wish, make sure you zoom out the Zoom-Dial by scolling back on the mouse scroll-wheel, or by pressing the comma key several times. It is still possible to fine tune in certain small steps by holding <shift> on the keyboard while moving the mouse back and forth.

3.2 Five Patch Banks

The G2500 synthesizer has five patch banks to hold up to five different parches using the same selection of modules in memory. This has primary two purposes:

1. Instant switching between sounds for live performance
2. To hold different versions of the same patch, when creating new patches

To store the current patch in bank one, press <Shift>-S on the computer keyboard. This will move the previous band one to bank two, bank two to bank three, bank three to bank four, and bank four to bank five. The previous bank five is lost, so first save this patch to disk, if needed.

The patches stored in the five banks can be selected as the current patch by pressing key <1> to <5> on the computer keyboard.

3.3 Record Audio

Audio can be recorded and saved to disk by pressing <F9> to start, and <F9> again to stop recording. A maximum of 10 MB is captured equivalent to 36 seconds at 96 kHz sampling rate. Even if you wait longer than 36 seconds, the recording will not be saved to disk until you press <F9> a second time.

MacOS

The recorded audio is saved to disk as WAV format in the file

```
~/Library/Application Support/
    NicomSoft/G2500/Samples/G2500.
    wav
```

”~/” is the users home directory (or folder). The ”~/Library/” folder may be hidden and can be accessed in Finder under MacOS from the ”Go/Go to Folder...” menu.

It is also possible to go to the folder from the G2500 synthesizer by opening a load requester and press ”Browse...”, which will open the ”Patches/” folder in Finder. From here go one folder back and then into the ”Samples/” folder.

Remember to rename the ”G2500.wav” file, if you wanna use it later, as it will be overwritten next time you hit <F9> to record again.

Linux

The recorded audio is saved to disk as WAV format in the file

```
~/.local/share/NicomSoft/G2500/
    Samples/G2500.wav
```

”~/” is the users home directory (or folder).

It is also possible to go to the folder from the G2500 synthesizer by opening a load requester and press "Browse...", which will open the "Patches/" folder in the file manager. From here go one folder back and then into the "Samples/" folder.

Remember to rename the "G2500.wav" file, if you wanna use it later, as it will be overwritten next time you hit <F9> to record again.

Windows

The recorded audio is saved to disk as WAV format in the file

```
%APPDATA%\NicomSoft\G2500\Samples\
    G2500.wav
```

"%APPDATA%" is the users AppData directory. It is something like the following depending on Windows install and setup:

```
C:\Users\<username>\AppData\
    Roaming\
```

, where <username> is the user's login name.

It is also possible to go to the directory from the G2500 synthesizer by opening a load requester and press "Browse...", which will open the "Patches" directory in the File Explorer. From here go one directory back and then into the "Samples" directory.

Remember to rename the "G2500.wav" file, if you wanna use it later, as it will be overwritten next time you hit <F9> to record again.

3.4 Temperament

The G2500 synthesizer can handle two different temperaments, the Bach-Lehman temperament (see http://www.larips.com/) and the even temperament. The default is Bach-Lehman temperament. Press <Ctrl>-E to switch to even temperament and <Ctrl>-L to switch back to Bach-Lehman temperament. The choice of temperament influence input from the built-in 3001 keyboard and from MIDI notes from external MIDI keyboard or from software.

3.5 Bandlimiting and Postfilter

The technique of "bandlimiting" is used to suppress audio frequencies above the Nyquist frequency, which is at 48 kHz for a sampling rate of 96 kHz. Bandlimiting is on by default, but can be turned off by pressing <Ctrl>-B. Pressing <Ctrl>-B again will turn bandlimiting back on. It is especially for waveforms with plenty of overtones (like square and saw) at high frequencies, that the result of bandlimiting is heard.

The G2500 synthesizer also has a postfilter, which is turned off by default. This filter soften transients for a less "hard" sound, if it is turned on by pressing <Ctrl>-F. A second time pressing the key combination <Ctrl>-F will turn the postfilter off again.

3.6 MIDI Controller

The G2500 synthesizer can be configured to recognize MIDI control messages from external MIDI controllers. The file

MacOS:

```
~/Application Support/NicomSoft/
    G2500/midi-settings.txt
```

Linux:

```
~/.local/share/NicomSoft/G2500/
    midi-settings.txt
```

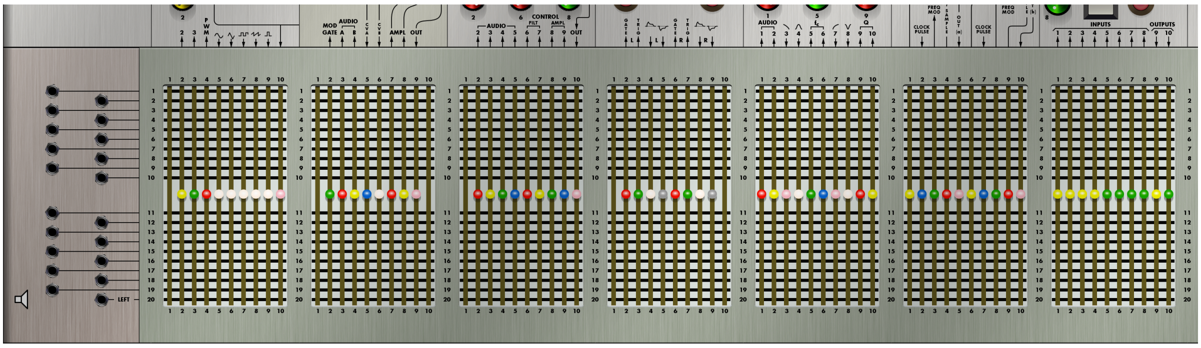
Windows:

```
%APPDATA%\NicomSoft\G2500\midi-
    settings.txt
```

holds a conversion table between MIDI control message numbers and G2500 control numbers for the different modules. This table is read, when the G2500 synthesizer is launched.

Some MIDI controllers sends relative values, when the user access the dial knobs on the controller. Other MIDI controllers sends absolute values. It is possible to toggle between both these kinds of values in the G2500 synthesizer by pressing the key combination <Ctrl>-M. If you are unaware, what kinds of messages, your MIDI controller or keyboard sends, try changing this by pressing <Ctrl>-M, until your MIDI controller is responsive.

Most MIDI control message numbers are used in more than one module in the G2500 synthesizer. The module, the mouse hovers over gets the MIDI control message.

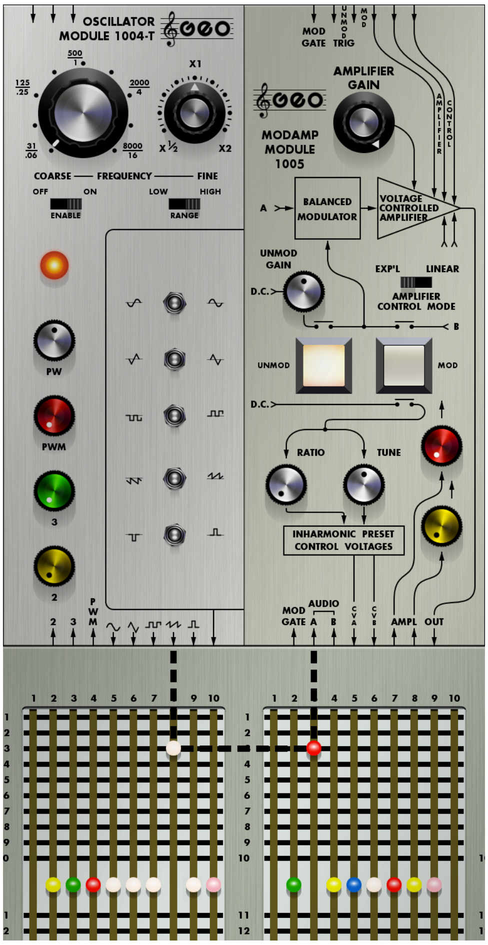


4 Matrix Switch Patching

4.1 Patching from one module output to the input of another module

The G2500 Virtual Analog synthesizer is equipped with matrix switches along the top and bottom of the cabinet. The matrix switches are used to make interconnections between the function modules in the cabinet. Note that the matrix switches are divided into groups of ten "sliders", each of which can be moved vertically to line up with any of the twenty horizontal lines. The spaces between the two groups of ten horizontal lines are "off" positions. Each of the 20 horizontal lines represents a free or uncommitted virtual buss wire which runs the whole length of the cabinet. Positioning a slider to any horizontal buss makes an connection between the function module input or output associated with the slider and that horizontal line. If any number of sliders on the cabinet are positioned to the same horizontal line, a connection will be made between the function module inputs and outputs associated with those sliders.

EXAMPLE: Positioning the sliders directly below the sawtooth wave output of the 1004-T Oscillator and the Audio "A" input to the 1005 ModAmp makes a connection between these modules. Any horizontal line could be used to make this connection. Any number of additional module input sliders may also be positioned to that same horizontal line and each of these inputs would receive the sawtooth output of the 1004-T Oscillator.

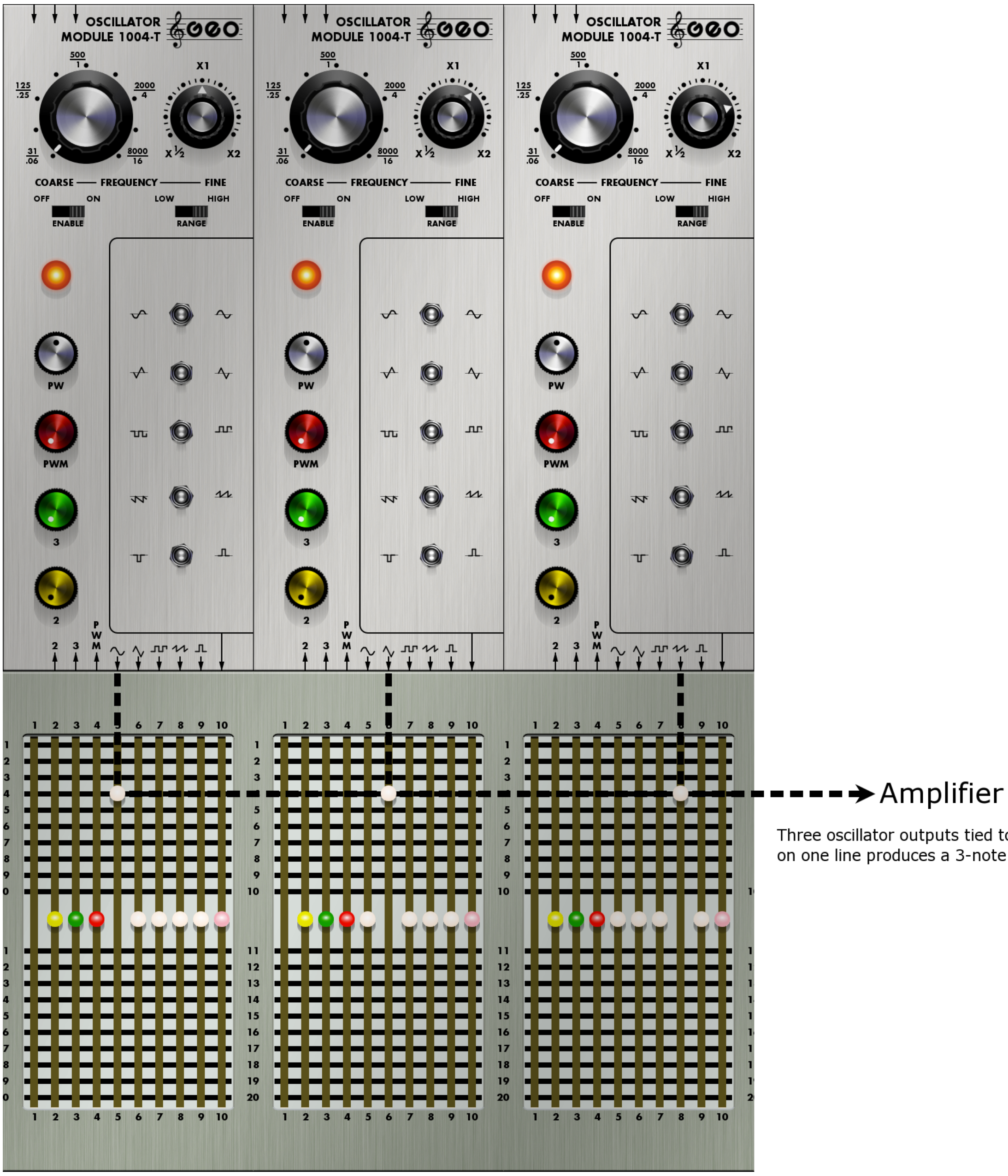


Connecting an additional input to a horizontal line will not affect the signal on that line. All module inputs receives the signal which is connected to them without affecting the signal itself. Therefore, any number of inputs can be connected to a single output.

4.2 Using the Matrix Switches to Mix Module Outputs

When the outputs of two or more modules are connected to the same horizontal buss, the signals appearing at the module outputs are "averaged" together.

EXAMPLE: If the outputs of three oscillators are connected together on the same line, the three tones will be "mixed" together in equal amounts. This provides a simple way of mixing signals together in equal proportions. Here a three-note chord is produced with all tones equal in intensity.



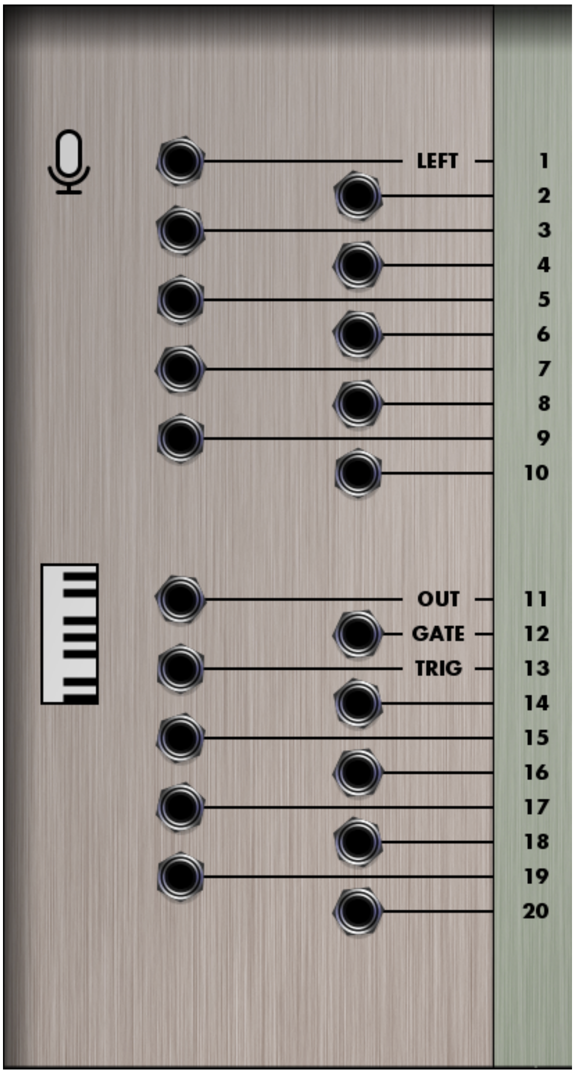
Three oscillator outputs tied together on one line produces a 3-note chord.

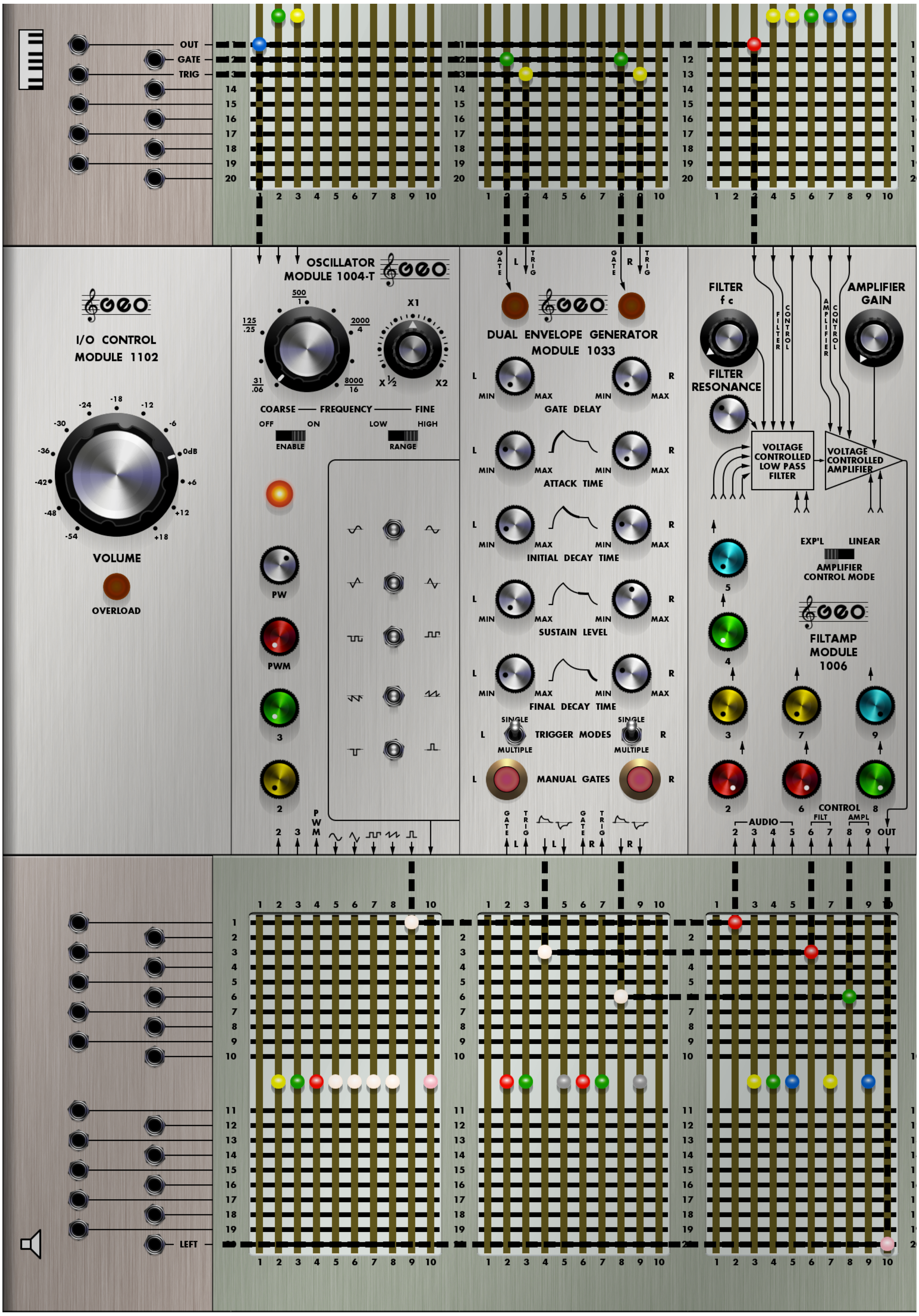
4.3 Use of Upper Matrix Switch Sections

The upper matrix switch sections are identical in function to the lower matrix switch sections except for audio input coming into line 1, and that a number of the horizontal lines are committed to use as keyboard outputs into the matrix. The jack panel in the upper left hand corner of the cabinet shows which keyboard output signals appear on which horizontal lines. Any horizontal lines which are unlabelled are uncommitted and may be used in the same manner as the lower matrix switches.

EXAMPLE: In most instances the upper matrix switches are used to couple keyboard output signals to function modules. Here the keyboard "Out" is applied to a 1004-P Oscillator and a 1006 FiltAmp while the "Gate" and "Trigger" outputs are applied to the "Gate" and "Trigger" inputs of a 1033 Dual Enveloper Generator. Output from the 1006 FiltAmt is sent to horizontal line 20 of the lower matrix to be heard in the speakers.

See the next page for an image of this example setup.




OUT
GATE
TRIG
I/O CONTROL
MODULE 1102
VOLUME
OVERLOAD
OSCILLATOR
MODULE 1004-T
COARSE
FREQUENCY
FINE
ENABLE
RANGE
PW
PWM
DUAL ENVELOPE GENERATOR
MODULE 1033
GATE DELAY
ATTACK TIME
INITIAL DECAY TIME
SUSTAIN LEVEL
FINAL DECAY TIME
TRIGGER MODES
SINGLE
MULTIPLE
MANUAL GATES
FILTER
FILTER RESONANCE
AMPLIFIER GAIN
VOLTAGE CONTROLLED LOW PASS FILTER
VOLTAGE CONTROLLED AMPLIFIER
EXP'L
LINEAR
AMPLIFIER CONTROL MODE
FILTAMP
MODULE
1006
AUDIO
CONTROL
FILT
AMPL
OUT
LEFT

5 Modules

5.1 1002 Power Control

G2500 module 1002 is used to turn the synthesizer on and off by cutting the power to all the other modules. The <Esc> key on the computer keyboard can be used as a shortcut to turn the synthesizer on and off.

So remember, <Esc> is your **PANIC!** button, if you experience too loud audio and need to turn if off quickly.

Turning the synthesizer off will also stop capturing audio from any audio input device and stop sending audio data to any audio output device.

5.2 1102 I/O Control

The Geo 1102 I/O Control Module holds a master volume dial knob and a volume overload red light indicator. At 0 dB the output from buss 20 in the lower matrix is sent without modification to the audio output device. Potential clipping is in effect though, if the audio data is out of range (too loud).

Turning the volume knob to minus dB will turn the audio down by modifying the audio data to lower values. Turning the volume knob to plus dB will turn the audio up again by modifying the audio data, this time to higher values.

If clipping is in effect, the red overload will light up.

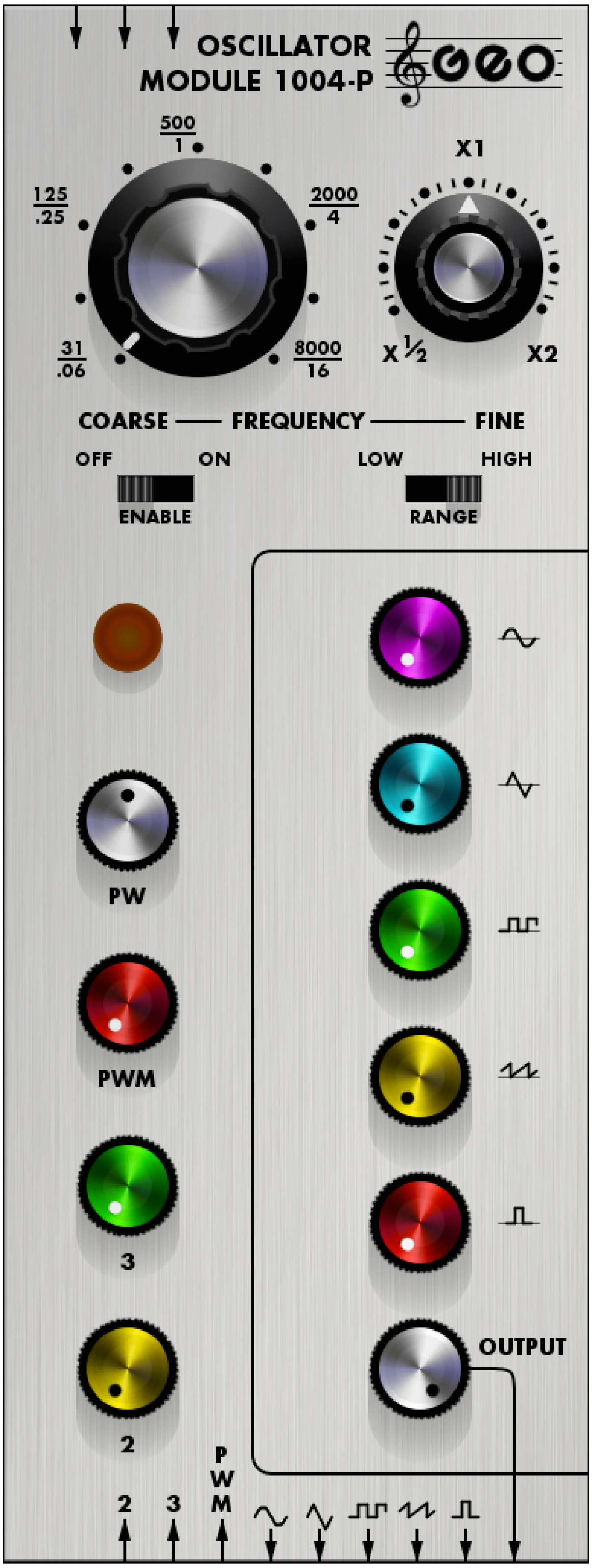
For best audio quality, it is often a good idea to keep the master volume at 0 dB, and modify the audio loudness at the different modules forming the sound. Some sounds needs an extra boost maybe, and this can be done with the master volume. The master volume can also be used with benefit, when testing and constructing sound patches, by turning the audio down a bit.

Always be nice to your ears, and they will serve you well.

5.3 1004-P Oscillator

The Geo 1004-P Oscillator Module is a signal-controlled waveform generator. Sine, triangle, square, sawtooth, and pulse outputs are available simultaneously. In addition, five dial knobs can be used to mix or algebraically sum these waveforms into an additional output. This module is particularly recommended for generating control waveforms and complex audio signals in the studio.

The output frequency range is from 0.03 Hz to 16,000 Hz in two ranges without external control signals, and the control signal range is 10 octaves on each range. Control signals may be either positive or negative, provided that the sum of the control signals does not drive the oscillator frequency beyond the above limits.



Controls

A coarse panel adjustment knob permits setting the zero-control-virtual-voltage frequency to anywhere within either of two ranges. The high range is the audio-frequency band, and the low range is a subsonic band. A fine adjust knob with a ±1 octave range is provided for accurate tuning.

Holding <Alt> on the computer keyboard while clicking the coarse adjustment knob will reset it to 32.70320 Hz, which is the C_1 note on a piano.

Below the frequency adjustment knobs are a ON/OFF switch to turn the oscillator on and off, and a range switch to select the low subsonic or high audio-frequency band. A light below the ON/OFF switch will indicate, when the oscillator is on, provided that the whole G2500 synthesizer is on (see the Geo 1002 Power Control Module).

The PW panel-knob control permits manual adjustment of pulse width for the pulse waveform output.

The PWM panel-knob control adjust the modulation depth of the pulse-width modulation control input (see Inputs).

The two panel-knob controls (2 and 3) are used to modulate two frequency modulation inputs (see Inputs).

Outputs

At the lower side, there are five waveform outputs, one for each waveform (sine, triangle, square, sawtooth, and pulse). In addition, the output in the lower right hand corner of the module is associated with the five dial knobs, one for each waveform, for a combination of waveforms to the one and same output. The sum of the five waveforms is associated with the attenuator marked "OUTPUT" before being sent out of the module.

Inputs

The three frequency modulation inputs in the upper left hand corner of the module are fixed sensitive inputs: 1 virtual volt/octave.

The two lower frequency modulation inputs (in positions 2 and 3) are associated with the two attenuators directly above the inputs (labeled 2 and 3). When the attenuators are rotated fully clock-wise, the input sensitivity is 1 virtual volt/octave. These controls are used to adjust frequency modulation depth.

The last lower control input, designated PWM, is a pulse-width modulation control input, which is also provided with a panel-knob-actuated modulation depth control (the red knob).

TECHNICAL SPECIFICATIONS

(*vvolt* is virtual volt)

OUTPUTS:

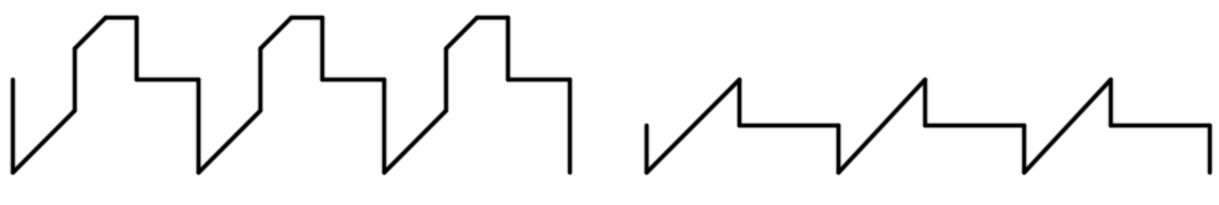
Frequency: 0.03 Hz - 16 kHz in two ranges without external inputs.
Sine: -5 vvolts to +5 vvolts.
Triangle: -5 vvolts to +5 vvolts.
Sawtooth: 0 vvolts to +10 vvolts.
Square: 0 vvolts to +10 vvolts.
Pulse: 0 vvolts to +10 vvolts.

INPUTS:

Frequency Modulation: 1 vvolt/octave.
Pulse Width Modulation: 10%/vvolt.

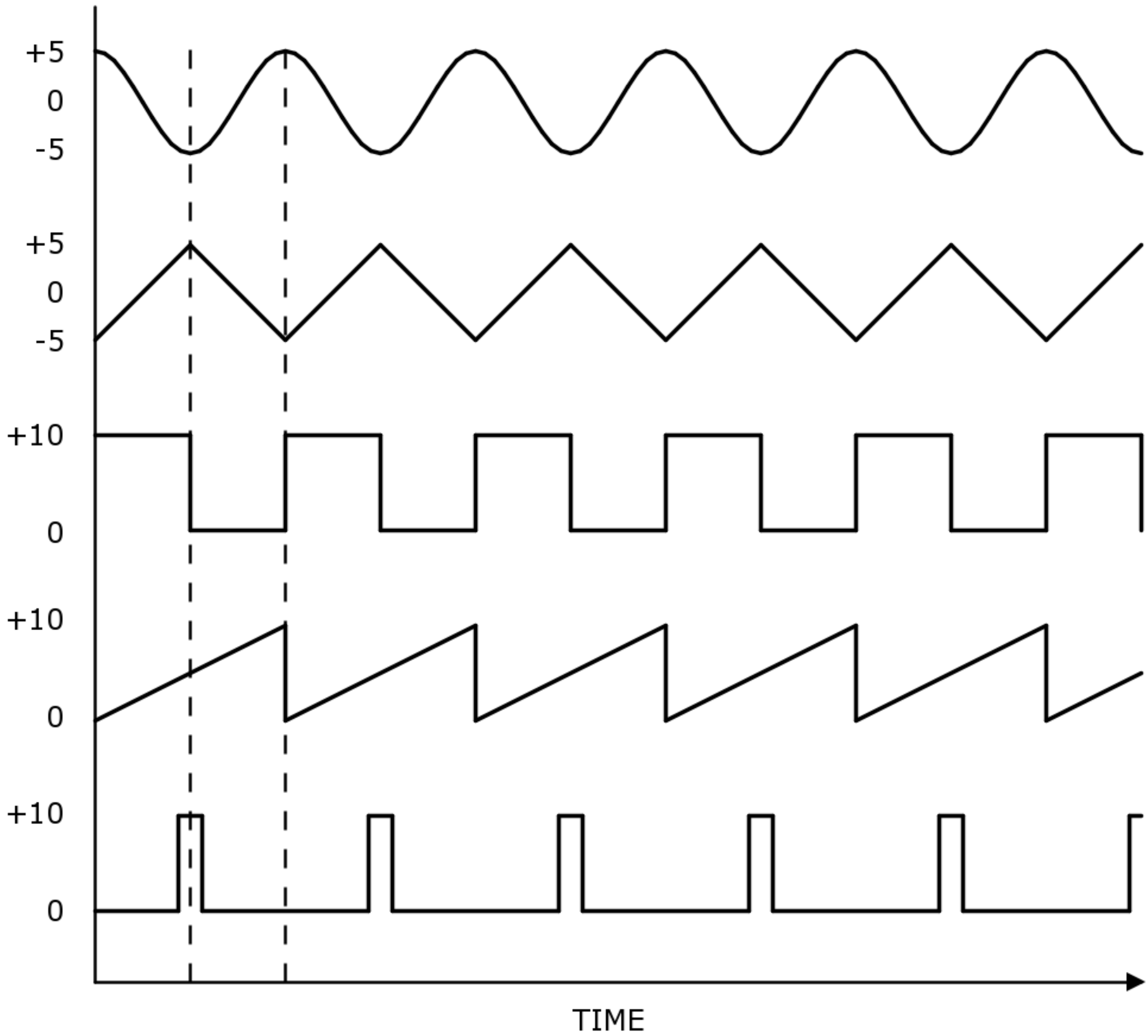
CONTROLS:

Frequency Range: Low (0.03 Hz - 32 Hz); High (31 Hz - 16 kHz).
Frequency, Coarse
Frequency, Fine: ±1 octave.
Frequency Modulation Depth (2)
Pulse Width: 0 - 100%
Pulse Width Modulation



TYPICAL WAVEFORMS PRODUCED BY MODULE 1004-P

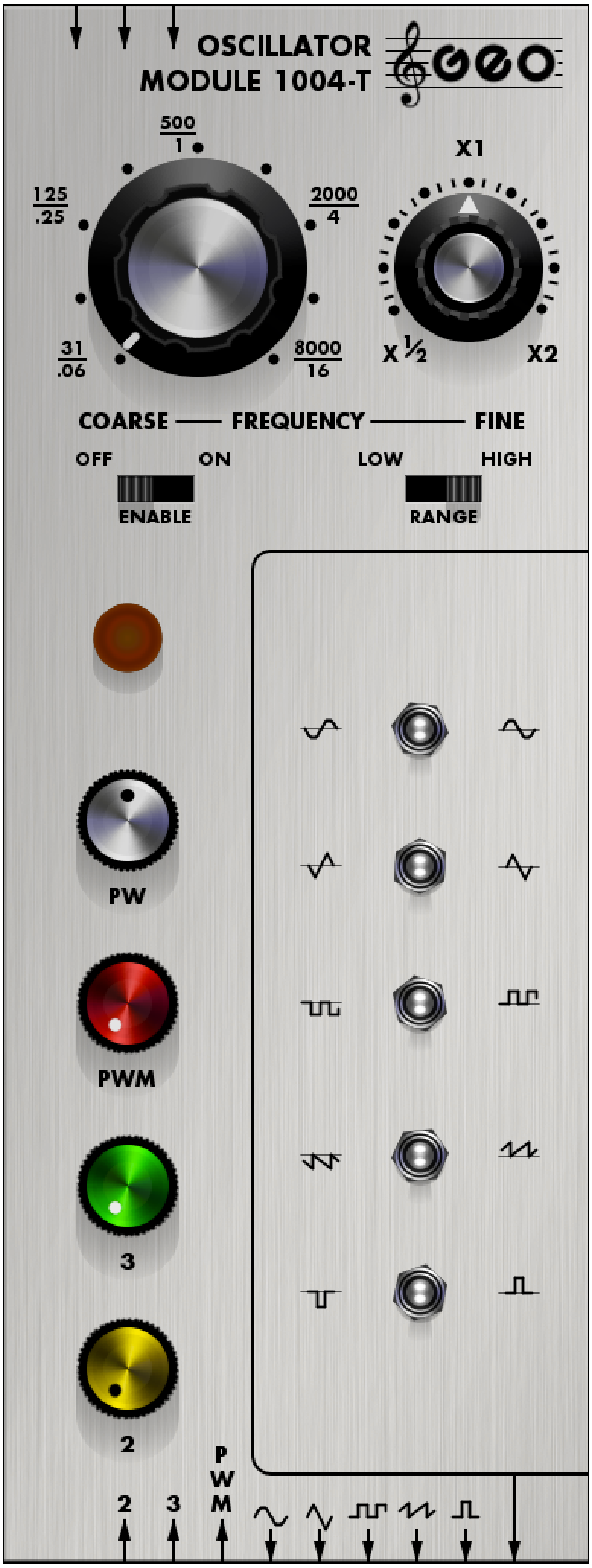
SYNCHRONIZATION OF OUTPUTS



5.4 1004-T Oscillator

The Geo 1004-T Oscillator Module is a signal-controlled waveform generator. Sine, triangle, square, sawtooth, and pulse outputs are available simultaneously. In addition, five center-off miniature toggle switches allow any of these waveforms or their inverses to be selected to an additional output. When more than one waveform is selected, the output is the instantaneous average of the selected waveforms. The Geo 1004-T module offer inverted and non-inverted waveform outputs simultaneously, and is therefore well suited for generating control signals.

The output frequency range is from 0.03 Hz to 16,000 Hz in two ranges without control voltages, and the control voltage range is 10 octaves on each range. Control signals may be either positive or negative, provided that the sum of the control voltages does not drive the oscillator frequency beyond the above limits.



Controls

A coarse panel adjustment knob permits setting the zero-control-voltage frequency to anywhere within either of two ranges. The high range is the audio-frequency band, and the low range is a subsonic band. A fine adjust knob with a ±1 octave range is provided for accurate tuning.

Holding <Alt> on the computer keyboard while clicking the coarse adjustment knob will reset it to 32.70320 Hz, which is the C_1 note on a piano.

Below the frequency adjustment knobs are a ON/OFF switch to turn the oscillator on and off, and a range switch to select the low subsonic or high audio-frequency band. A light below the ON/OFF switch will indicate, when the oscillator is on, provided that the whole G2500 synthesizer is on (see the Geo 1002 Power Control Module).

The PW panel-knob control permits manual adjustment of pulse width for the pulse waveform output.

The PWM panel-knob control adjust the modulation depth of the pulse-width modulation control input (see Inputs).

The last two panel-knob controls (2 and 3) are used to modulate two frequency modulation inputs (see Inputs).

Outputs

At the lower side, there are five waveform outputs, one for each waveform (sine, triangle, square, sawtooth, and pulse). In addition, the output in the lower right hand corner of the module is associated with the five center-off miniature toggle switches for a combination of waveforms to the one and same output.

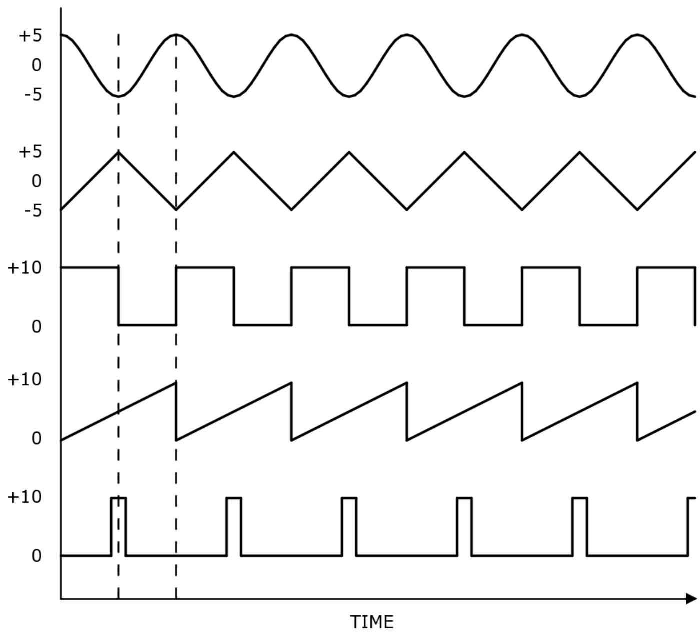
Inputs

The three frequency modulation inputs in the upper left hand corner of the module are fixed sensitive inputs: 1 virtual volt/octave.

The two lower frequency modulation inputs (in positions 2 and 3) are associated with the two attenuators directly above the inputs (labeled 2 and 3). When the attenuators are rotated fully clock-wise, the input sensitivity is 1 virtual volt/octave. These controls are used to adjust frequency modulation depth.

The last lower control input, designated PWM, is a pulse-width modulation control input, which is also provided with a panel-knob-actuated modulation depth control (the red knob).

SYNCHRONIZATION OF OUTPUTS



TECHNICAL SPECIFICATIONS

(*vvolt* is virtual volt)

OUTPUTS:

Frequency: 0.03 Hz - 16 kHz in two ranges without external inputs.
Sine: -5 vvolts to +5 vvolts.
Triangle: -5 vvolts to +5 vvolts.
Sawtooth: 0 vvolts to +10 vvolts.
Square: 0 vvolts to +10 vvolts.
Pulse: 0 vvolts to +10 vvolts.

INPUTS:

Frequency Modulation: 1 vvolt/octave.
Pulse Width Modulation: 10%/vvolt.

CONTROLS:

Frequency Range: Low (0.03 Hz - 32 Hz); High (31 Hz - 16 kHz).
Frequency, Coarse
Frequency, Fine: ±1 octave.
Frequency Modulation Depth (2)
Pulse Width: 0 - 100%
Pulse Width Modulation

5.5 1005 Modulator Amplifier

Geo Module 1005 is a virtual functional circuit package containing a balanced modulator, a virtual voltage controlled amplifier, and certain associated virtual circuitry.

The balanced modulator can accept two input signals A and B in the frequency range from D.C. (Direct Current) to 20 kHz, and will produce the output function $(A \times B\ /\ 10)$.

If A and B are both sine waves of equal amplitude with respective frequencies f_1 and f_2, the output will consist of the sum and difference frequencies $(f_1 + f_2)$ and $(f_1 - f_2)$ only. The original frequencies f_1 and f_2 will be suppressed.

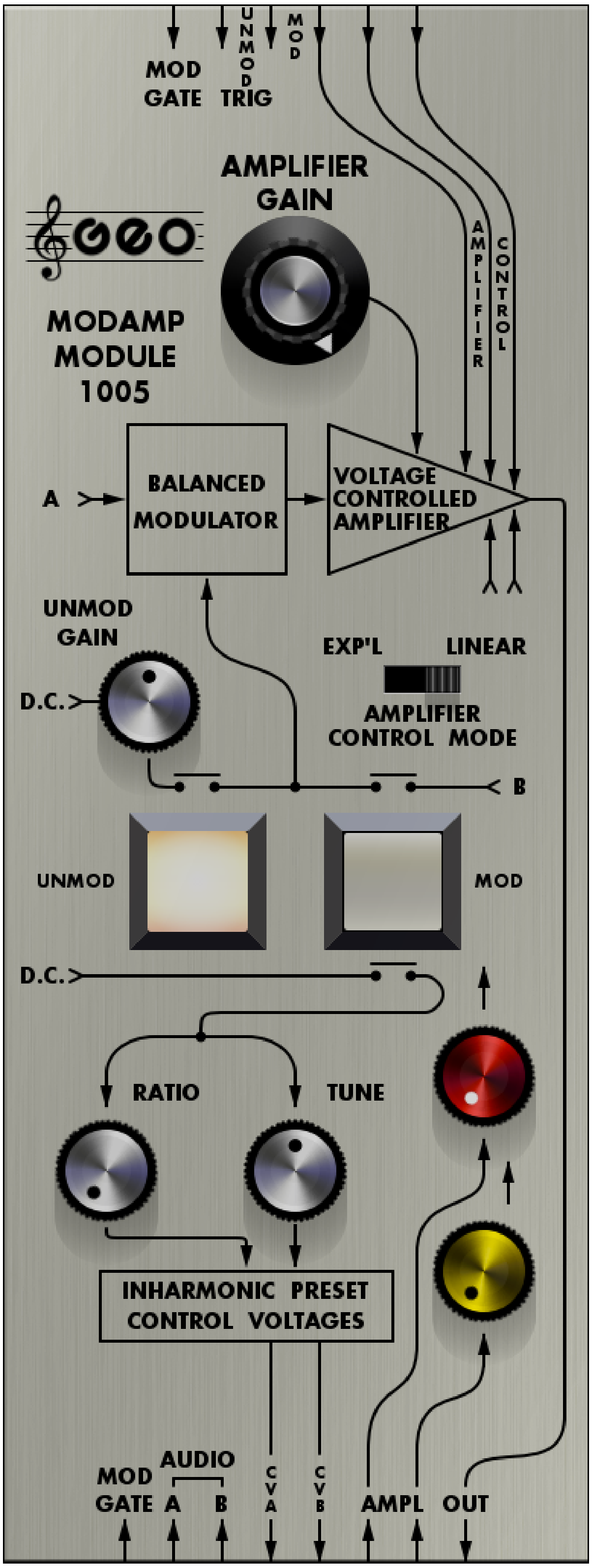
If A is a complex wave with harmonics f_1, $2f_1$, $3f_1$, $4f_1$, $5f_1$, etc. and B is a sine wave of frequency f_2, the resulting output will consist of the frequencies $(f_1 + f_2)$, $(f_1 - f_2)$, $(2f_1 + f_2)$, $(2f_1 - f_2)$, $(3f_1 + f_2)$, $(3f_1 - f_2)$, etc.

If f_1 and f_2 are chosen properly, the output will be a complex wave with inharmonic overtones. In electronic music this is extremely useful in simulating gong timbres, etc.

For the user's convenience, Module 1005 contains virtual circuits which produce two D.C. output control virtual voltages, V_a and V_b, which may be used to control two virtual voltage-controlled oscillators which are supplying audio signals A and B respectively.

With a exponentially controlled oscillator such as the Geo 1004-T module, the difference virtual voltage $V_a - V_b$ controls the frequency ratio and the average virtual voltage $(V_a + V_b)\ /\ 2$ control the tuning of the input signals A and B. For the user's convenience, ratio and tuning control knobs are located on the panel of the 1005 module.

The modulator can be activated or disengaged from the audio signal by pushing the illuminated push-button labelled "Mod" and "Unmod" on the front panel. With the "Mod" button illuminated, audio signals A and B are modulated by one another as described in the specifications. With the "Unmod" button illuminated, audio signal A is passed through the modulator unaffected and audio signal B is not used. A control is provided to adjust the gain when the "Unmod" button is illuminated. The modulator may also be switched from "Unmod" to "Mod" by applying a Gate signal to the input marked "Mod gate".



When the gate signal is removed, the modulator will return to the "Unmod" mode. On the other hand, the upper inputs labelled "Unmod" and "Mod" are latching and a pulse applied to either input will switch the operating mode to either "Unmod" or "Mod". The mode will remain as set until a pulse is applied to switch to another mode or until the mode is changed by using the front panel push-buttons.

The 1005 also contains a virtual voltage controlled amplifier which may be controlled with external signals from either the upper or lower matrix switch section, or manually by means of a panel knob. A panel slide switch gives the user the choice of linear or exponential control modes.

TECHNICAL SPECIFICATIONS

(*vvolt* is virtual volt)

BALANCED MODULATOR SECTION:

Output: $V_{out} = (IN_A \times IN_B)/10$.

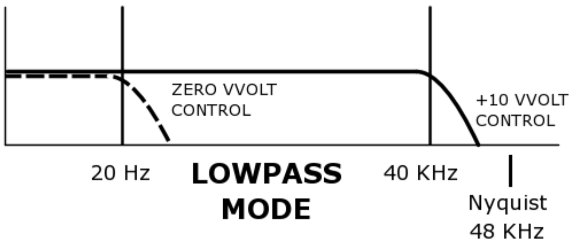
VIRTUAL VOLTAGE CONTROLLED AMPLIFIER SECTION:

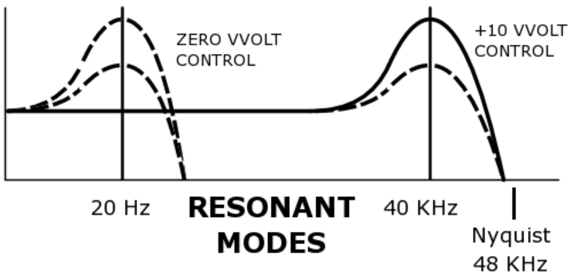
(Input attenuators fully clockwise)
V_{out}: 0 to Unity, Linear Mode.
V_{out}: -100 dB to 0 dB, Exponential Mode.

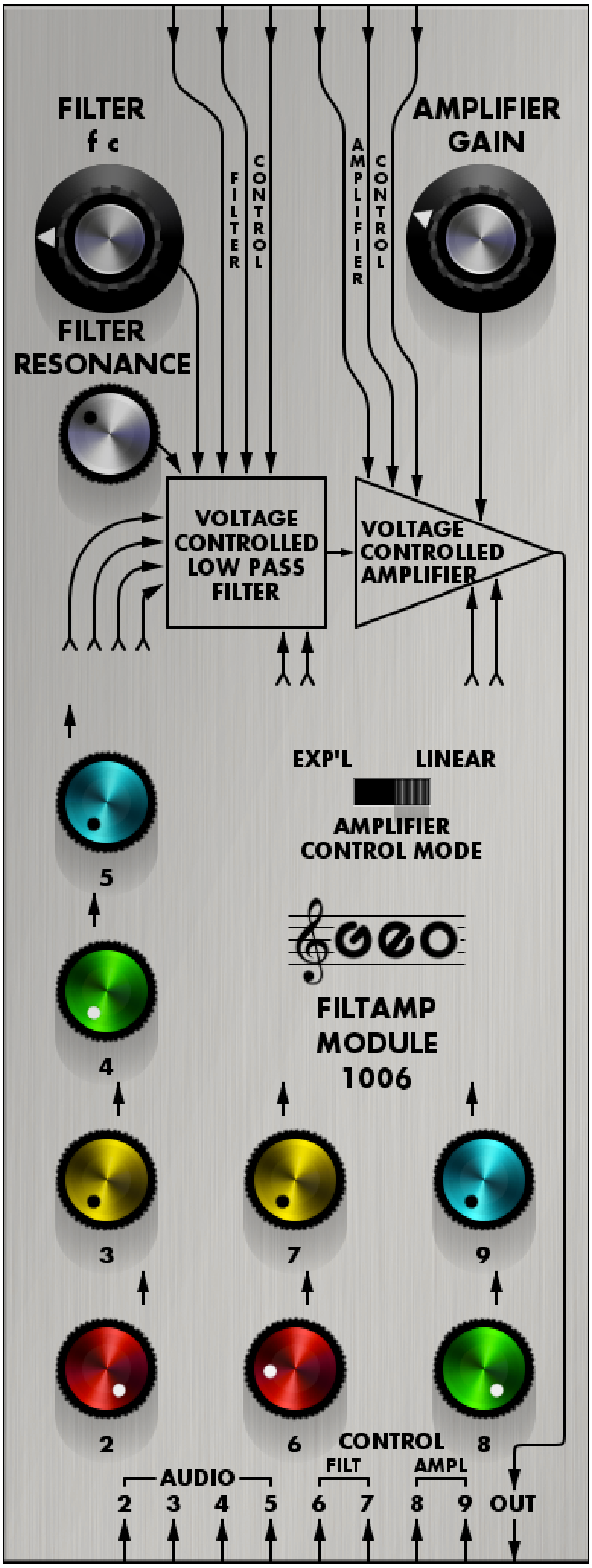
5.6 1006 Filter Amplifier

Geo Module 1006 contains a four-input mixer, a virtual voltage controlled low-pass filter (VVCLPF) plus a virtual voltage controlled amplifier with associated virtual circuitry.

A resonance or "peaked" response at the cutoff frequency of the low-pass filter may be obtained if so desired. This is useful for creating certain types of formants, such as "wa-wa" or "yeow" effects.







The virtual voltage controlled amplifier may be operated in one of two selectable modes. The exponential mode has a control transfer function of 10 dB per virtual volt. The linear mode has a control function, so V_{out} goes from silence with the amplifier gain in the extreme counter-clockwise position to V_{in} with the amplifier gain in the extreme clockwise position.

The range of the virtual voltage controlled amplifiers is over 100 dB, which permits the VCA to be used as a squelch gate control device. By proper adjustment of controls no discernible output should be obtained in the absense of virtual control voltages, even when the audio inputs are operated at maximum levels.

Inputs

There are three separate filter control inputs at the top of the module and two at the bottom. The three at the top are fixed in sensitivity (like the 1004 oscillator) at 1 virtual volt/octave.

The inputs from the bottom of the module are each associated with an attenuator (”2” to ”5”). With the attenuators rotated fully clockwise, the sensitivity of these inputs is also 1 virtual vold/octave. The virtual voltage appearing at each control input are summed internally and the cutoff frequency of the filter will be determined by this sum. Although the sum of all the control inputs may exceed the effective input range of the filter, (i.e., +10 vvolt), no damage can be done to the virtual circuitry by such overdrive.

Like with the filter, there are three separate amplifier control inputs at the top of the module and two at the bottom.

Controls

Top left is the filter f_C control knob to set the filter cutoff frequency, and below that the filter resonance control knob, which control the height of the resonant peak.

In the upper right is the control knob to manually set the gain of the virtual voltage controlled amplifier. Like on the Geo 1005 Module, a panel slide switch gives the user the choise of linear or exponential control modes.

Four control knobs (labelled ”2” to ”5”) are used to attenuate the four audio inputs from the bottom of the module.

Two control knob (labelled ”6” and ”7”) are used to attenuate the two filter control inputs from the bottom of the module.

And finally two control knobs (labelled ”8” and ”9”) are used to attenuate the two amplifier control inputs from the bottom of the module.

Outputs

A single output is in the lower right corner of the module. This is the result after the four audio signals are mixed, sent through first the filter section and then the amplifier both controlled by control signals and manual control by adjusting the knobs.

TECHNICAL SPECIFICATIONS

(*vvolt* is virtual volt)

FILTER:

24 dB/octave attenuation, 20 Hz - ∼48 kHz (Nyquist frequency) unity gain in passband.
Control Inputs: 0 to +10 vvolt operating range.
Sensitivity: 1 vvolt/octave, 0 vvolt = 20 Hz.
Filter Resonance: 0 to 20 dB peak.

AMPLIFIER:

(*Response:* ±3 dB, 2 Hz to 30 kHz.)
Maximum Gain: Unity.
Maximum Attenuation: Infinite.
Control Inputs: 0 to +10 vvolt operating range.
Sensitivity: 10 dB attenuation per vvolt (Amplifier Control in Exponential Mode).
In Linear Control Mode, 0 to Unity.

AUDIO OUTPUT:

±10 vvolt max.

AUDIO INPUTS:

±10 vvolt max. after attenuators.

5.7 1016 Dual Noise / Random

The Geo Module 1016 contains two identical White/Pink Noise and Random Virtual Voltage Generators.

The two noise outputs, *A* and *B*, are generated from two independent high quality software noise algorithms. Through successive filtering, the whte noise is transformed into pink noise and finally into a slow random virtual voltage.

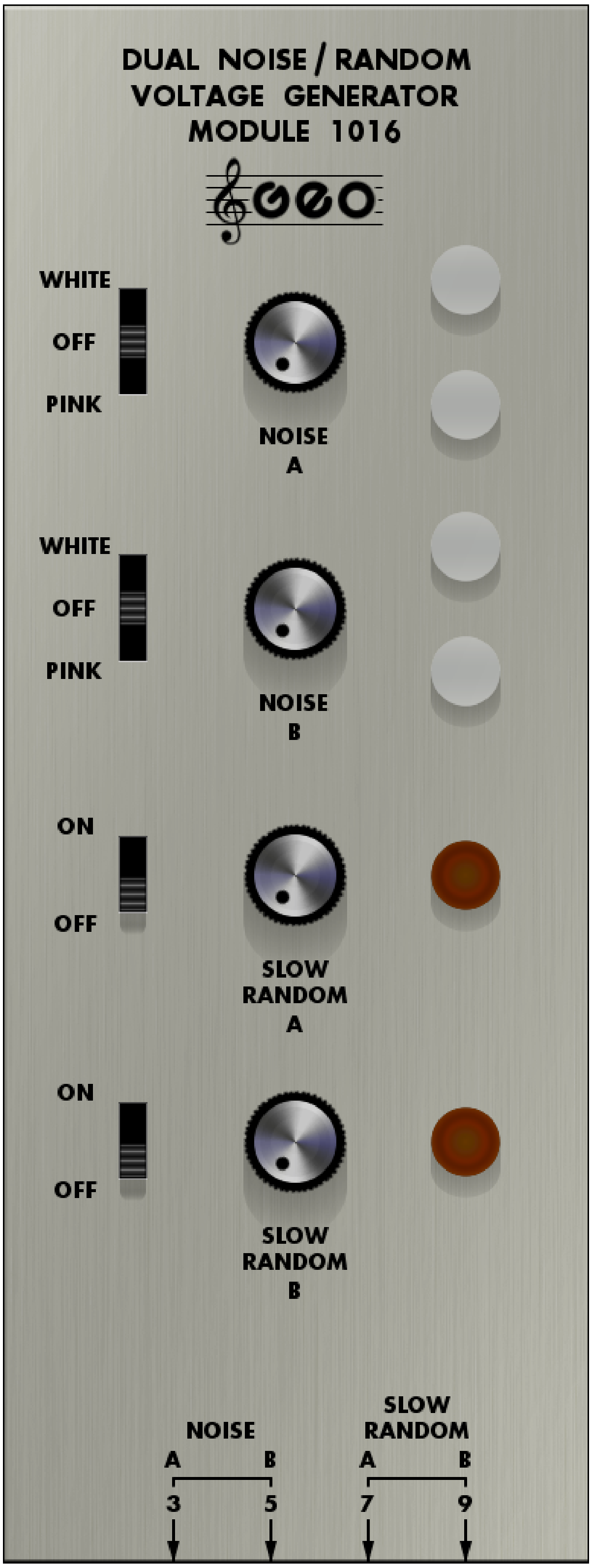
Controls

Each noise generator, *A* and *B*, is controlled by a switch to select white or pink noise, or to turn the output off. Attenuator dial knobs control the amount of output signal, and two white lights show, if white or pink noise is selected.

In the lower part of the panel, each slow random noise is controlled by an on/off switch and a attenuator control knob. A red light for each slow random output indicate, if the slow random is turned on.

Outputs

Two outputs at the bottom left is for the *A* and *B* noise generators producing white or pink noise, and two outputs at the bottom right is for the slow random *A* and *B* noise generators.




CLOCKED SEQUENTIAL CONTROL
MODULE 1027
PULSE
REPETITION
FREQUENCY
S
F
RATE
LOW
HIGH
% PULSE
WIDTH
0
100
%
INT
EXT
ON
GATE
TRIG
OFF
CLOCK
CONTROLS
STEP
RESET
A
B
R
S
ON
OFF
VC WIDTH
VC FREQ
CLOCK OUT
A
B
C
POSITION GATES
1
2
3
4
5
6
7
8
9
10

5.8 1027 Ten-Position Sequencer

The Geo 1027 Ten-Position Sequencer is a compact sequential virtual voltage generator used for controlling oscillators, filters, amplifiers, and other modules in the G2500 Synthesizer. The Geo 1027 Sequencer contains a ten-step counter and three rows of dial knobs to provide three independently adjustable virtual voltage outputs for each sted of the counter. In addition, a built-in time base generator allows the sequencer to step along automatically. A variety of inputs, outputs, and panel controls facilitates the execution of complex sequencing patterns, rhythmic pattes, and external control. When used at switching rates in the audio spectrum, the sequencer can generate complex waveforms by stepwise approximations.

The sequencer produces a 10 virtual volt gate pulse every time the sequencer steps to a new position. The width of this pulse, normally used for controlling envelope generators, amplifiers, filters, etc., is controlled from the front panel or from an external virtual voltage and can vary from ∼0% to ∼100% of the period between steps.

Inputs

An external virtual voltage applied to the "S" and "R" inputs will step the sequencer and reset it. Complex sequential patterns are generated using the "S" and "R" inputs and the "Position Gates".

The pulse width of the gate signals can be controlled from an external souce; an input to the sequencer labeled "V.C. Width" is provided for this purpose. Set the "Pulse width" switch on the panel to "Ext." to choose this input.

The clock frequency can be controlled from an external source; an input to the sequencer labeled "V.C. Freq." is provided for this purpose. This external virtual control voltage is added internally to the virtual voltage generated by the front panel "rate" control.

The internal clock can be turned on and off by applying pulses to the "on" and "off" inputs. Set the "Clock controls" swith to "Gate" or "Trig" to choose between a gate and trigger signals.

Controls

The three virtual voltage outputs, A, B, and C, are shown on the panel with their associated column of dial knobs. Each row of three dial knobs is adjacent to an indicator light which displays the sequencer count, and hence the three dial knobs whics are active.

At the upper left is a control labeled "Pulse Repetition Frequency", which adjusts the stepping rate of the sequencer from 20 per minute to 400 per second in two ranges. The low and high range can be set with a switch.

Next is a control labeled "% Pulse width" to adjust the width of the gate pulses. A switch is used to choose if the gate pulse width is controlled by this dial knob or an external source.

Illuminated push button switches are used to start and stop the internal clock. A switch is used to select, if external gate control signals to the "on" input turns the sequencer clock on and off, or if external trigger control signals to the "on" and "off" inputs turns the sequencer clock on and off.

With the clock turned off, the sequencer may be steppted along and reset manually using the front panel push buttons in the lower left.

Outputs

The "Position Gate" outputs correspond to the ten lamps and rows of dial knobs on the panel. A position gate output goes from 0 virtual volts to +10 virtual volts when the sequencer reaches the step which corresponds to the number of the "Position Gate" output.

Connecting the "R" input of the sequencer to a "Position Gate" output will cause the sequencer to reset when the sequencer reaches that position. For instance, if one wiches the sequencer to count to five and then reset, the sixth position gate would be connected to the "R" input using the matrix switches. The sequencer would actually count to six, but would instantly reset to the first position.

Similar the "S" input can be connected to any "Position Gates" to cause the sequencer to skip those positions.

The "Clock out" sends the gate signal for each step of the sequencer.

In the lower right are the three virtual voltage outputs from the A, B, and C column of dial knobs.

TECHNICAL SPECIFICATIONS

(*vvolt* is virtual volt)

INPUT SENSITIVITY:

"S", "R", "ON", "OFF" inputs: +8.0 vvolts.
"V.C. Width", "V.C. Freq." inputs: 0-10 vvolts.

PULSE REPETITION FREQUENCY:

20 pulses/minute to 400 pulses/second, without external control.

5.9 1033 Dual Envelope Generator

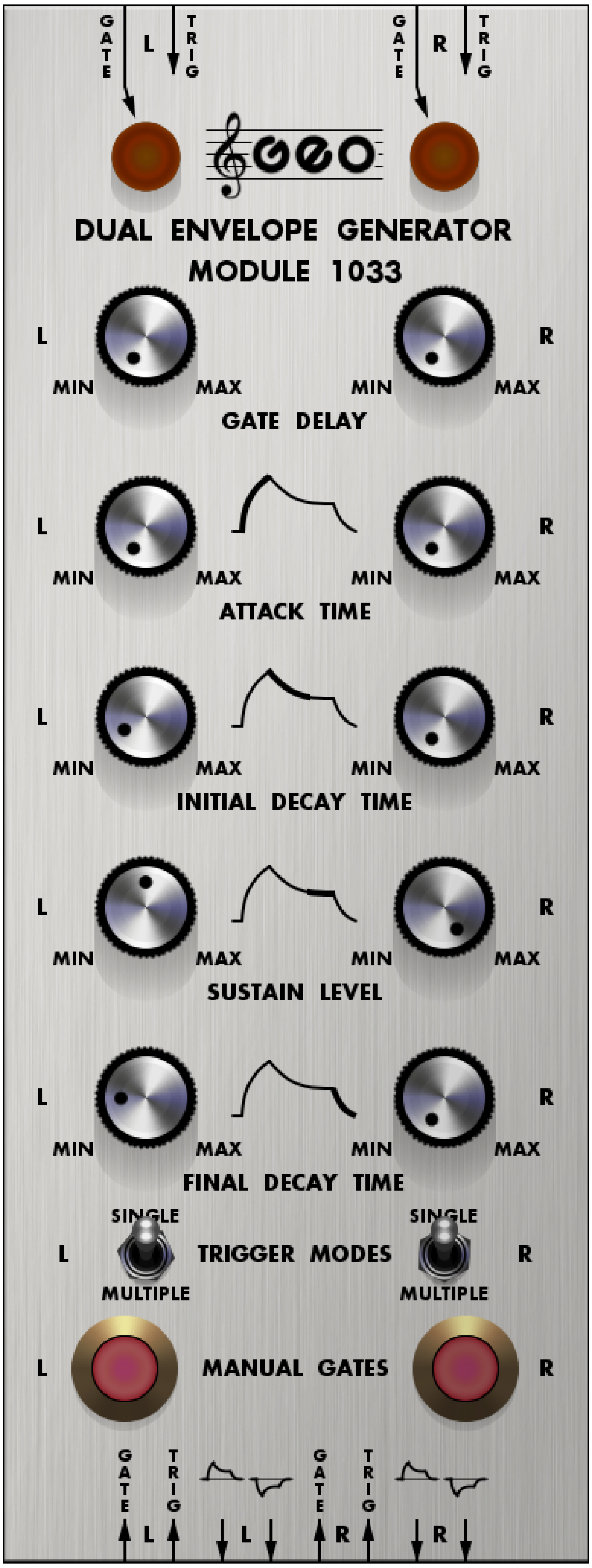
The Geo Module 1033 contains two identical delayed-gate exponential envelope generators.

The 1033 Dual Delayed Gate Envelope Generator is usually used with virtual voltage-controlled filters, amplifiers, and other modules requiring triggered control signals. For instance, when used with Geo Module 1006 FiltAmp, the 1033 Envelope Generator can be used to control the amplitude envelope or timbre variations of signals passing the FiltAmp with respect to time. The delayed-gate feature permits the user to delay the beginning of an envelope so that complex amplitude and timbre characteristics may be synthesized.

An exponential envelope generated by the Geo 1033 Module may be defined by four adjustable parameters: Attack Time, Initial Decay Time, Sustain level, and Final Decay Time. The panel graphics emphasize the effects and use of each of these controls.

An envelope is initiated when appropriate signals are applied to the Gate and Trigger inputs. These inputs are accessible at both the upper and lower matrix switches, as shown on the panel graphics. In the Module 1033 the control signal which starts the envelope always passes through a virtual delay circuit which allows the user to postpone the beginning of an attack from instantly to 3 seconds by adjusting the "Gate Delay" panel control.

The operating mode of the envelope generator is determined by the switches labelled "Trigger Modes". When the "Trigger Modes" switch is in the "single" position, the Gate inputs are used to initiate an envelope; the Trigger inputs are not used. When the Gate signal is applied, the delay circuit is activated; after a time period selected by the front panel "Delay Time" control, the delay circuit produces a pulse which initiates the attack. During the attack, the output of the envelope generator rises exponentially to 10 virtual volts at a rate determined by the setting of the "Attack Time" control. When the output of the envelope generator reaches 10 virtual volts, the attack is ended and the output decays exponentially to the "Sustain Level" at a rate determined by the "Initial Decay Time" control. The sustain level is adjustable from 0 to 10 virtual volts. The



output remains at the sustain level until the Gate is removed. When the Gate is removed, the output immediately begins an exponential decay to 0 virtual volts at a rate determined by the "Final Decay Time" control (Fig. A).

If the Gate voltage is removed before the delay circuit has time to produce a pulse, the delay circuit will be reset immediately and will not produce a triggering pulse. Consequently, no envelop will be produced.

If the Gate voltage is removed during any part of the envelope cycle, the output of the envelope generator will always return directly to zero at the rate set by the "Final Decay Time" control. Similarly, if the Gate virtual voltage is reapplied before the output returns to zero, a new attack will begin after the time period specified by the "Trigger Delay" control. The output need not return to zero before the initiation of a new attack (Fig. B).

When the "Trigger Modes" switch is in the "Multiple" position, the attack is initiated by a positive pulse at the "Trig" input provided that a Gate signal is also present. In order to begin an attack, bot the Gate and the Trigger must be applied. The presence of a Gate signal or a Trigger pulse alone will not produce an attack. A new attack is generated each time a Trigger pulse is applied, and as long as a Gate signal is present. It should be noted that the Trigger input is connected to the input of the virtual delay circuit which in turn triggers the attack. Therefore an attack can be generated if a Gate signal is present when the delay circuit produces its pulse which may be some time later than the initial trigger pulse.

If the gate signal is applied in the absence of a trigger, the output virtual voltage will rise to the sustain level at a rate determined by the setting of the "Initial Decay Time" control. The output virtual voltage will remain at the sustain level until the gate voltage is removed, at which time the output voltage will return to zero at a rate determined by the final decay control. (Fig. C).

Inputs

Gate and Trigger inputs are located at both the upper and lower matrix switches.

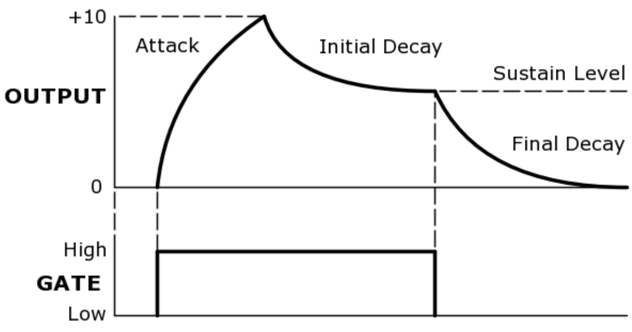


FIGURE A

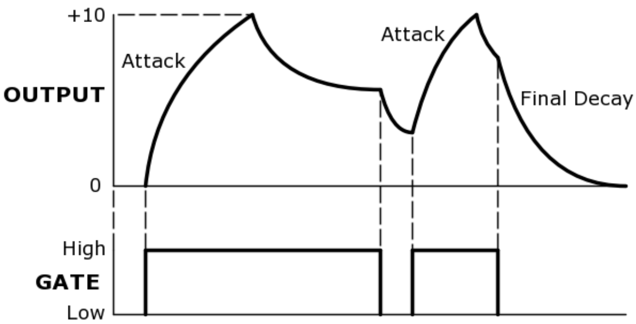


FIGURE B

Controls

The left and right envelopes, L and R, has control dial knobs to control gate delay, attack time, initial decay time, sustain level, and final decay time.

Trigger modes can be set with toggle switches below the dial knobs.

An attack may be started manually bypassing the gate delay using the front panel push buttons near the bottom of the panel.

Outputs

Envelope outputs for the left and right envelope are available at the lower matrix switch.

Also an inverted envelope for both left and right envelope with output from 0 to -10 virtual volts is available at the lower matrix switch.

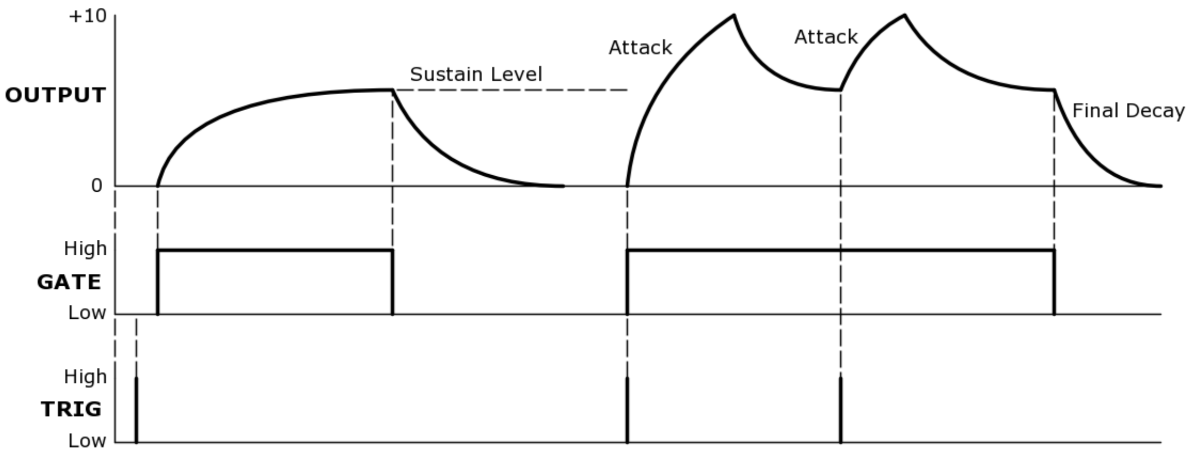


FIGURE C

TECHNICAL SPECIFICATIONS

(*vvolt* is virtual volt)

OUTPUT WAVEFORMS:

Attack: $E_{out} = 11.0 - 11e^{-k_a t}$
Initial Decay: $E_{out} = E_{sus} + (10 - E_{sus})e^{-k_{id} t}$
Final Decay: $E_{out} = E_{sus} e^{-k_{fd} t}$

CONTROLS:

Attack Time: 0.001 secs to 2.0 secs
Initial Decay Time: 0.001 secs to 2.0 secs
Sustain Level: 0 to 10 vvolts.
Final Decay Time: 0.001 secs to 2.0 secs.
Delay Time: Instantly to 3.0 secs.

INPUTS:

Gate Sensitivity: 1.8 vvolts, lower patrix switch; 8.0 vvolts, upper matrix switch.
Trigger Sensitivity: 1.8 vvolts.

OUTPUTS:

0 to +10 vvolts.
0 to -10 vvolts.

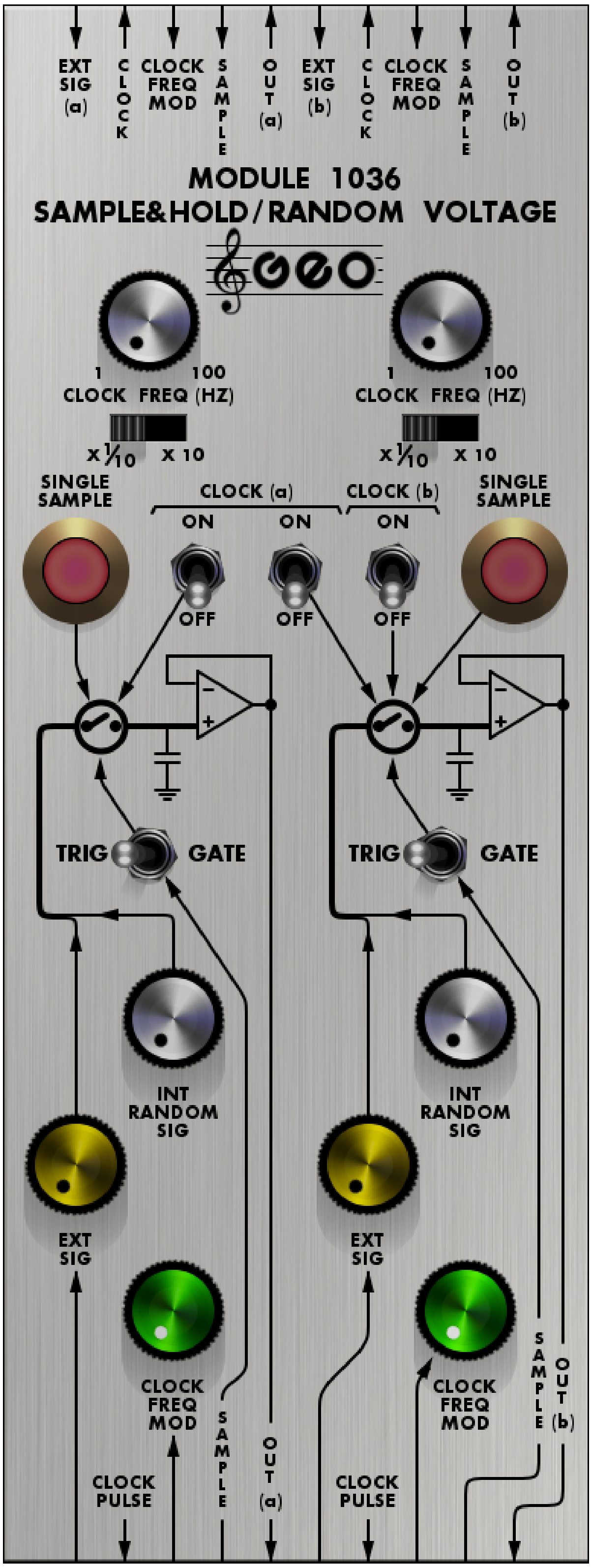
5.10 1036 Sample & Hold / Random Voltage

The Geo 1036 Dual Sample & Hold/Random Voltage module contains two sample and hold virtual circuits, two random noise generators, and two virtual voltage controlled pulse generators. The 1036 is usually used in conjunction with virtual voltage controlled oscillators to produce random tone sequences, scales, arpeggios and programmed melodic patterns. The module can also be used to control virtual voltage controlled filters, amplifiers, etc.

A sample and hold virtual circuit has a signal input, a signal output, and a sample command input. When a pulse is applied to the sample command input, the output signal virtual voltage immediately assumes the same value as the input signal virtual voltage. After the sample command pulse, the output signal vill hold at that same level until anther sample command pulse is applied. During the holding period between pulses, the input signal has no effect on the output signal. In the case shown in Figure A, a sawtooth waveform is applied from an external oscillator to the "Ext Sig" input of a 1036 sample and hold. Sample command pulses can be generated by pushing the "Single Sample" button, applying an external pulse (as from an oscillator or keyboard trigger) to the "Sample" input (with the "Trig/Gate" switch set to "Trig"), or by using an internal clock pulse generator.

There are two separate clock pulse generators. The frequencies of the clock pulse generators are determined by the front panel "Clock Freq" knobs and range switches. An external signal applied to the "Clock Freq Mod" inputs will also affect clock frequency. Clock (a) can be used to provide sample command pulses to both the (a) and (b) sample and hold virtual circuits. Of the three toggle switches between the "Single Sample" buttons, two are connected to clock (a). The switch on the let connects clock (a) to sample and hold (a) while the center switch connects clock (a) to the sample and hold virtual circuit (b). The right hand switch connects clock (b) to sample and hold (b).

The "Clock Pulse" output is a 10 virtual volt pulse that corresponds to the sample period of any sample command pulse reaching the sample and



hold virtual circuit. The internal clock, the "Single Sample" button, or external pulses all produce pulses at the "Clock Pulse" output. Usually the pulse can be used to trigger envelope generators, sequencers, and so forth.

When a sample command pulse is received from the clock, "Single Sample" button, or external pulse, the output virtual voltage appearing at "Out (a)" or "Out (b)" assumes the same value as the input virtual voltage. In the case of Figure A, a sawtooth wave going from 0 virtual volts to +10 virtual volts is sampled as irregular intervals by the application of sample command pulses.

Any external signal which one desires to sample must be applied to the "Ext Sig" inputs. The knobs associated with the "Ext Sig" inputs are used to attenuate the incoming signal.

The output virtual voltage from the sample and hold virtual circuit will usually be a series of steps or discrete virtual voltages. The output signal shown in Figure A is typical. Normally this output signal is used to control virtual voltage controlled oscillators, filters, amplifiers, and so forth. If a waveform is sampled at a high enough frequency, however, the output signal can be used as and audio source.

In addition to sampling external signals, the module 1036 has built-in random signal generators. By advancing the front panel knobs labelled "Int Random Sig", noise can be applied to the signal input of the sample and hold virtual circuits. When this random signal is sampled by the application of a sample command pulse, the output signal is a series of stepwise random virtual voltages, as shown in Figure B. If an external signal is also applied, the random signal and the external signal will be mixed internally before being sampled.

When an external sample command pulse (as from an oscillator) is applied to the "Sample" input, two different results can be selected by the "Trig/Gate" switch. In the "Trig" position, the input pulse is differentiated and the leading or positive going edge of the external pulse triggers the sampling virtual circuit. When the "Trig/-Gate" switch is in the "Gate" position, the output signal of the sample and hold circuit will track the input signal as long as the external sample command pulse is positive. As soon as the pulse ends and the virtual voltage at the "Sample" input returns to zero, the sample and hold virtual circuit will store and hold the last value of the input signal before the sample command pulse returned to zero. Figure C shows an example; when the sample command pulse is high, the output signal tracks the triangle wave at the signal input. When the sample pulse goes to zero virtual volts, the output signal holds at the virtual voltage which was present when the sample command pulse dropped to zero.

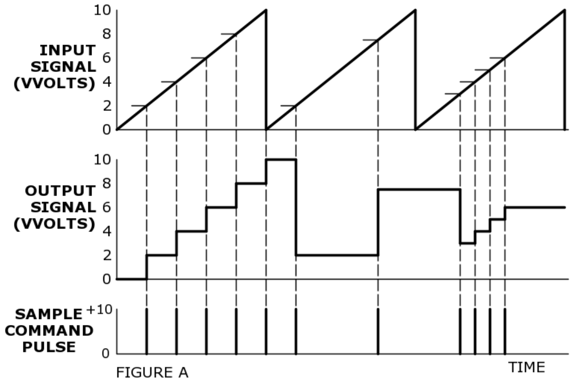


FIGURE A

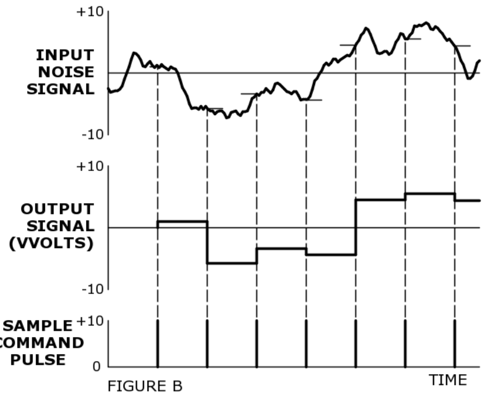


FIGURE B

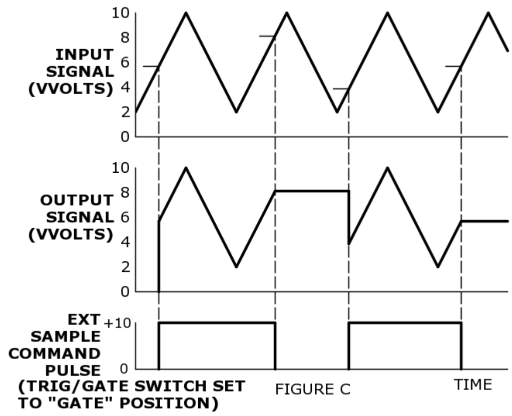


FIGURE C

5.11 1046 Quad Envelope Generator

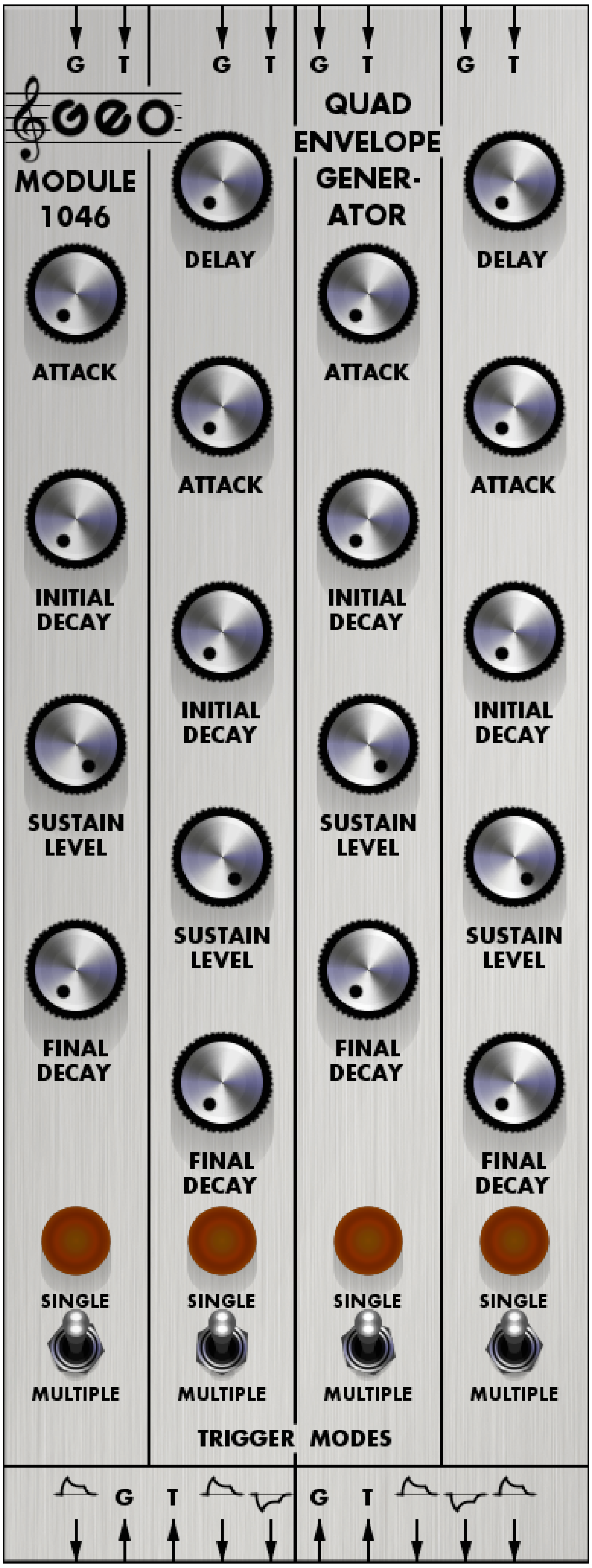
The Geo Module 1046 contains four exponential envelope generators, two of which are delayed-gate.

The 1046 Quad Envelope Generator is usually used with virtual voltage-controlled filters, amplifiers, and other modules requiring triggered control signals. For instance, when used with Geo Module 1006 FiltAmp, the 1046 Envelope Generator can be used to control the amplitude envelope or timbre variations of signals passing the FiltAmp with respect to time. The delayed-gate feature for two of the envelopes permits the user to delay the beginning of an envelope so that complex amplitude and timbre characteristics may be synthesized.

An exponential envelope generated by the Geo 1046 Module may be defined by four adjustable parameters: Attack Time, Initial Decay Time, Sustain level, and Final Decay Time.

An envelope is initiated when appropriate signals are applied to the Gate and Trigger inputs. These inputs are accessible at both the upper and lower matrix switches, as shown on the panel graphics. For the second and fourth envelope, the control signal which starts the envelope always passes through a virtual delay circuit, which allows the user to postpone the beginning of an attack from 0.003 to 3 seconds by adjusting the "Delay" panel control.

The operating mode of the envelope generator is determined by the switches labelled "Trigger Modes". When the "Trigger Modes" switch is in the "single" position, the Gate inputs are used to initiate an envelope; the Trigger inputs are not used. When the Gate signal is applied, the delay circuit is activated if one is present; after a time period selected by the front panel "Delay" control, the delay circuit produces a pulse which initiates the attack. During the attack, the output of the envelope generator rises exponentially to 10 virtual volts at a rate determined by the setting of the "Attack" control. When the output of the envelope generator reaches 10 virtual volts, the attack is ended and the output decays exponentially to the "Sustain Level" at a rate determined by the "Initial Decay" control. The sustain level is adjustable from 0 to 10 virtual volts.



The output remains at the sustain level until the Gate is removed. When the Gate is removed, the output immediately begins an exponential decay to 0 virtual volts at a rate determined by the "Final Decay" control (Fig. A).

For the second and fourth envelope, if the Gate voltage is removed before the delay circuit has time to produce a pulse, the delay circuit will be reset immediately and will not produce a triggering pulse. Consequently, no envelop will be produced.

If the Gate voltage is removed during any part of the envelope cycle, the output of the envelope generator will always return directly to zero at the rate set by the "Final Decay" control. Similarly, if the Gate virtual voltage is reapplied before the output returns to zero, a new attack will begin after the time period specified by the "Delay" control, if one is present. The output need not return to zero before the initiation of a new attack (Fig. B).

When the "Trigger Modes" switch is in the "Multiple" position, the attack is initiated by a positive pulse at the "Trig" input provided that a Gate signal is also present. In order to begin an attack, bot the Gate and the Trigger must be applied. The presence of a Gate signal or a Trigger pulse alone will not produce an attack. A new attack is generated each time a Trigger pulse is applied, and as long as a Gate signal is present. For the second and fourth envelope, it should be noted, that the Trigger input is connected to the input of the virtual delay circuit, which in turn triggers the attack. Therefore an attack can be generated if a Gate signal is present when the delay circuit produces its pulse which may be some time later than the initial trigger pulse.

If the gate signal is applied in the absence of a trigger, the output virtual voltage will rise to the sustain level at a rate determined by the setting of the "Initial Decay" control. The output virtual voltage will remain at the sustain level until the gate voltage is removed, at which time the output voltage will return to zero at a rate determined by the final decay control. (Fig. C).

Inputs

Gate and Trigger inputs are located at both the upper and lower matrix switches.

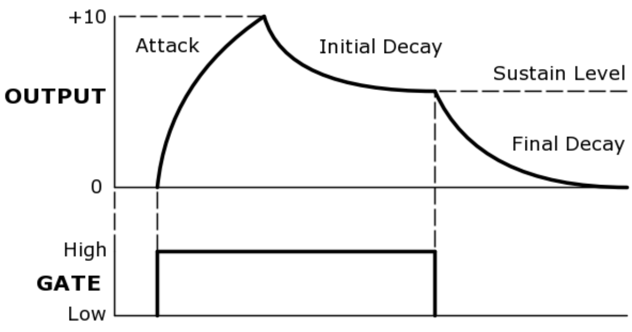


FIGURE A

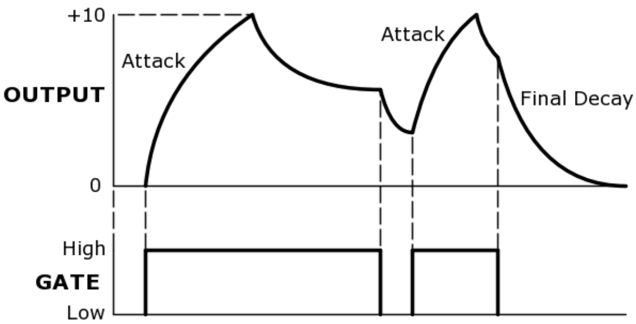


FIGURE B

Controls

All four envelopes has control dial knobs to control attack time, initial decay time, sustain level, and final decay time.

In addition, the second and fourth envelope has control dial knobs to control gate delay.

Trigger modes can be set with toggle switches below the lamps.

Outputs

Envelope outputs for all four envelopes are available at the lower matrix switch.

Also an inverted envelope for the second and fourth envelope with output from 0 to -10 virtual volts is available at the lower matrix switch.

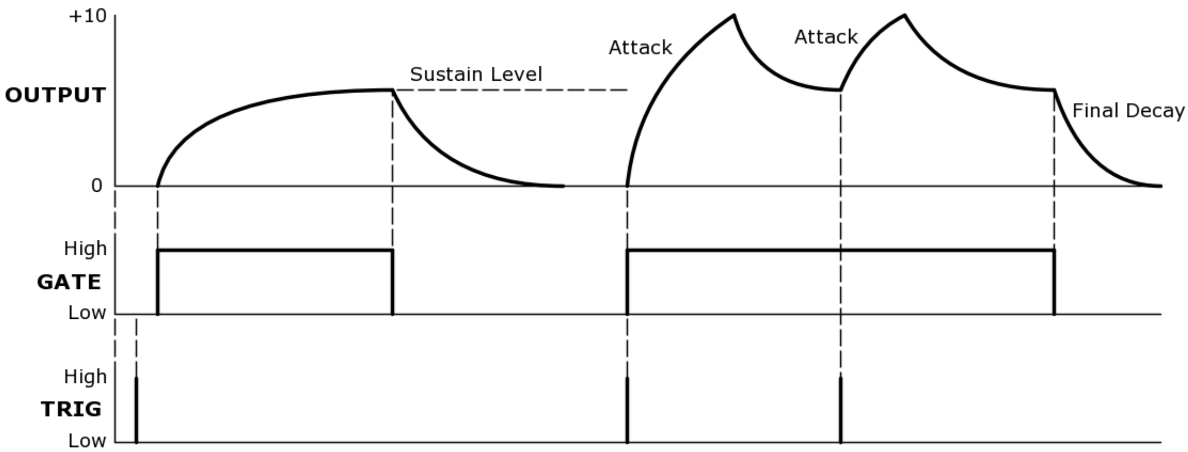


FIGURE C

TECHNICAL SPECIFICATIONS

(*vvolt* is virtual volt)

OUTPUT WAVEFORMS:

Attack: $E_{out} = 11.0 - 11e^{-k_a t}$
Initial Decay: $E_{out} = E_{sus} + (10 - E_{sus})e^{-k_{id} t}$
Final Decay: $E_{out} = E_{sus}e^{-k_{fd} t}$

CONTROLS:

Attack Time: 0.001 secs to 2.0 secs
Initial Decay Time: 0.001 secs to 2.0 secs
Sustain Level: 0 to 10 vvolts.
Final Decay Time: 0.001 secs to 2.0 secs.
Delay Time: 0.003 secs to 3.0 secs.

INPUTS:

Gate Sensitivity: 1.8 vvolts, lower patrix switch; 8.0 vvolts, upper matrix switch.
Trigger Sensitivity: 1.8 vvolts.

OUTPUTS:

0 to +10 vvolts.
0 to -10 vvolts.

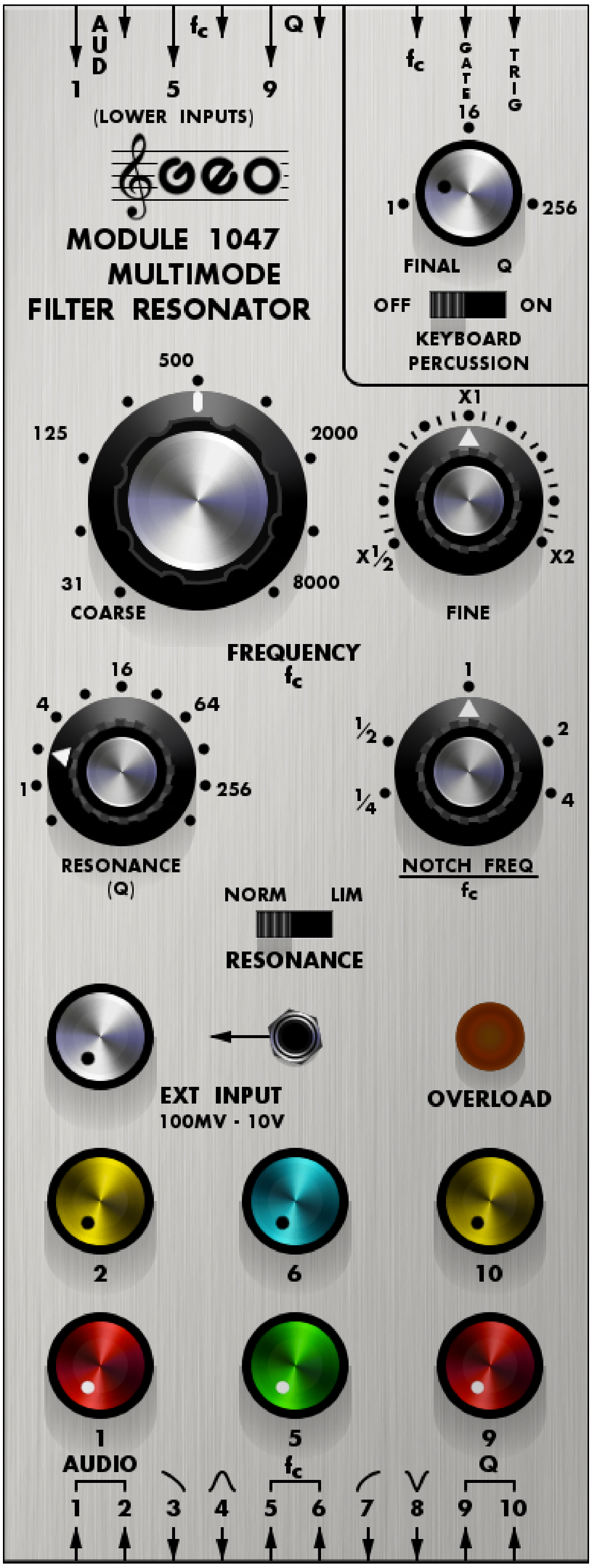
5.12 1047 Multimode Filter / Resonator

The Geo Module 1047 consists of a highly resonant filter with virtual voltage controlled frequency and resonance, and simultaneously provides high-pass, band-pass, low-pass, and notch outputs. The filter is capable of providing a side variety of formant shaping and tonal modulation. The band-pass response is that of a natural acoustic resonator, and is most useful in synthesizing instrumental timbres. In addition, the high degree of resonance and frequency tracking accuracy attainable enables the filter to perform precise, narrowband spectrum analysis of audio signals.

The center frequency of the band-pass output is the cutoff frequency of the high-pass and low-pass outputs, and is referred to as "Fc". Fc may be set by the coarse and fine frequency knobs over the range of 16 Hz to 16 kHz. Control signals applied to any Fc input will change the center frequency from the knob setting by 1 octave per virtual volt when the knob above the control input is at maximum. Control signals from the individual inputs are summed with the Fc knob controls, and may be positive, negative, or audio.

With the RESONANCE (Q) knob at minimum and the RESONANCE switch set to "NORM", the band-pass output has a gain of 0.5 at Fc and attenuates 6 dB per octave above and below Fc. The high-pass output has unity gain from Fc to close to the Nyquist frequency at 48 kHz and attenuates 12 dB per octave below Fc. The low-pass output has unity gain from DC to Fc and attenuates 12 dB per octave above Fc. The notch output has flat response everywhere except for a deep notch at a frequency determined by the $\frac{NOTCH\ FREQ}{Fc}$ knob. With this knob set to 1, the notch occurs at Fc. NOTE: The notch output is effective only at low Q.

As the RESONANCE (Q) knob is turned up, a resonant peak occurs at Fc in all four outputs, except in the notch output when the notch frequency is at Fc. The gain at this peak is numerically equal to the "Q", and the 3 dB bandwidth of this peak is equal to Fc/Q. Thus, as Q is varied from 1/2 to 512, the bandwidth varies from 2 Fc (2 octaves) to Fc/512 (1/32 of a semitone). When using high resonance, the audio input controls may have to be turned down to prevent overload.



An overload light is provided for this purpose. The Q may be controlled by external signals. The Q control characteristic is exponential; that is, each virtual volt applied to a "Q" input doubles the Q when the input know is at maximum.

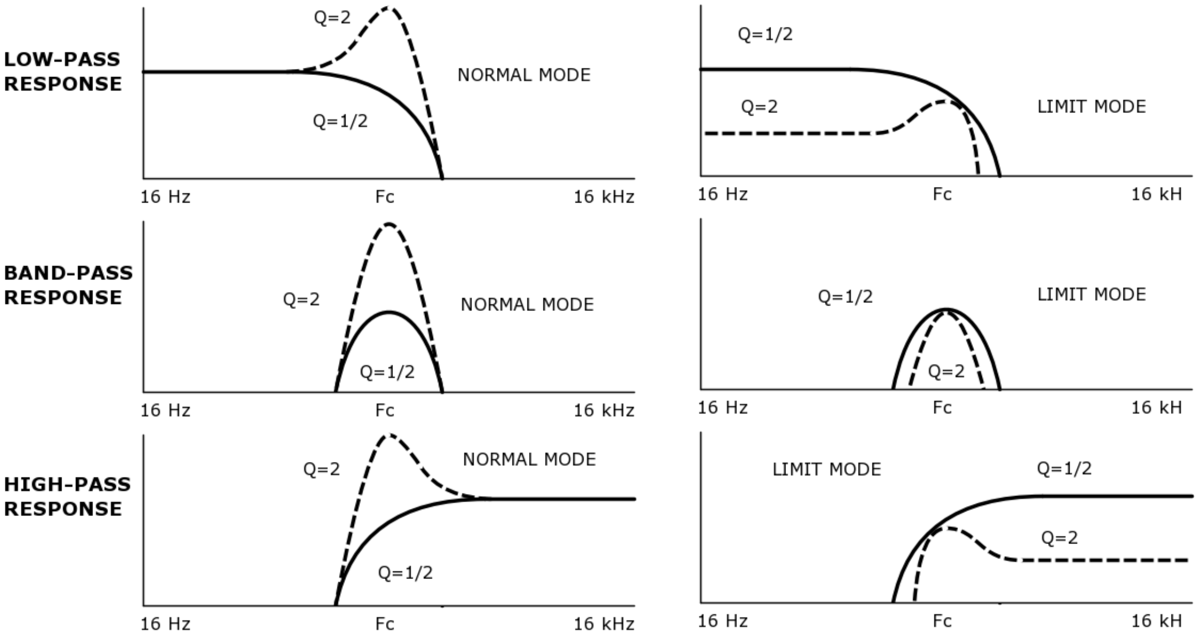
With the RESONANCE switch set to "LIM", the height of the resonant peak is limited to unity gain at Fc, and the response on either side falls off as the Q is increased. This mode is useful when tuning sharply about a strong fundamental or harmonic of the input signal, but will otherwise result in a very low output signal at high resonance. For most applications, this switch should be set to "NORM".

The front panel has an extra input jack marked "EXT INPUT", which is mixed with the lower matrix switch audio inputs.

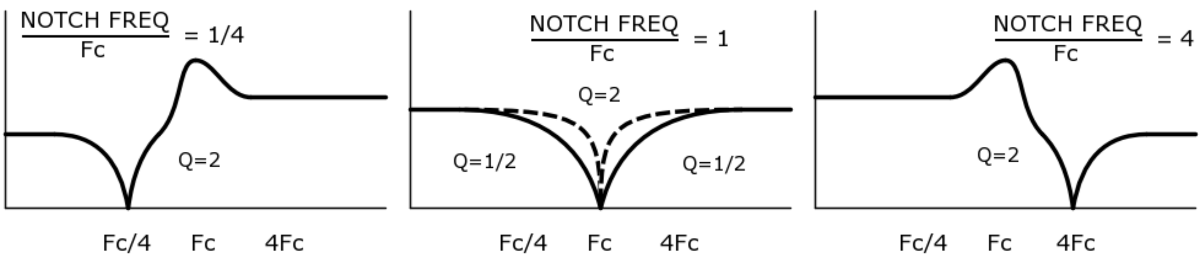
Upper matrix switch inputs for audio, Fc, and Q are provided. The short arrows are independent, unattenuated inputs, while the long arrows marked 1, 5, and 9 are wired directly to the corresponding lower inputs for the purpose of attenuating upper matrix switch inputs.

Another feature is keyboard percussion, which allows the filter to generate a wide variety of percussive tones from the keyboard. The keyboard gate and trigger output should be connected to the GATE and TRIGGER inputs at the upper right corner of the panel, and the keyboard control voltage applied to any one Fc input. With the KEYBOARD PERCUSSION switch on, striking a key produces a sharp percussive attack followed by a tone which varies from a slightly pitched click resembling a castanet clap (at low Q) to a slowly decaying sine one at high Q. Upon releasing the key, the tone damps at a rate determined by the FINAL Q knob. The band-pass output gives the most natural percussive quality, although the high-pass and low-pass outputs may be used. They give a sharper and a duller attack, respectively.

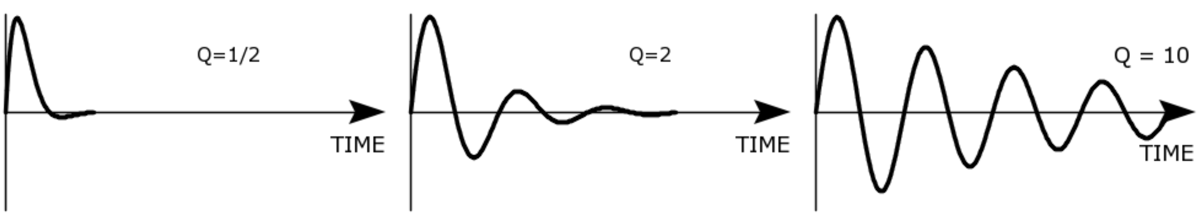
See next page for module 1047 filter response curves.



NOTCH RESPONSES



PERCUSSIVE OUTPUT WAVEFORMS



5.13 1050 Sequential Mixer

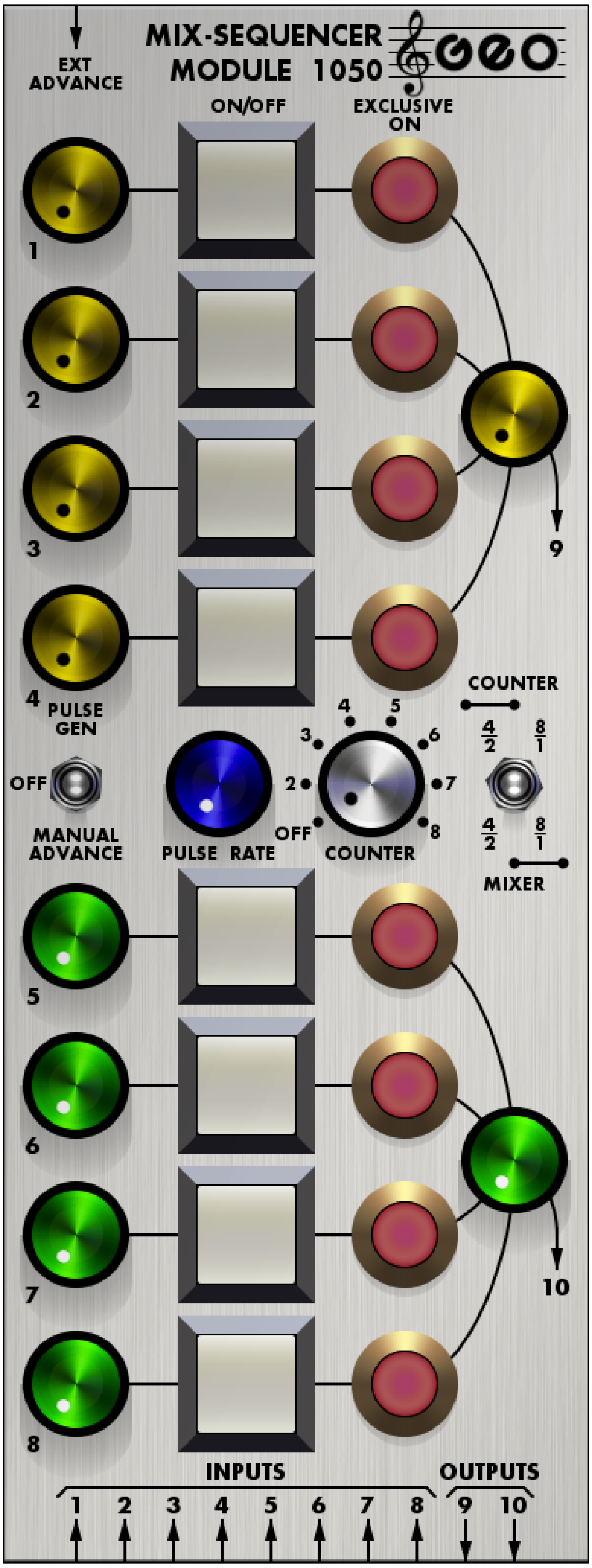
The Geo Module 1050 Sequential Mixer incorporates sequential switching functions necessary for rapid selection of preset waveforms and signals into a conventional audio mixer format. The Module 1050 contains two four-input mixers with gated inputs, an eight step counter and clock, and associated virtual logic and switching circuitry. Each input has its own attenuator and each output has a master gain control.

The Geo Module 1050 may be used as an eight input mixer with two adjustable outputs or as two separate four input mixers. A toggle switch at the right center of the panel couples the audio circuitry to provide either the 1 x 8 or two 1 x 4 mixer configurations.

A column of illuminated push-buttons indicates which inputs are gated on. The switches are pushed to change the state of an input, push-on/push-off. A column of ”Exclusive-on” push-buttons will turn on a particular input while simultaneously turning all others off. This function is particularly useful for quick and convenient selection of preset signals. When the mixer is being used as two four-input mixers, the ”Exclusive-on” button affects all eight inputs.

The panel symbols around the ”Counter/Mixer” switch indicate how the switching logic (upper symbols) and audio circuitry (lower symbols) are set for the three switch positions. In the right position, the audio circuitry is coupled to form one eight-input mixer with two adjustable outputs. The logic is also set so that an ”Exclusive-on” button will affect all eight inputs. In the center position, the audio circuitry is again set up as an eight-input mixer.

With the ”Counter/Mixer” switch in the left position, both the audio circuitry and the logic circuitry are arranged as if the module were two separate four-input mixers. ”Exclusive-on” switches will affect either the upper or lower set of four inputs without interaction between sets. This position, and the center position of the ”Counter/Mixer” switch also permits ”Parallel step” operation of the sequencer, as shall be discussed below.



In addition to the manual switching operations described in the preceding paragraphs, the Module 1050 contains a clock pulse generator and an eight step counter. A toggle switch at the left center of the panel enables or disables the clock. When this switch is in the "Pulse Gen" position, the counter will sequentially enable inputs to the mixer (and illuminate the appropriate indicator lamps) one at a time, resetting at the end of every cycle. The length of the cycle, i.e., the number of counts in a cycle, is determined by the rotary switch at the center of the panel. Setting this switch to the "off" position disables the counter. The stepping rate is adjusted by the "pulse rate" control. The counter may be manually advanced by either the front panel toggle switch or an External Advance pulse.

The "parallel step" operation mentioned earlier permits the upper and lower sets of four inputs to be sequenced in tandem. In other words, the counter would actuate inputs in pairs: (1, 5), (2, 6), (3, 7), (4, 8).

The outputs of the counter or the front panel push-buttons can actuate a mixer input. Inputs can be held on by setting the appropriate push-buttons even though the counter may be operating.

TECHNICAL SPECIFICATIONS

(*vvolt* is virtual volt)

AUDIO INPUTS:

$\pm$10 vvolts.

AUDIO OUTPUTS:

$\pm$10 vvolts.

INPUT ATTENUATION:

Linear: $-\infty$ - 0 dB.

EXTERNAL ADVANCE:

Sensitivity: 1.3 vvolts.

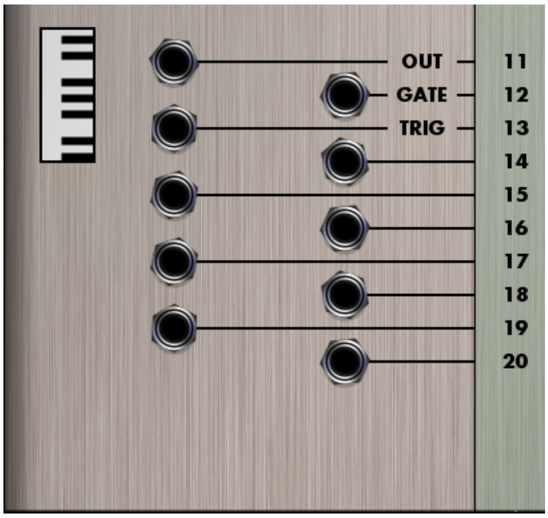
5.14 3001 Keyboard

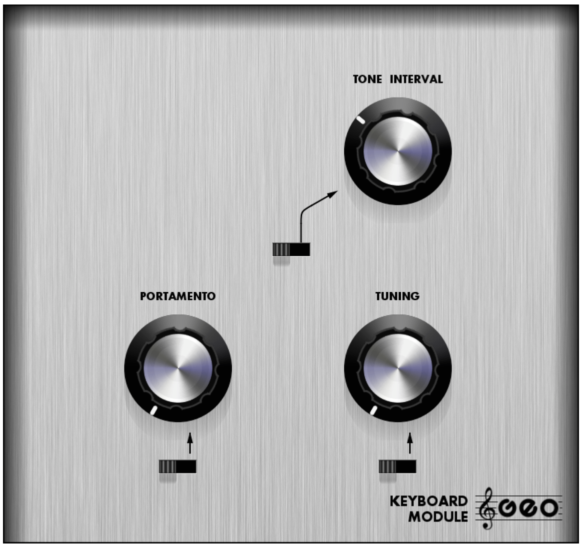
The keyboard has the following output virtual voltages, which comes in to the upper matrix row 11, 12, and 13:

1. Trigger - a short transient 10 virtual volt pulse, which occurs whenever a key is depressed.
2. Gate - switched 10 virtual volt signal indicating that a key is depressed.
3. Output - virtual control voltage whose amplitude is related to lowest key being depressed.

The trigger and gate virtual voltages are typically used to control enveloper generators. The "Output" virtual voltage is used to control virtual voltage controlled oscillators, filters, and amplifiers.

Right of the keyboard is a panel with three dial control knobs and switches to turn the functionality on and off.





Tone interval

This control set the output virtual voltage between adjacent notes. This "Tone interval" may be varied from roughly 48 notes per virtual volt to 6 notes per virtual volt by using the "Variable" knob with the slide switch beneath that knob in the right position. Reversing the position of the slide switch disconnects the dial knob and connects the "fixed" adjustment for 12 notes per virtual volt, corresponding to the equal tempered scale.

Tuning

The "Tuning" control permits the keyboard output virtual voltage to be raised by about 1/2 virtual volt. Normally the lowest note on the keyboard produces zero output voltage. This would be the case if the "Tuning" knob were rotated fully counterclockwise or if the "Tuning" knob were deactivated by using the slide switch beneath it.

Portamento

The portamento control is used to cause the output virtual voltage to slide from one point to another. Advancing this control will increase the time constant for the slide.

Company

NicomSoft v/John Niclasen is a company that develops and provides software and consulting services.

Authors

- G2500 is a product developed by John Niclasen
- Additional testing: John Ångstrøm
- User Interface: John Niclasen
- Manual: John Niclasen

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