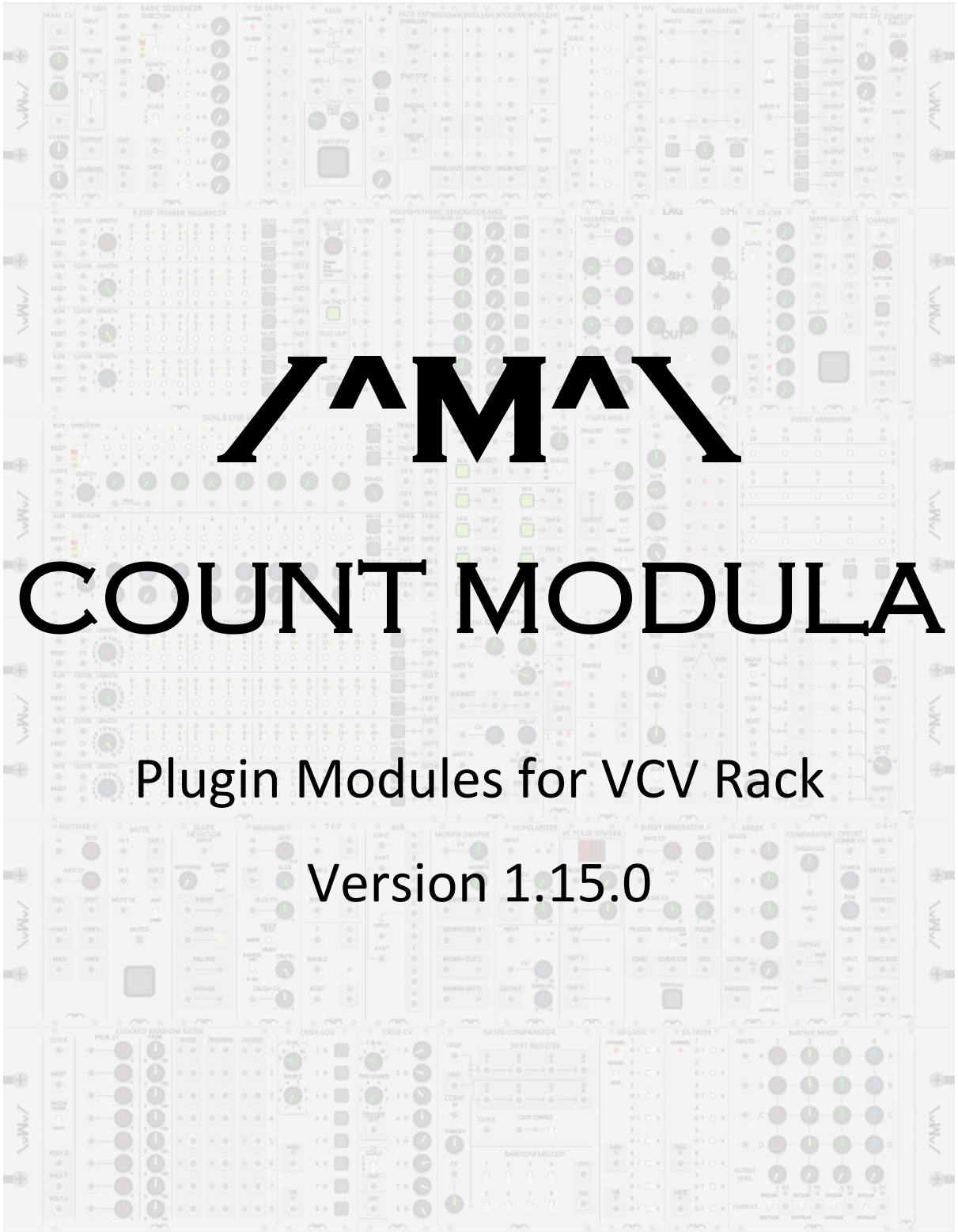

COUNT MODULA

Plugin Modules for VCV Rack

Version 1.15.0

CONTENTS

COUNT MODULA PLUGINS

LICENSES

All source code for these plugins can be found on GitHub (https://github.com/countmodula/VCVRackPlugins). Note all code is copyright © 2021 Adam Verspaget/Count Modula and licensed under GNU GPLv3

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Whilst these modules are offered free of charge, if you like them or are using them to make money, please consider a small donation to The Count for the effort. Donations can be made via PayPal here:

STAY INFORMED

To keep up to date, follow Count Modula on facebook – click on the facebook logo below:

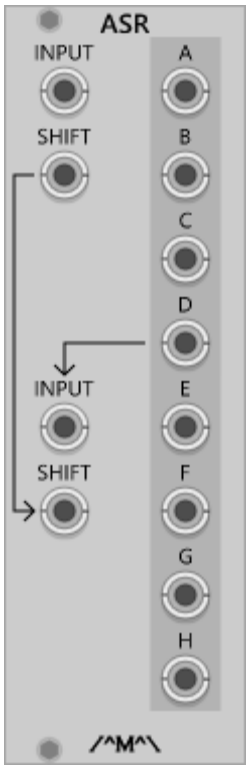
GENERAL

COLOUR THEMES

Pop-up menus on all Count Modula modules allow one of many themes to be selected either individually for modules already in a patch via the "Theme" menu option, or to all modules as they are added to a patch via the "Default Theme" option. Once set, modules in a patch will retain their themes regardless of the default setting.

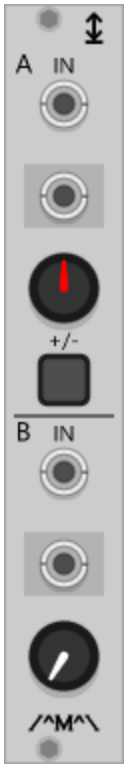
PLUGIN MODULES

ANALOGUE SHIFT REGISTER



A dual 4 output or single 8 output shift register. On each the rising edge at the shift input, the signal present at each output is propagated to the next successive output and the input is simultaneously sampled and sent to the first output. The shift input on channel 2 is normalled to the shift input on channel 1 and the signal input on channel 2 is normalled to output 4 of channel 1 so that, with no cables connected to channel 2, the module functions as a single 8 output shift register.

ATTENUATOR



A basic dual attenuator with switchable attenuverting capability on the top channel. With no CV input the module will output control voltage between 0 and 10V (top channel -10V and +10V when in attenueverter mode) proportional to the position of the level knob.

This module can process polyphonic signals. All channels are attenuated or attenuverted by the same amount.

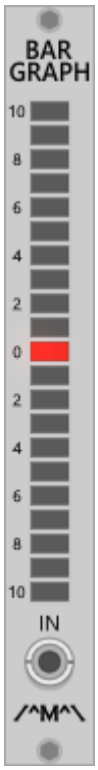
ATTENUVERTER

A single switchable attenuator/attenuverter with large knob for ease of use during live performance. The module can attenuate or attenuate and invert (attenuvert) two separate channels of polyphonic signals and offers simultaneous inverted outputs for both channels.

The Mode switch toggles the module between attenuation and attenuversion.

The Level light displays the attenuation/inversion level not the actual signal level. The light will be brightest when the knob is fully CW in attenuation (least attenuation) mode or fully CW/CCW (least attenuation/full inversion) in attenuverting mode. The light glows green when attenuating or red when inverting.

BAR GRAPH



A basic tool that displays bipolar voltage values on a LED bar graph. The display response is linear, and the display scale can be selected as 1V, 5V or 10 V via the Scale context menu.

BASIC SEQUENCER

A single basic 8 step trigger/gate sequencer with voltage control over sequence length and direction. For a more fully featured version of this sequencer see the 8 and 16 Step Sequencers.

The Reset input restarts the sequence at step one on the next clock cycle.

The Run input allows the sequencer to be started and stopped by the application of a gate signal with a low gate inhibiting the sequencer and a high gate enabling it. This functions like a pause button and operation resumes at the next clock cycle.

With a cable plugged into CV input, the Length switch is disabled, and control of the sequence length is determined only by the applied voltage. Full sequence length is achieved with a 10V input.

The current sequence length is indicated by the small green lights situated next to the step numbers.

The sequencer has a selectable output range of 2, 4 or 8 volts via the Scale switch.

Three direction options are available via the direction switch or control voltage applied to the Direction input:

- Forward: The sequence travels from left to right and restart on the left-hand side. When in this mode the direction indicator will be green.
- Pendulum: The sequence travels from left to right then back again before starting over. When in this mode the direction indicator will be yellow.
- Reverse: The sequence travels from right to left then start again on the right-hand side. When in this mode the direction indicator will be red.

With a cable plugged into the direction CV input, the direction switch is disabled, and control of the direction is determined only by the applied voltage which responds as follows:

- Under 2 Volts: Forward
- 2 Volts to 4 Volts: Pendulum
- Over 4 Volts: Reverse

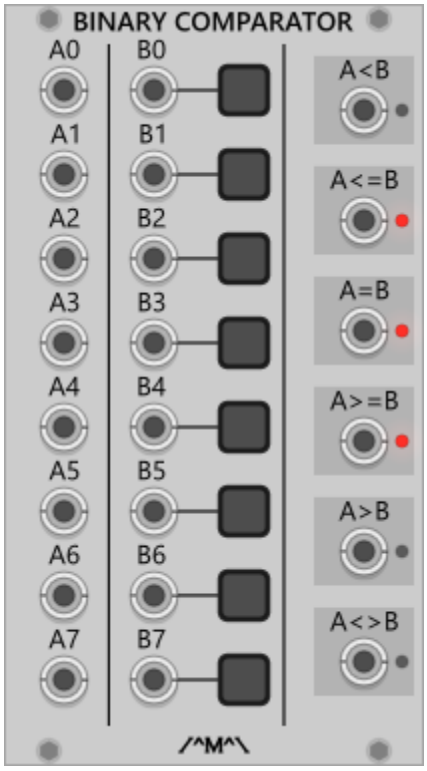
There is 1 gate and 1 trigger output which can be selected via the individual step switches. The trigger outputs follow the pulse width of the clock signal and the gate outputs stay high for the duration of any selected step. Selecting the gate output for two consecutive steps results in a single gate signal for the duration of both steps. Note that the CV outputs will still change for each step even though the gate does not.

The following context menu options are available to facilitate initialization and randomization of each section independently:

- Initialize CV Only: Reset only the CV knobs to their default values
- Initialize Gates/Triggers Only: Reset only the gate/trigger selection switches to their default values
- Randomize CV Only: Set only the CV knobs to random values
- Randomize Gates/Triggers Only: Set only the gate/trigger selection switches to random values

Extra channels can be added via expander modules. Refer to the appendix for a list of expander modules that are compatible with this module.

BINARY COMPARATOR



Compares two 8 bit binary values and determines if the first is

- less than,
- less than or equal to,
- equal to,
- greater than or equal to,
- greater than or,
- not equal to the second value.

Unconnected “A” inputs are treated as binary zero.

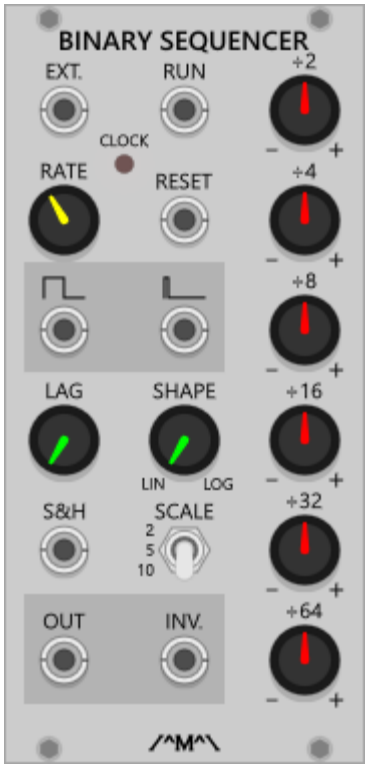
The “B” buttons can be used to program a specific value to compare to the “A” inputs to.

Inserting a cable into a “B” input disconnects the associated button and only the logical level of the input will be used for the comparison.

The inputs can accept any type of signal with any voltage over 2 Volts being considered a binary one.

The x0 inputs are the least significant bits and the x7 inputs are the most significant bits.

BINARY SEQUENCER



Similar to a now discontinued Frac format module, this is a binary counter based sequencer where the individual bits of the counter are mixed together in varying proportions to produce a repeating CV pattern.

The output can be smoothed into slowly varying voltages with the Lag and Lag Shape controls and the output range can be set to 2, 5 or 10 volts. The selected output range indicates the maximum voltage that can be produced when all of the knobs are fully clockwise. i.e. the selected value is divided equally across the bit knobs.

The sequencer can be internally or externally clocked and offers both gate and trigger outputs.

Prior to v0.6.2, the Run/Reset input functions like a gate with a low gate value stopping the count and holding the outputs at 0V. A high gate value enables the sequencer with the count being reset on the positive edge of the gate.

From v0.6.2, the reset and run functions have been split into separate jack with the run functioning as outlined above however with a cable plugged into the rest input, it will not reset the sequencer on the positive edge of the gate.

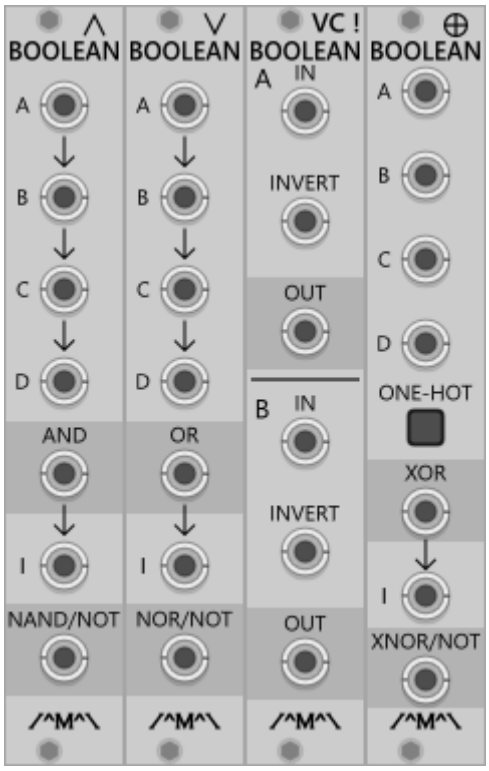
When a cable is connected to the S&H input, the Scale functionality is bypassed, and the voltage presented to the input is sampled (taken at the leading clock edge) and used as the base for the division knobs. Note that each knob will equate to 1/6th of the input voltage when at full scale.

The following context menu options are available to facilitate initialization and randomization of the division knobs independently:

- Initialize Division Mix Only: Reset only the division knobs to their default values
- Randomize Division Mix Only: Set only the division knobs to random values

Refer to the appendix for a list of expander modules that are compatible with this module.

BOOLEAN LOGIC MODULES



A selection of polyphonic Boolean logic gates:

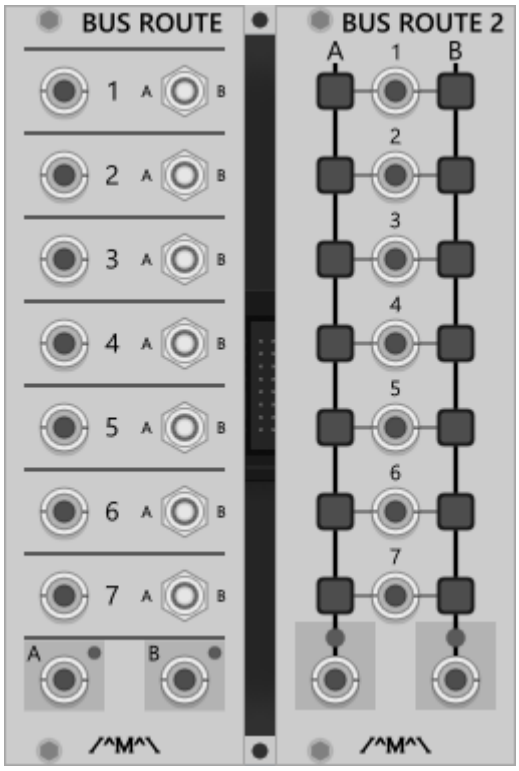
AND: A quad input AND/NAND gate with built in NOT gate (logical inverter). The AND output is high if all connected inputs are also high. With nothing connected to the Inverter input (I), the NOT output will perform the NAND function.

OR: A quad input OR/NOR gate with built in NOT gate (logical inverter). The OR output is high if any connected input is high. With nothing connected to the Inverter input (I), the NOT output will perform the NOR function.

VC Inverter: a logical inverter with voltage control over the invert function. Will only invert if the enable input is High.

XOR: A quad input XOR/XNOR gate with built in NOT gate (logical inverter). The XOR output is high if only one connected input is high (ONE-HOT mode) or the number of connected inputs that are high is odd (normal mode). With nothing connected to the Inverter input (I), the NOT output will perform the XNOR function.

BUS ROUTE/BUS ROUTE 2



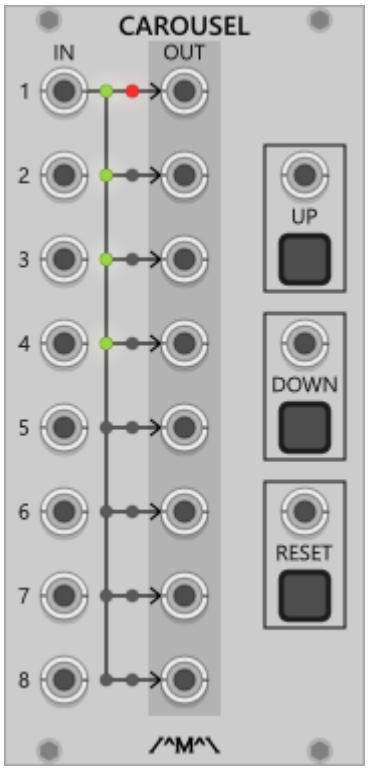
Two different flavours of dual bus gate combiner/router.

Bus Route allows up to 7 gate/trigger signals to be routed and combined to one of two busses. Each bus is a 7 input OR gate and the switches determine to which bus the signal is to be sent.

Bus Route 2 allows up to 7 gate/trigger signals to be combined and sent either bus or both busses at the same time. Each column is a 7 input OR gate and the switches/buttons determine if the applied signal on the given row is to be included in the “OR” operation for the given column.

Note that these are not switches or mixers. Any signals presented at the inputs will be internally converted to gates before being combined with voltages over 2 Volts being considered a “high” gate.

CAROUSEL



Carousel is a kind of switch that takes a certain number of inputs and routes them to the same number of outputs with the ability to simultaneously shift the connections up or down via button press or triggers. Think of it as a rotating router if you will. It's a country dance for your signals…

By default, the number of active routes, and therefore inputs/outputs used, is determined by the highest connected input jack. A cable connected to input 6 for example will set the number of routes and inputs/outputs used to 6. This behaviour can be changed via a context menu option which allows specification of the desired number of routes regardless of the input connections. Active routes are indicated by the small green LEDs next to the input jacks.

Clicking the Up/Down button or applying a trigger to the Up/Down inputs causes the Carousel to rotate thereby shifting the internal connections along by 1 as shown in the following 4-input example.

Start		
I		O
1	→	1
2	→	2
3	→	3
4	→	4

Up		
I		O
2	→	1
3	→	2
4	→	3
1	→	4

Up		
I		O
3	→	1
4	→	2
1	→	3
2	→	4

Up		
I		O
4	→	1
1	→	2
2	→	3
3	→	4

As can be seen, from the starting position of Input 1 routed to Output 1, Input 2 routed to Output 2 etc. that each successive "Up" operation shifts the inputs up one with the top input wrapping around to the bottom output each time. Input 2 connects to output 1, Input 3 connects to Output 2 etc and Input 1 connects to Output 4. Then Input 3 connects to Output 1, Input 4 connects to Output 2, Input 2 connects to output 4 and so on.

This video will help explain it further: https://youtu.be/sw9G5PnpuvU

The red LED next to the outputs indicates to which one Input 1 is currently routed.

The Reset button/trigger input sets the routing back such that Input 1 connects to Output 1, Input 2 connects to Output2 etc.

When using a specified number of active routes, zero volts will be sent to the the unused outputs however the "Inactive Route Passthrough" context menu option can be used to allow voltages at the "unrouted" inputs to be passed through to the equivalent outputs.

CHANCES

A single voltage-controlled Bernoulli gate that randomly sends gate a gate signal to either one of the two outputs.

The Chance control determines the probability of the given output being selected on each gate transition. With the Chance control fully CCW, the A output is favoured 100% of the time and with the control fully CW the B output is favoured 100% of the time.

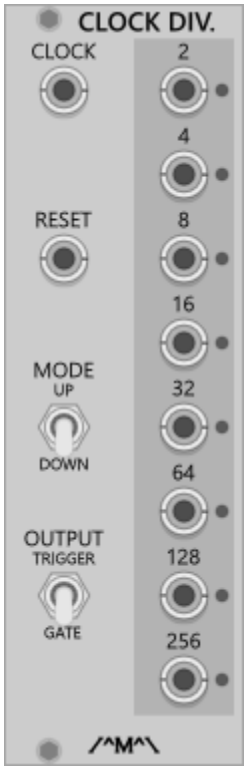
The chance input value is added to the Chance control value with 0V favouring the A output 100% and 10V favouring the B output 100% when the Chance control is set fully CCW.

There are two operational modes:

- Latched (Switch in the up position): The A/B output is selected based on the outcome of the “coin toss” and the selected output latches on until that outcome changes. i.e. either the A or B output will always be high regardless of the current state of the gate input.
- Normal (Switch in the centre position): The A/B output is selected based on the outcome of the “coin toss” and the selected output follows the input gate length.
- Toggle (Switch in the down position): The selection toggles between A and B only if the outcome of the “coin toss” is different to that of the last toss. The selected output follows the input gate length

A polyphonic version “Poly Chances” is also available.

CLOCK DIVIDER



A clock/pulse divider with simultaneous outputs for division by 2, 4, 8, 16, 32, 64, 128, and 256. The divider is essentially a binary counter with the division outputs reflecting the status of each bit.

A pulse presented to the Reset input will cause the divider to reset to a zero state where all outputs are low (zero volts).

The Mode switch determines how the divider behaves after reset and in what order the outputs go high/low. Assuming the gate output mode is selected then the mode functions as follows:

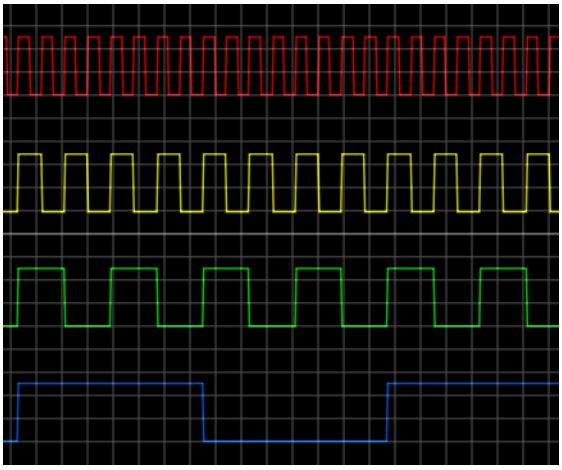
- UP: All outputs go low on reset and the divide by two output will go high (10 volts) on the first clock pulse after the reset. The other outputs follow a binary count in the upward direction up on each subsequent clock pulse until all outputs are high after which they will wrap around to all low and start again.
- DOWN: the outputs will all go high on the first clock pulse after the reset and the outputs will follow a binary count in the downward direction until all outputs are low after which they will wrap around to all high again.

Where the trigger output mode is selected, the reset and count behaviour are the same as described above however the outputs will be converted to triggers that will only fire when the associated bit transitions from low to high.

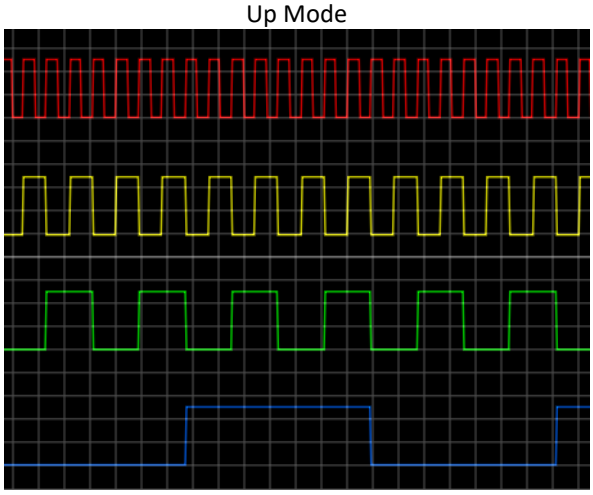
Whilst this divider can be clocked by audio oscillators, doing so is highly likely to introduce aliasing artefacts.

The two scope captures below show the difference between the count up/down modes. The red trace is the clock, yellow is divide by 2, green is by 4, and blue by 16. In both cases, reset has been triggered just before the rising edge of the first clock pulse.

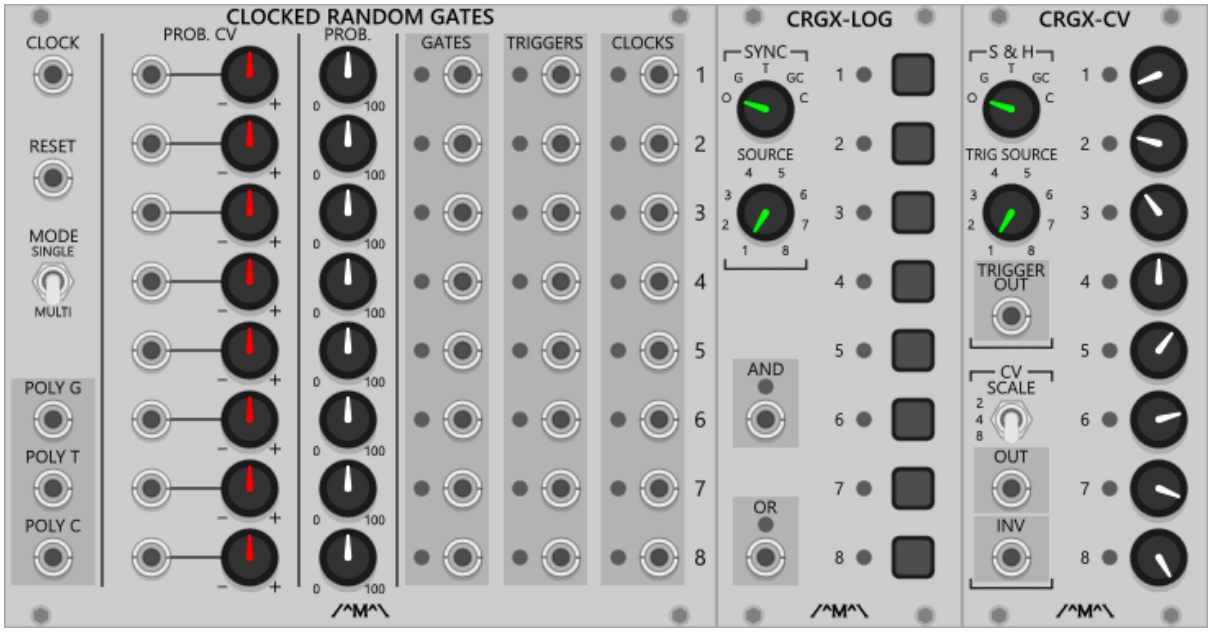
Down Mode



Up Mode



CLOCKED RANDOM GATES



Generates a set of 8 random gate, trigger and gated clock signals quantised to the incoming clock.

There are two modes of operation Single mode and Multi mode.

- Multi-mode: Functions like a set of 8 single sided Bernoulli gates (i.e. having only an "A" output) and all connected to the same source. This generates a set of 8 individual random gates, triggers and gated clocks timed to the clock input. The Probability and Probability CV determine the likelihood of the gate being set on any given clock pulse.
- Single mode: Selects one of the 8 gates at random and outputs a trigger and a gated clock to the associated trigger and clock outputs. This is essentially an 8 way Bernoulli gate. In this mode, the Probability and Probability CV set the likelihood that a particular gate will be set relative to the other gates. In this mode, only channel 1 is used if a polyphonic clock is supplied.

A polyphonic clock (up to 8 channels) can be applied to the clock input in Multi mode and the module will behave like 8 individual single sided Bernoulli gates, randomly passing the gate signal based on the chosen probability.

Note the trigger outputs only fire when the associated gate transitions from low to high.

Also note that the clock outputs pass the incoming clock only when the associated gate output is high (Gated Clock function).

CRGX-CV: CV EXPANDER.

This expander must be placed immediately to the right of the Clocked Random Gate module (or another connected expander) and generates CV values based on the state of the 8 Gate outputs. The scale can be set to 2, 4, or 8 Volts and the scale value represents the maximum voltage that is output if all 8 gate outputs are high.

The S & H section controls when the CV output changes and can be used to synchronise the CV outputs to a particular gate, trigger, gated clock or clock. The lower rotary switch selects the row or channel of the sample & hold trigger whilst the upper rotary switch selects the source type as outlined below:

- O: Off – The CV outputs change when any of the output gates change.
- G: Gate – The CV outputs change based on the state of the gate outputs at the positive transition of the Gate output of the selected row/channel.
- T: Trigger – The CV outputs are refreshed based on the state of the gate outputs at the positive transition of the Trigger output of the selected row/channel.
- GC: Gated Clock – The CV outputs are refreshed based on the state of the gate outputs at the positive transition of the Clock output of the selected row/channel.
- C: Clock – The CV outputs are refreshed based on the state of the gate outputs at the positive transition of the Clock input. Where the clock input polyphonic, the clock of the selected channel is used.

The selected S & H trigger source is sent to the Trigger Out. No signal is sent to this output if the S & H function is Off.

CRGX-LOG: LOGIC EXPANDER.

This expander adds logic processing of the gate outputs to the Clocked Random Gate module. The state of the gate outputs is compared to the state of the user selected buttons to generate the logical AND/OR outputs. The AND output is set high if the Gate outputs matching the “On” buttons are all high. The OR output is set high if any of the Gate outputs matching the “On” buttons are high.

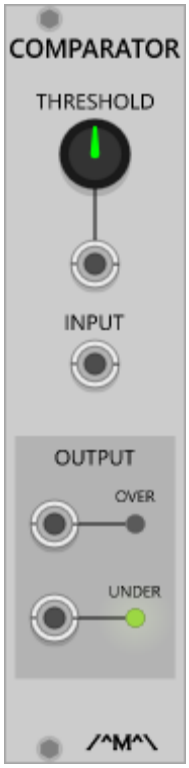
The Sync section can be used to synchronise (or quantise in DAW parlance) the logical evaluation to a particular gate, trigger, gated clock or clock. The lower rotary switch selects the row or channel of logical evaluation trigger whilst the upper rotary switch selects the source type as outlined below:

- O: Off – The logical evaluation occurs whenever the output gates change.
- G: Gate – The logical evaluation occurs at the positive transition of the Gate output of the selected row/channel.
- T: Trigger – The logical evaluation occurs at the positive transition of the Trigger output of the selected row/channel.
- GC: Gated Clock – logical evaluation occurs at the positive transition of the Clock output of the selected row/channel.
- C: Clock – logical evaluation occurs at the positive transition of the Clock input. Where the clock input polyphonic, the clock of the selected channel is used.

OTHER EXPANDERS AND MODULES

Note that the Sequencer Expanders and Gated Comparator expanders will not work with this module. Similarly, the Clocked Random Gate expanders will not work with any other modules. Refer to the appendix for a full list of expander module compatibilities.

COMPARATOR



Compares the input signal with either an internal or external threshold value and outputs gate signals indicating if it is under or over that threshold.

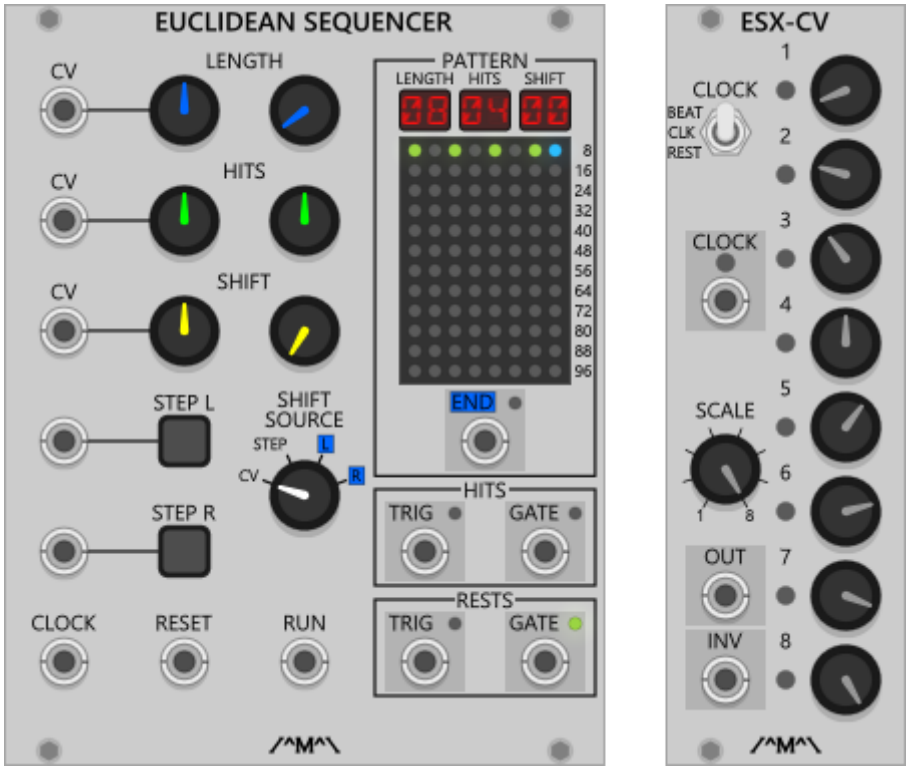
D FLIP FLOP (SINGLE)

A single D type flip flop with optional clock-enable.

The D type flip flop operates like a sample & hold for gate signals. When enabled, the logical state of the D input is propagated to the Q output whenever the rising edge of a clock or gate signal at Clock input occurs. The NOT Q output is always set to the logical inverse of the Q output.

With nothing plugged into the Enable input, the flip flop is permanently enabled however with a cable plugged in, a high gate signal must be present to allow the flip flop to be clocked.

EUCLIDEAN SEQUENCER + EXPANDER



The Euclidean Sequencer is a 96 step Euclidean Algorithm based sequencer with voltage control over the length, number of hits and rotational position/offset (shift). Patterns are generated by attempting to evenly spread the selected number hits out over the selected length. More information on Euclidean rhythms can be found in the paper “The Euclidean Algorithm Generates Traditional Musical Rhythms” published by Godfried Toussain which can found here: http://cgm.cs.mcgill.ca/~godfried/publications/banff.pdf

Pattern Display:

The pattern display shows the current parameter settings on the at the top along with a visual representation of the corresponding pattern in the LED matrix below that. Each LED in the matrix corresponds to a step in the sequence with each hit showing as green and each rest being unlit. The last step is indicated in blue and will be a much lighter blue if it coincides with a hit. The current step is shown in red if there is no hit on the given step or yellow if there is a hit at that step. The exception to this is the last step which will light up white or off-white depending on whether there is a hit at that position or not.

Controls:

Each parameter has two knobs, one for CV amount and one for manually setting the associated parameter. The CV amount knobs are attenuverters and the resulting CV amount is summed with the value of the manual control.

The Length knob sets the overall number of steps in the sequence, the Hits knob sets the number of hits in the sequence and the Shift knob sets the offset or rotation of the sequence (depending on the setting of the Shift Source switch). Note that the Hits and the Shift parameters are set as percentages of the length rather than actual numbers of steps. The Step buttons shift the pattern left or right depending on the setting of the Shift Source switch.

Shift Source:

The shift source switch determines what causes the current pattern to shift or rotate:

- CV: The rotational position is directly controlled by the Shift knob and the CV input.
- STEP: The rotational position is manually shifted left or right by each press of Step L and Step R buttons.
- L/R: The rotational position is automatically shifted left or right at the end of each sequence cycle. If the sequence length is 8 then the sequence will shift by 1 position every 8 clock cycles.

Outputs:

The Step gate and trigger outputs operate when the current active step is a hit, whilst the Rest outputs operate when the current active step is not a hit. Gates stay high for the duration of the step and the triggers follow the pulse width of the clock input.

The End output is a trigger output that fires after the last step of the sequence has completed.

ESX-CV EXPANDER

The Euclidean Sequencer CV expander adds CV generation based on the state of the Euclidean Sequencer. It must be placed immediately to the right of a Count Modula Euclidean Sequence module and will not function with any other sequencers.

The Clock switch determines how the steps on the expander are advanced which can be:

- BEAT: The sequence is advanced every time a hit occurs on the parent sequencer
- CLK: The sequence is advanced on every clock received by the parent sequencer
- REST: The sequence is advanced every time a rest occurs on the parent sequencer.

The Clock output follows the state of the selected clocking source

The Scale switch determines the range of voltages that are output by the expander CV outputs from 1 to 8 volts.

This expander will not function with any other sequencers.

OTHER EXPANDERS

This module is not compatible with any other sequencer expander modules. Refer to the appendix for a full list of expander module compatibilities.

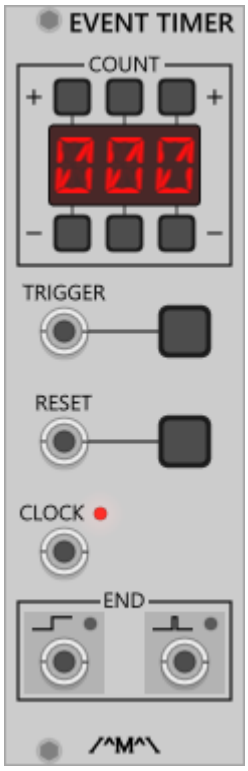
EVENT ARRANGER

This is a VCV Rack implementation of the VC Clock and Event Arranger published in an article by John Blacet in the Jan/Feb edition of Synapse magazine. Without the VC clock but with an added twist.

Each switch corresponds to a bit in a binary counter and can be "mixed" into the output depending on the switch position. In position 1, the bit will be logically ANDed with any other "active" bit when it is high. In position 0, the bit will be inverted and logically ANDed with any other "active" bit i.e when it is low. In the centre or "X" position, the bit is considered to be "inactive" and is ignored. Depending on how the switches are set, this module can be used as a simple clock divider or a complex gate pattern generator.

Due to the large division ratios that can occur with this module, it is best driven by a very fast clock signal.

EVENT TIMER



A triggered count down timer that outputs a trigger and gate at the end of the count.

The plus/minus buttons above and below the display set the count value in 100's, 10's and 1's. The counter counts down from this value to zero. Note that these buttons are functional whilst the timer is running however in this case, they can be difficult to use when clocking at faster speeds.

The Trigger button/input start the timer.

The Reset button/input set the counter back to its starting (or edited value if changed whilst running) and arms it for triggering again. Restart can be achieved by connecting the reset signal to both the Trigger and Reset inputs. Once the timer has started it cannot be stopped. Once the timer has hit 0 it cannot be retriggered until reset.

The Trigger and Reset buttons work in parallel with their respective inputs (i.e. the inputs do not disable the buttons).

When the timer reaches zero, the Gate output goes high (10 volts) and stays high until reset whilst the trigger output fires only briefly at the same time.

By plugging the Trigger or Gate output into the Trigger input and manually triggering the count, the timer will count down and restart automatically making it a rudimentary clock divider.

The Clock input can accept most signal types so can be used to trigger events after a given number of gates or LFO cycles as well as clock cycles. With no clock connected, the timer counts down in 1 second intervals.

FADE + FADE EXPANDER

A controller intended for use with recording modules to provide automated fade in and out in the recording. This is essentially a VCA controlled by an inbuilt ASR Envelope generator. Connect the signals to be recorded into the L/Mon and Right inputs and connect the L/Mon and Right outputs to the appropriate inputs on the recording module. Click on the Start/Stop button to initiate the fade-in (Start) and click again to initiate the fade out (Stop). The two knobs control the fade-in and fade-out times (0.1 to 10 seconds). The Gate and Trigger outputs can be used to control the recording process. The Gate output goes high at the start of the fade-in/fade-out envelope and low at the end. A trigger pulse is presented to the Trig output at both the start and end of the fade-in/fade-out envelope.

The Monitor button passes the input signals through to the outputs to allow recording levels to be set without sending the start/stop/run signals. The Start/Stop and Monitor buttons cannot be operated at the same time.

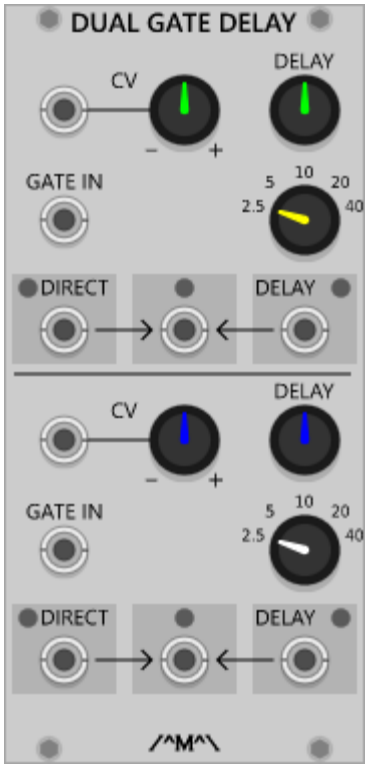
Note that once started, the fade-in/fade-out cycle will always complete regardless of how long the button is left in the on position. i.e. Stopping the process during the fade-in stage will still result in both the fade-in and fade-out completing. If the start button is clicked during fade-out stage and is still in the on position at the end of the stage, the cycle will recommence at the fade-in stage with the gate output remaining high and no trigger being sent until the end of the new cycle.

The expander module, when placed to the immediate right-hand side of the Fade module adds the following outputs:

- Envelope: breaks out the internal envelope signal for use in external processing.
- Inverted: an inverted version of the internal envelope signal.
- Run and Start/Stop: these output a gate and start/stop triggers that follow the state of the Fade button allowing it to synchronise the starting sequencers at the beginning of recording and stop them before the fade out starts so that an attached recording module can capture decaying sounds such as reverb tails etc.
- Fading In and Fading Out: these output high gate signals during the respective fade-in and fade-out stages.

This module can process polyphonic signals.

GATE DELAY



A dual gate delay line giving up to 40 seconds of delay with voltage control over the delay time. Note that switching from a shorter delay time range to a longer one may introduce time travel artefacts were a gate that has already been output may be output again at the end of the new longer delay time depending on where it is in the pipeline. This is due to the way the delay line functions and is normal behaviour. Three gate outputs are available with the Direct output following the gate input, the Delay output providing only the delayed gates middle output providing a logical mix of the two.

GATE MODIFIER

A voltage-controlled gate length modifier with the following selectable ranges:

- Short: up to approx. 1 second
- Medium: up to approx. 10 seconds
- Long: up to 1 approx. 20 seconds

The CV input allows modulation of the gate length by approximately 1, 10 or 20 seconds depending on the selected range.

The Retrigger/On-shot switch selects how the gate length modification is applied:

- Retrigger: sets Output high for the duration of input gate plus the selected length.
- One-shot: sets Output high only for the selected length regardless of the input gate length.

To shorten a gate signal, select One-shot and a length that is shorter than the input gate signal.

A trigger pulse is sent to the End output at the end of the extended or shortened gate cycle.

G2T GATE CONVERTER

Converts any signal into gate and trigger signals.

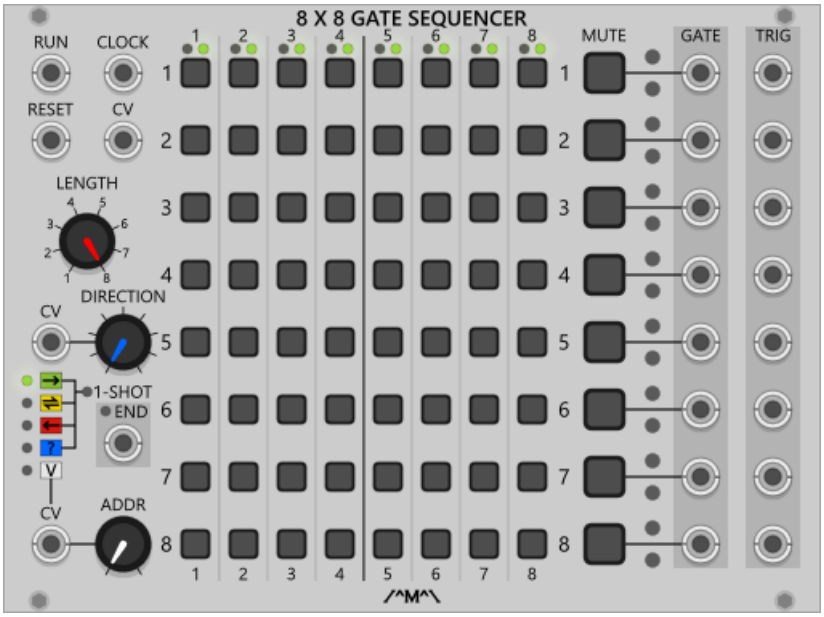
The gate output will be at 0V unless the voltage presented at the input is greater than 2.0V in which case the Gate output will be high (10V).

The Inv Gate output functions the other way around, 10V unless the input voltage is over 2.0V in which case the output will be 0V.

The Start trigger output will fire a 10ms pulse at the start or leading edge (i.e. on the transition from low to high) of the generated gate and the End trigger output will fire a 10ms pulse at the end or trailing edge (i.e. on the transition from high to low) of the generated gate.

The Start/End output is a logical OR of the Start and End trigger outputs giving a trigger pulse on both transitions of the generated gate signal.

8 X 8 GATE SEQUENCER



An 8-channel x 8 step gate sequencer with voltage control over sequence length and direction. This sequencer differs from the 8 Step Trigger Sequencer in that all channels are commonly clocked and addressed rather than individually.

The Reset input restarts the sequence at step one on the next clock cycle (when not in Random or Voltage Addressed mode).

The Run input allows the sequencer to be started and stopped by the application of a gate signal with a low gate inhibiting the sequencer and a high gate enabling it. This functions like a pause button and operation resumes at the next clock cycle.

With a cable plugged into CV input, the Length switch is disabled, and control of the sequence length is determined only by the applied voltage. Full sequence length is achieved with a 10V input.

The current sequence length is indicated by the small green lights situated below the step numbers at the top of the panel.

Nine directional modes are available via the Direction knob or control voltage applied to the Direction input:

1. Forward: The sequence travels from left to right and restarts at the left.
2. Pendulum: The sequence travels from left to right then back again before starting over.
3. Reverse: The sequence travels from right to left then starts again at the right.
4. Random: The steps are selected randomly with no set pattern or order.
5. Forward 1-Shot: The sequence travels from left to right and stops at the end of the last step. In this mode the red 1-shot light will be on.
6. Pendulum 1-Shot: The sequence travels from left to right then back again and stops at the end of the last (first) step. In this mode the red 1-shot light will be on.
7. Reverse 1-Shot: The sequence travels from right to left and stops at the end of the last (first) step. In this mode the red 1-shot light will be on.

8. Random 1-Shot: The steps are selected randomly with no set pattern or order and the sequencer runs until the last step is selected, stopping at the end of that step. In this mode the red 1-shot light will be on.
9. Voltage Addressed: The active steps are selected by the Addr knob and associated CV input.

In the 1-Shot modes, the sequencer will run for 1 cycle only then stop. At the end of the last step, the End light will turn on and the End gate output will go high.

In the Voltage Addressed directional mode, the value of the Addr knob is used to determine which step is active and this is sampled at the start of each clock pulse. If a cable is connected to the Address CV input, then the Addr knob becomes an attenuator. The addressing voltage is scaled such that 10 volts always equals the last step regardless of the sequence length. 1-Shot mode is not available for this mode.

With a cable plugged into the direction CV input, the direction switch is disabled, and control of the direction is determined only by the applied voltage which responds as follows:

Input Voltage	Direction
< 1.000	Forward
1.000 to 1.999	Pendulum
2.000 to 2.999	Reverse
3.000 to 3.999	Random
4.000 to 4.999	Forward 1-Shot
5.000 to 5.999	Pendulum 1-Shot
6.000 to 6.999	Reverse 1-Shot
7.000 to 7.999	Random 1-Shot
8.000 +	Voltage Addressed

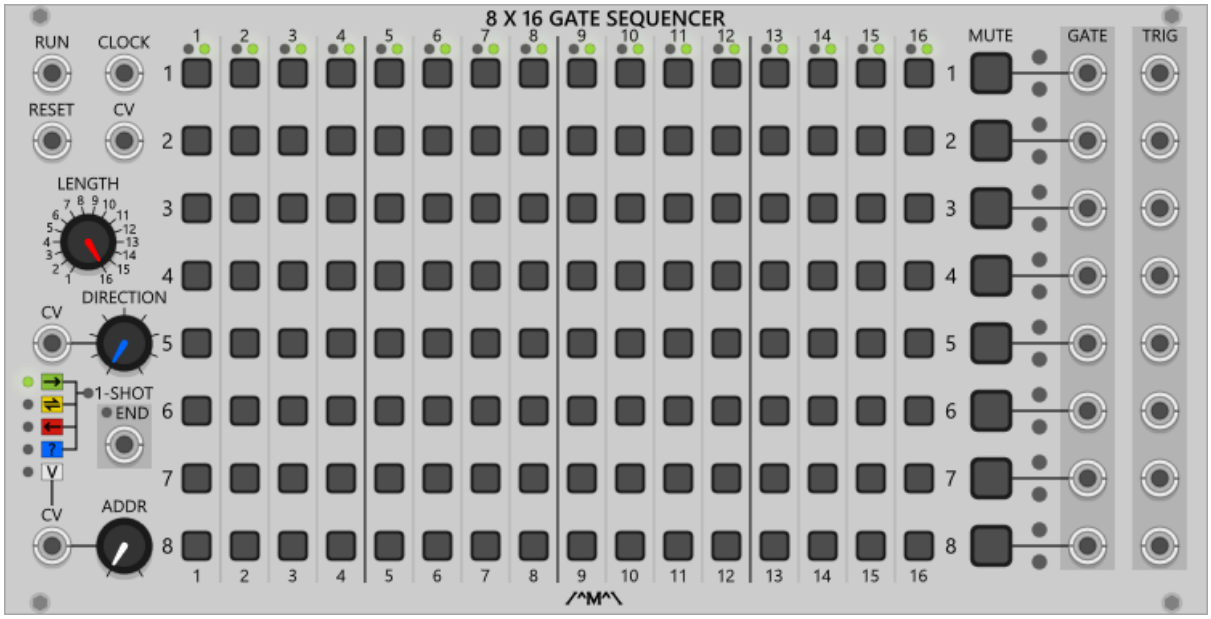
The step buttons determine whether that step is on or off and the gate and trigger outputs on each channel operate concurrently. The trigger outputs follow the pulse width of the clock signal and the gate outputs stay high for the duration of any selected step. Setting the buttons on for two consecutive steps results in a single gate signal for the duration of both steps.

The following context menu options are available to facilitate initialization and randomization of each channel independently:

- *Channel x → Initialize*: Reset the step selection buttons for the channel to their default values.
- *Channel x → Randomize*: Randomize the step buttons for the selected channel.
- *Channel x → On the One*: Sets the step buttons 1 and 5 for the selected channel to on.
- *Channel x → On the Two*: Sets the step buttons 2 and 6 for the selected channel to on.
- *Channel x → On the Three*: Sets the step buttons 3 and 7 for the selected channel to on.
- *Channel x → On the Four*: Sets the step buttons 4 and 5 for the selected channel to on.
- *Channel x → Odds*: Sets the all the odd step buttons for the selected channel to on.
- *Channel x → Evens*: Sets all the even step buttons for the selected channel to on.
- *Channel x → The Lot*: Sets all the step buttons for the selected channel to on.

This module is not compatible with any of the sequencer expanders. Refer to the appendix for a full list of sequencer expander compatibilities.

8 X 16 GATE SEQUENCER



An 8-channel x 16 step gate sequencer with voltage control over sequence length and direction. This sequencer differs from the 16 Step Trigger Sequencer in that all channels are commonly clocked and addressed rather than individually.

The Reset input restarts the sequence at step one on the next clock cycle (when not in Random or Voltage Addressed mode).

The Run input allows the sequencer to be started and stopped by the application of a gate signal with a low gate inhibiting the sequencer and a high gate enabling it. This functions like a pause button and operation resumes at the next clock cycle.

With a cable plugged into CV input, the Length switch is disabled, and control of the sequence length is determined only by the applied voltage. Full sequence length is achieved with a 10V input.

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1. Forward: The sequence travels from left to right and restarts at the left.
2. Pendulum: The sequence travels from left to right then back again before starting over.
3. Reverse: The sequence travels from right to left then starts again at the right.
4. Random: The steps are selected randomly with no set pattern or order.
5. Forward 1-Shot: The sequence travels from left to right and stops at the end of the last step. In this mode the red 1-shot light will be on.
6. Pendulum 1-Shot: The sequence travels from left to right then back again and stops at the end of the last (first) step. In this mode the red 1-shot light will be on.
7. Reverse 1-Shot: The sequence travels from right to left and stops at the end of the last (first) step. In this mode the red 1-shot light will be on.

8. Random 1-Shot: The steps are selected randomly with no set pattern or order and the sequencer runs until the last step is selected, stopping at the end of that step. In this mode the red 1-shot light will be on.
9. Voltage Addressed: The active steps are selected by the Addr knob and associated CV input.

In the 1-Shot modes, the sequencer will run for 1 cycle only then stop. At the end of the last step, the End light will turn on and the End gate output will go high.

In the Voltage Addressed directional mode, the value of the Addr knob is used to determine which step is active and this is sampled at the start of each clock pulse. If a cable is connected to the Address CV input, then the Addr knob becomes an attenuator. The addressing voltage is scaled such that 10 volts always equals the last step regardless of the sequence length. 1-Shot mode is not available for this mode.

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Input Voltage	Direction
< 1.000	Forward
1.000 to 1.999	Pendulum
2.000 to 2.999	Reverse
3.000 to 3.999	Random
4.000 to 4.999	Forward 1-Shot
5.000 to 5.999	Pendulum 1-Shot
6.000 to 6.999	Reverse 1-Shot
7.000 to 7.999	Random 1-Shot
8.000 +	Voltage Addressed

The step buttons determine whether that step is on or off and the gate and trigger outputs on each channel operate concurrently. The trigger outputs follow the pulse width of the clock signal and the gate outputs stay high for the duration of any selected step. Setting the buttons on for two consecutive steps results in a single gate signal for the duration of both steps.

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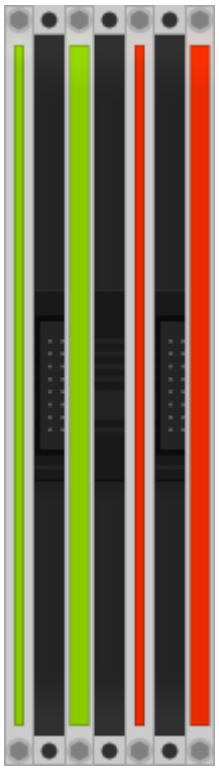
- *Channel x → On the Three*: Sets the step buttons 3 and 7 for the selected channel to on.
- *Channel x → On the Four*: Sets the step buttons 4 and 5 for the selected channel to on.
- *Channel x → Odds*: Sets the all the odd step buttons for the selected channel to on.
- *Channel x → Evens*: Sets all the even step buttons for the selected channel to on.
- *Channel x → The Lot*: Sets all the step buttons for the selected channel to on.

This module is not compatible with any of the sequencer expanders. Refer to the appendix for a full list of sequencer expander compatibilities.

LIGHT STRIP



An LED strip for decoration or patch block separation.

Standard LED colours can be selected from the Preset context menu whilst custom colours can be set using the Select Colour option within the Strip Colour context menu item. Move the sliders to adjust the colour. The colour is applied as the sliders are moved and is saved when you click off the menu. Whilst the menu is open, the colour can be returned to the starting colour by clicking on Revert Changes.

The current colour can be set as the default colour for all new instances of the Light Strip via the Save As Default option within the Strip Colour context menu item. A Light Strip can be set to the current default by using the Revert To Default option in the same menu.

The strip can be set to narrow or wide via the Strip Size context menu item and a default size can also be set.

MANGLER

A voltage-controlled sample rate and bit depth reducer or "bit crusher" designed to make a lo-fi mess of your audio or CV signals.

Three operational modes allow for different lo-fi effects to be achieved:

- Slice: Slices the input signal at the selected sample rate.
- Crush: Crushes the bit depth down to the selected the number of steps.
- Blend: Combines the Slice and Crush modes for maximum mangling effect.

Note - it is possible to have no output with low Crush settings and low-level input signals. The input level control will amplify the input signal past about 2:00 up to a maximum of 150%.

The Range switch determines how control and audio voltages are handled:

- 0-10V: For processing unipolar control signals in the range of 0-10V signals like envelopes or unipolar LFOs.
- +/-5V: For processing bipolar signals within the -5V to +5V range such as VCOs.

Signals outside the selected range will be clamped to that range so oscillators processed via the 1-10V setting for example, will be half wave rectified and control signals processed using the +/-5V setting will be truncated at +5V.

This module can process polyphonic signals with each channel being mangled at the same sample rate and bit depth.

MANUAL CV

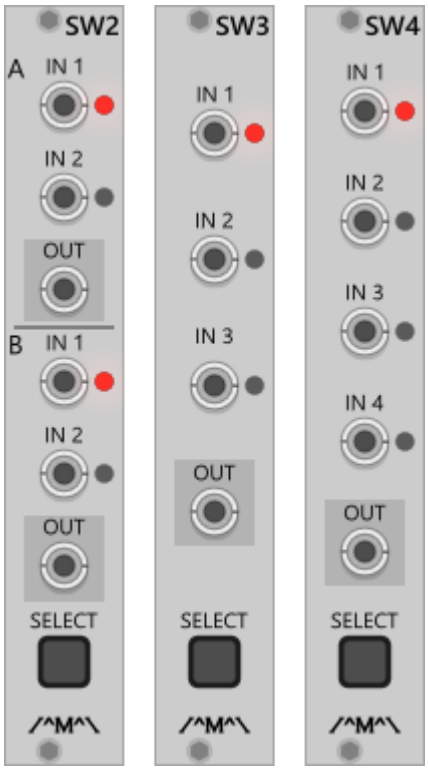
A simple dual manual CV generator offering +/- 10V with both coarse and fine controls.

MANUAL GATE

A manually triggered gate generator offering a number of simultaneous gate and inverted gate outputs.

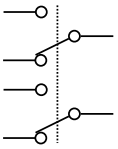
- Gate/Inv Gate: Outputs a high (or low in the case of the inverted output) gate level as long as the button is held down.
- On/Off: Latched outputs that alternate between high and low with each press of the button.
- Extended Gate: Functions like the Gate output but with a variable gate length
- Trigger: Outputs a trigger signal of 10ms duration each time the button is pressed.

MANUAL SWITCHES



Manually operated “select” switches. The Select button sequentially connects each input to the output in turn with each successive press.

The Manual DPDT or Double Pole Double Throw Switch (SW2) is capable of simultaneously selecting between 2 sets of 2 inputs as shown below:

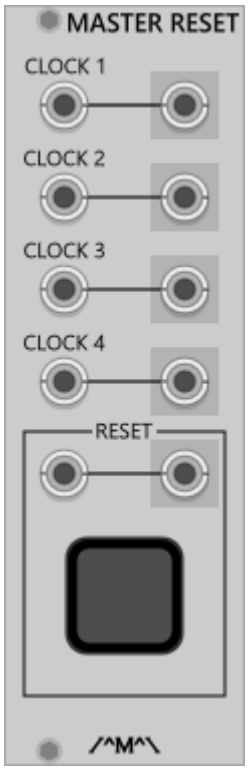


The Manual 3 Input Switch (SW3) allows selection of one of three signal sources.

The Manual 4 Input Switch (SW4) allows selection of one of four signal sources.

These switches were designed with fixed architecture, or performance patches in mind. An example for their use would be for selection of VCO waveforms prior to a filter.

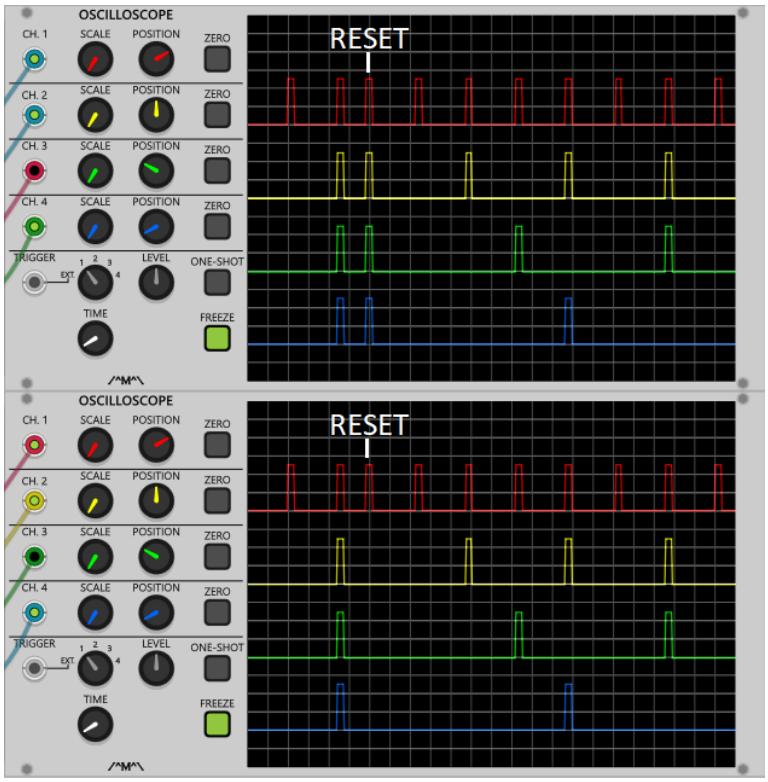
MASTER RESET



Master reset button and clock wrangler.

One thing that many people seem to find is that sequencers do not always seem to restart correctly when a reset is triggered. This is most evident where multiple sequencers are driven by different divided/multiplied clocks where the phase of the clock signals at the time the reset is performed can be different. When the reset is performed, if the clock output is high at the time, the clock phase restarts but the output stays high, therefore no rising edge occurs. Given that most sequencers are edge driven this means that any sequencer connected will not advance until the next leading edge of the clock cycle occurs which puts that sequencer 1 or more clock cycles out. Where clock/divided clock outputs are low and a reset is performed, the receiving modules behave correctly as the leading edges of the clocks are generated as expected.

The Master Reset module processes clock signals and forces a low level at the outputs for 100us when the reset button is clicked (or a gate signal is received at the reset input) to ensure a leading edge will occur on all clocks being processed. In turn, this ensures that any edge triggered sequencers being driven by them advance correctly after the reset. This does introduce a 100uS delay to the first clock after the reset however this should not be noticeable. This module will have no effect on clocks that reset to a low state rather than a high state.



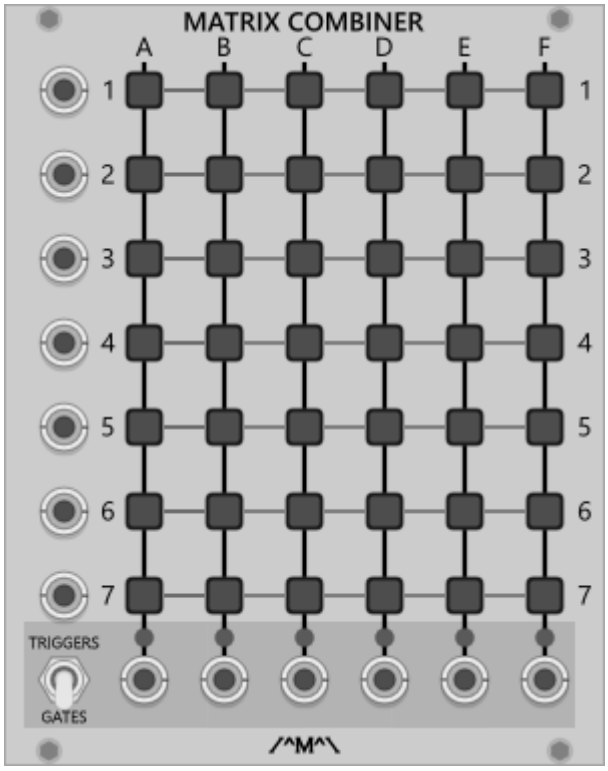
The scope image to the left shows the outputs of 4 divided clock outputs from a single clock module that were converted to trigger signals.

The upper scope shows the results of processing the clocks through the Master Reset module first whilst the lower scope shows the results of running the clock signals directly into the trigger converters.

At the time the reset occurred, the clock driving the red trace was low and all others were high.

It can be seen in the upper scope (the processed clocks) , that all four triggers fired correctly straight after the reset however in the lower scope (the unprocessed clocks) only one of the four triggers fired.

MATRIX COMBINER



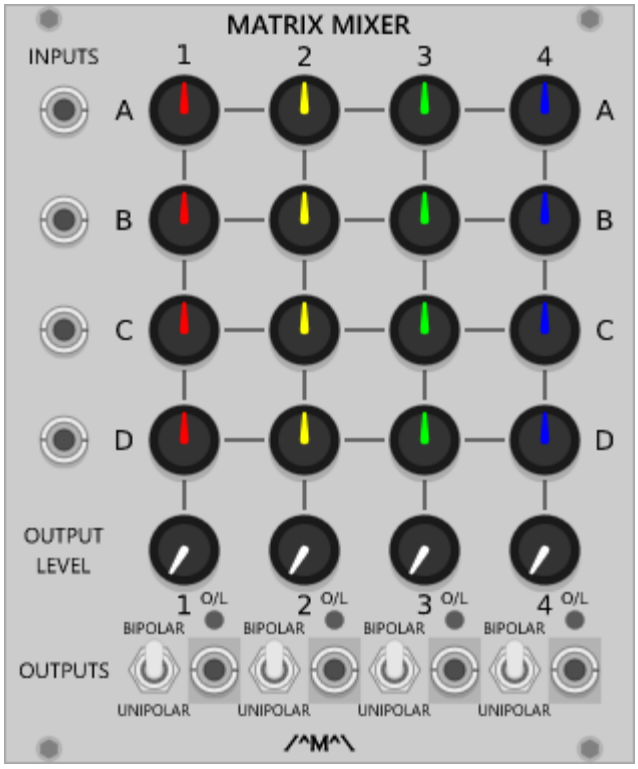
A push button matrix that allows up to 7 gate/trigger signals to be independently “OR” combined and routed to any of 6 output destinations.

Each row is essentially a switched multiple and each column is a 7 input OR gate. The buttons determine if the applied signal on the given row is to be included in the “OR” operation for the given column.

The Triggers/Gates switch determines if the outputs of each column are converted to triggers at each leading edge of the combined gate signals (Triggers position) or if they just follow the results of the combined gates (Gates position).

Note that this is not a switch or a mixer. Any signals presented at the inputs will be internally converted to gates before being combined with voltages over 2 Volts being considered a “high” gate.

MATRIX MIXER



A 4 x 4 matrix mixer allowing up to 4 input signals to be independently mixed to 4 different outputs.

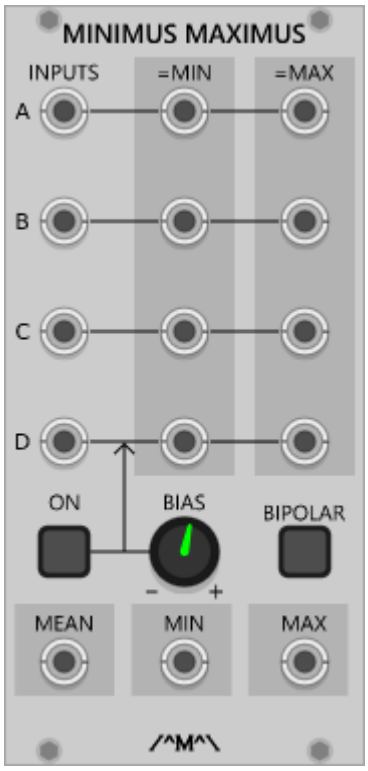
Inputs down the left-hand side can be mixed to the outputs at the bottom via the columns of knobs.

A main level control is provided for each output along with an overload indicator.

The knobs on each output channel can be set to attenuate or attenuvert using the associated Unipolar/Bipolar switch next to the output jack.

The first input channel (top row) acts as a CV source if no cable is plugged into the jack.

MINIMUS MAXIMUS



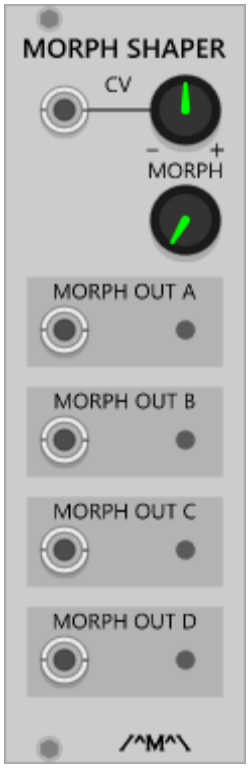
A signal processor that determines and outputs the minimum, maximum and mean (average) of up to 4 input signals along with gate signals (switchable between unipolar and bipolar values via the Bipolar button)) for each input channel indicating that the associated input is equal to either the minimum or maximum value.

The Bias controls allow the 4th channel to be set manually. When engaged, the 4th Channel input is ignored and the value of the Bias knob is used instead.

MIXER

A basic 4 input utility mixer with output level control, overload indicator, inverted output and selectable bipolar/unipolar operation. The first input channel acts as a CV source if no cable is plugged into the jack.

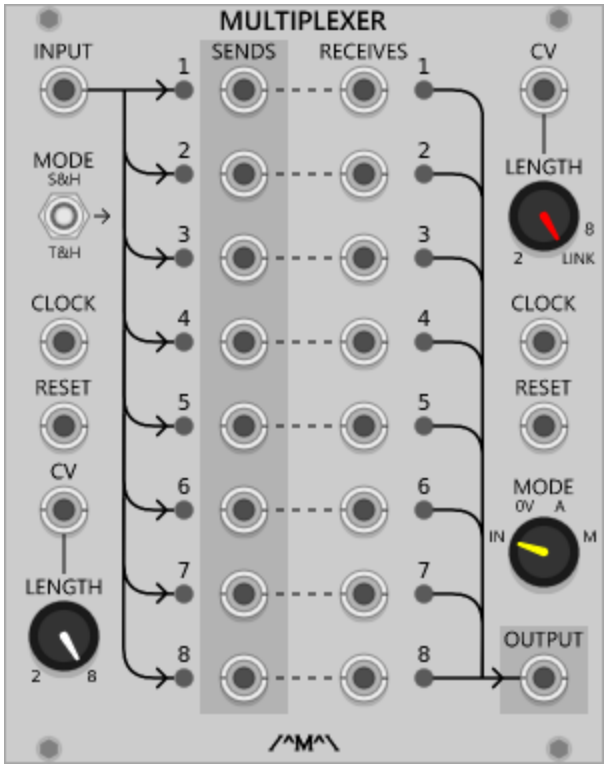
MORPH SHAPER



With kind permission from Dieter Doepfer, this is a VCV Rack version of the A-144 Morphing Controller.

This module takes a ramped (typically) CV input signal and produces a set of 4 overlapping triangles depending on the position of the signal. These overlapping triangle signals can be used to control the levels of a VC mixer allowing it to morph between up to 4 different signals. The module is sensitive to input signal levels so the input level attenuverter control is capable of applying some amplification (up to 2 x positive or negative) to achieve the full morphing range on smaller signals. The manual control when used in conjunction with the CV input, acts as an offset to the CV input i.e. the CV input value is added (or subtracted from depending on the attenuverter setting and CV input polarity) to the manual value before being processed. Note that the input is not limited to ramp signals and by inputting other signal types, interesting wave shaping effects can be achieved.

MULTIPLEXER



The multiplexer operates in two independent but interconnected parts:

- A 1 input to 8 output router (sends)
- An 8 input (receives) to 1 output selector

The number of steps in each half is user selectable and voltage controllable with the selector section able to be linked to use the length of the router section.

The Clock input advances the router/selector to the next step on with each pulse received. The router Clock input is normalled to the selector Clock input.

The Reset input sets all outputs to 0V and sets the router/selector such that the first step will occur on the next clock pulse after the reset input goes low. The selector Reset input is normalled to the send router input. Operation is inhibited whilst the reset input is high.

The router side has three operational modes:

- S&H: Sample & Hold - the input is sampled on the rising edge of the clock and sent to the current output which is held at that value until the next time is selected.
- →: Through - the input is directly sent to the selected output for the duration of the step then the output returns to 0V.
- T&H: Track & Hold - operates the same way as the through mode but the output is held at the value of the input at the end of the step.

The selector has four modes of operation which control the normalling behaviour of any unconnected inputs:

- IN: Router Input - The output will follow the raw input (i.e. the router mode is ignored) of the router section for the duration of the step.
- 0V: 0V Mode - 0V will be output for the duration of the step
- A: Associated Output - The value of the associated router step output is used (i.e. if the selector is at step 7 then the value of router output 7 is used regardless of the length and current step of the router)
- M: Multiplex - The value of the currently selected router output is used, taking the router mode into consideration.

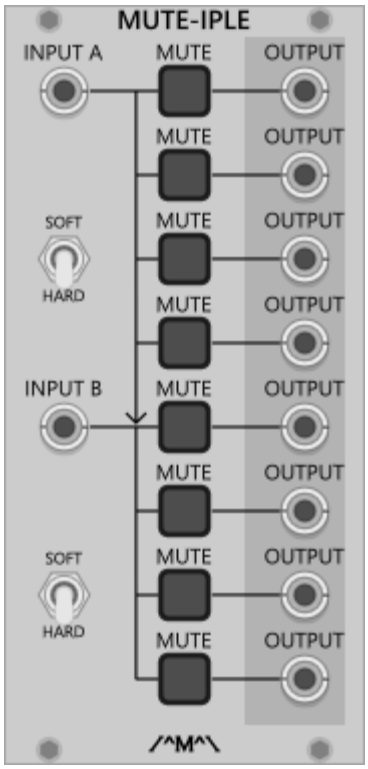
MUTE

A performance mute controller with two independent inputs and outputs, voltage control over the mute function and switchable response (hard/soft) for instant processing of control signals or fast but pop free muting of audio signals.

With no cable plugged into the Mute In, The Mute button mutes and un-mutes the outputs with each press. Plugging a cable into the Mute IN disables the button and the muting is controlled by the presence of a high gate signal.

This module can process polyphonic signals. All channels are muted at the same time.

MUTE-IPLE

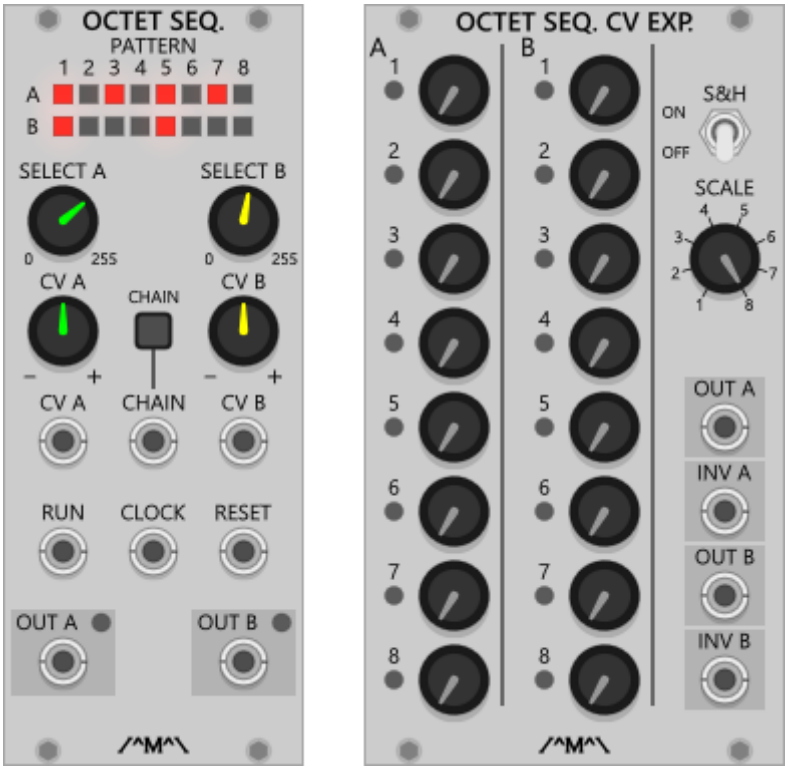


A dual 4-way/ Single 8 way mutable multiple. The top input is normalled to the bottom input creating a 1 to 8 mutable multiple.

New feature in v1.0.2: Soft/hard muting option. Use the soft muting option to avoid clicks when muting audio signals.

This module can process polyphonic signals. All channels presented to the inputs are multed to the associated outputs and all channels on any given output are muted at the same time.

OCTET TRIGGER SEQUENCER + EXPANDER



A two-channel trigger sequencer based on the principal that every 8-step pattern can be represented by an 8-bit binary number or “octet” and hence, any integer number between 0 and 255 inclusive.

Each channel features a pattern select knob, CV for pattern selection and an attenuverter for the CV input. The two channels share clock, run, and reset inputs and are locked in step with each other. The lights at the top show the currently selected patterns and pattern changes are only presented to the outputs on the next rising clock edge to ensure there are no false triggers created hen scrolling through the patterns.

The two channels can be chained to make a 16-step pattern by using the Chain button or by applying a gate signal to the Chain Input. When running in “chained” mode, the channel A output plays pattern A followed by pattern B. In this mode, the function of the channel B output can be set via the Channel B Chained Pattern Mode context menu option to have:

- no output,
- follow the triggers being output by channel A or,
- output triggers for the “off” beats (inverse of channel A output).

The outputs can be individually configured to output triggers, gates, or clock width pulses via the Output Mode context menu.

The scale for CV selection of patterns can be set to allow finer control via the CV Scale context menu options which limit how the maximum change a 10V signal can have. This is useful as, at full scale, a small change can have a large effect on the pattern making it difficult to dial in subtle changes.

CV EXPANDER

The Octet Sequencer CV Expander adds CV generation to the Octet Trigger Sequencer. It must be placed immediately to the right of a Count Modula Octet Trigger Sequencer module and will not function with any other sequencers. More expanders can be added by placing them immediately to the right of any that are already connected to an Octet Trigger Sequencer. When connected, the pointers on the CV knobs will change from grey to coloured.

The expander features two channels of CV knobs and CV outputs arranged in two columns. The lights next to the knobs indicate the active steps based on the current pattern selection of the master sequencer.

The S & H switch determines how the CV outputs behave:

- On: The CV value of any step is sampled and when the gate/trigger for that step transitions from low to high and is held until then low-high transition from any other step at which point the value for that step will be sampled and held.
- Off: The CV outputs change on every step regardless of the state of the trigger or gate outputs.

When the master sequencer is running in chained mode, the CV outputs behave differently depending on the master's Channel B Chained Pattern Mode as outlined below

Channel B Chained Pattern Mode (Master)	Expander CV Output B Behaviour
No Output	No Output
Follow A	Current step (same as Channel A)
Inverse or Channel A	*When S&H is off:* Current step (same as Channel A) *When S&H is on:* Current step is sampled at the low to high transition of the B output on the master sequencer.

The Scale switch determines the range of voltages that are output by the expander CV outputs from 1 to 8 volts.

This expander will not function with any other sequencers.

OTHER EXPANDERS

This module is not compatible with any other sequencer expander modules. Refer to the appendix for a full list of expander module compatibilities.

HOW OCTET SEQUENCING WORKS

Octet sequencing uses the principal that every 8-step pattern can be represented by an 8-bit binary number or "octet" where the Most Significant Bit (MSB) equates to step 1 and the Least Significant Bit (LSB) equates to step 8.

Consider a basic sequence with a trigger on steps 1 and 5 and rests on the other steps. This pattern can be represented by the binary number 10001000 (integer value 136) as shown below:

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Sequence	X	-	-	-	X	-	-	-
	128	**64**	**32**	**16**	**8**	**4**	**2**	**1**
Binary	1	0	0	0	1	0	0	0

Similarly, sequence with a trigger on steps 1, 3, 5, and 7 and rests on the other steps can be represented by the binary number 10101010 (integer value 170):

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Sequence	X	-	-	-	X	-	-	-
	128	**64**	**32**	**16**	**8**	**4**	**2**	**1**
Binary	1	0	1	0	1	0	1	0

SAMPLE PATTERN VALUES:

Some basic 8 step patterns to get you started.

Pattern								**Binary Value**	**Integer Pattern Value**
X								10000000	128
X				X				10001000	136
X		X		X		X		10101010	170
				X				00001000	8
X				X		X		10001010	138
X		X		X		X	X	10101011	171
		X				X		00100010	34
X	X	X	X	X	X	X	X	11111111	255

OFFSET GENERATOR

Adds or subtracts the selected offset amount to or from the input CV value.

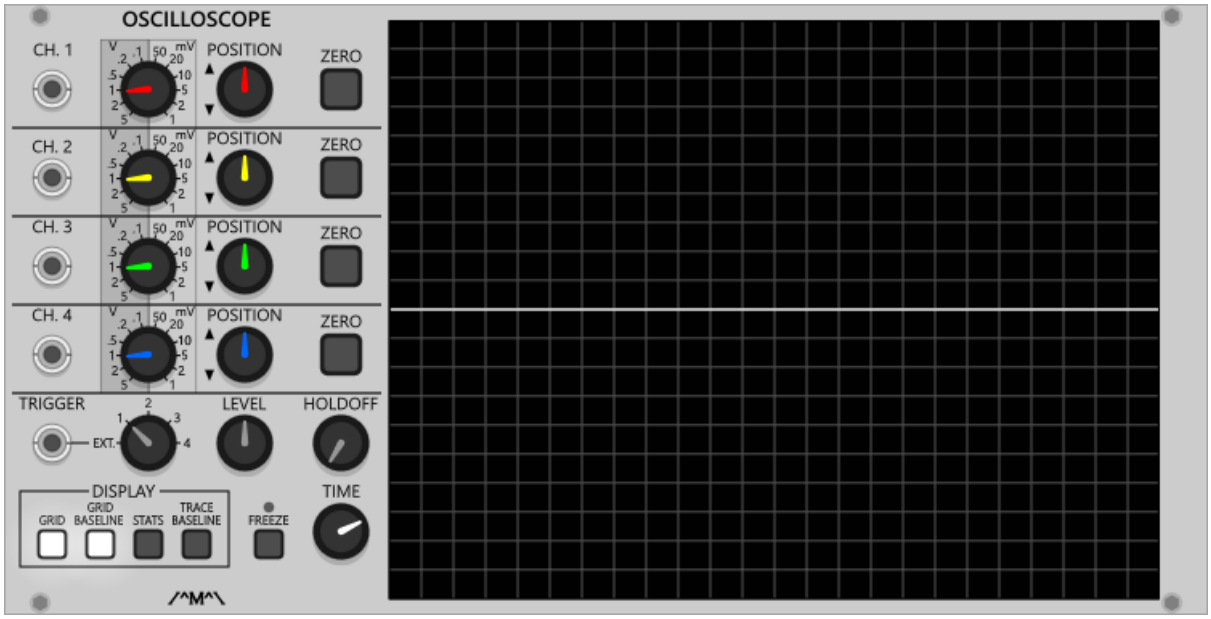
The Coarse control selects values from -8V to +8V in 1V increments, the Fine control selects continuous values between -1 and +1 volt.

With a cable connected to the Coarse CV input, the Coarse control is disconnected, and the supplied voltage is used to determine the base (coarse) offset value. Note that the Coarse CV value is quantized to 1-volt increments.

The trigger input adds a sample and hold function to the offset generator. With a cable connected, the inputs are sampled and sent to the output on a positive going edge so that they can synchronised with a sequencer or clock. With nothing connected to the trigger input, changes are immediate.

This module can process polyphonic signals with all channels being offset by the one offset amount.

OSCILLOSCOPE



An oscilloscope with a large display and 4 independent traces. Note this oscilloscope is NOT capable of displaying polyphonic signals.

Channel Controls:

The left-hand knob (Scale) on each channel controls the scale of the display for that channel's trace on the display. The values are specified per division on the display. At a scale of 2V/Division a signal that is 10Vp-p will span the full height of the display.

The Position knob sets the horizontal position of the trace.

The Zero button sets the trace value to zero volts, effectively muting the input signal. Useful for aligning the horizontal position with division markers.

Trigger Section:

The scope triggers when the selected trigger signal crosses the level set by the Level control or the hold time is exceeded, whichever comes first. The trigger source can be selected with the Trigger rotary switch.

The Holdoff control sets the amount of time that the trigger section will wait before automatically triggering. This can be useful to get certain signals to trigger correctly.

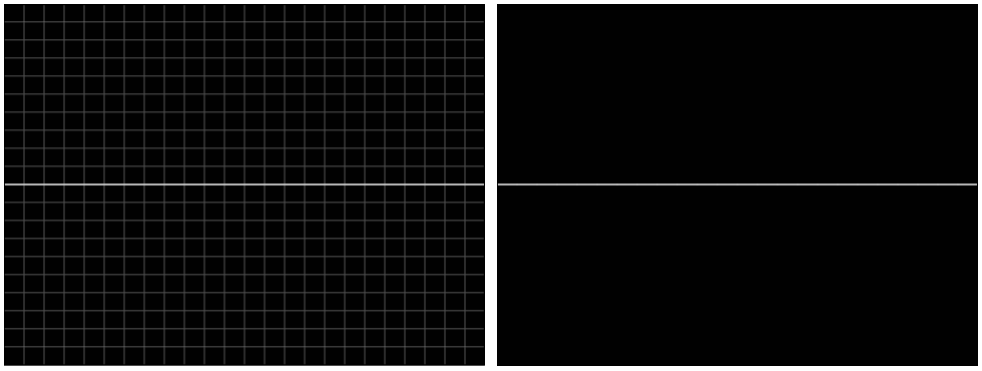
The Time control sets the speed of the trace. Slower speeds are useful for LFOs, envelopes etc, faster speeds are more suited to audio rate signals. On slower time-bases, a vertical trace marker is displayed.

The Freeze button freezes the display once the currently executing trace cycle completes. This can be useful capturing snapshots of the display.

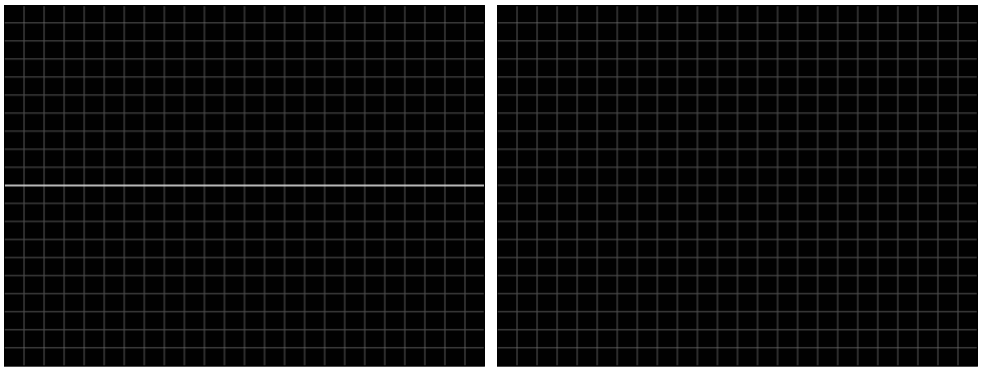
Display Section:

The buttons in the display section turn various display features on and off as follows:

Grid: Turns the vertical and horizontal gridlines on and off as shown below:

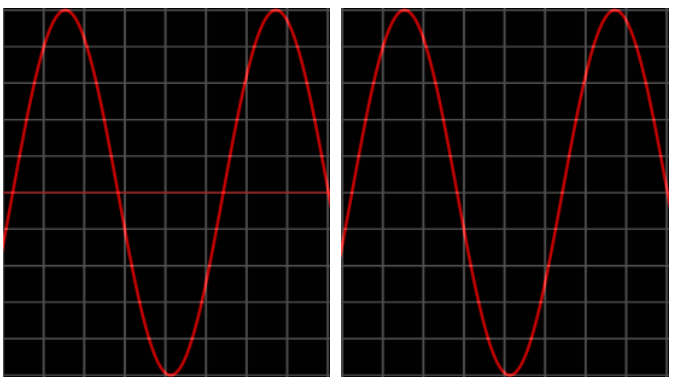


Grid Baseline: Turns the central white baseline (0 Volt line) on and off as shown below:

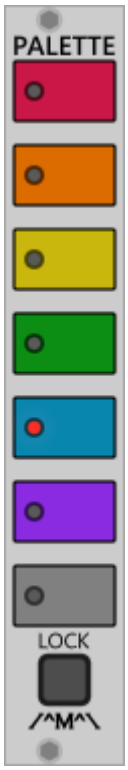


Stats: Turns the statistics display on and off. Statistics are shown at the top left of the display for every connected channel and include the peak to peak, minimum and maximum voltages along with the currently selected scale for the channel.

Trace Baseline: Turns the 0 Volt baseline for the traces on and off. This is the line around which the traces are displayed. Shown below with the trace baseline on and off:



PALETTE



A cable colour management tool that offers specification of up to 7 colours*.

Each colour button represents the available cable colours. Clicking on a colour button selects that colour for the next cable. The LED on each button indicates the colour that will be used by the next new cable.

The lock button stops the automatic selection of the next available colour. All new cables will have the same colour until another colour is selected or the colour is unlocked.

For users with less than 7 colours, the unused colour slots are disabled. New colours can be added by the first free buttons Add context menu item which will pop up a list of standard colours from which to choose.

Colours can be removed from the cable colour list Via the associated colour buttons Remove context menu item.

There are 3 context menu options to set the cable colour:

- Pick: Pops up a list of standard colours from which the colour for the given slot can be selected.
- Custom: Pops up a colour mixer with sliders for Red, Blue, and Green amounts along with Apply and Cancel options. The button colour changes as the sliders are adjusted and Apply must be clicked to save the change to that colour slot.
- Random: Sets the given slot to a random colour.

By default, the following hotkeys are available whenever the mouse is hovered over the module:

- 1-9: Selects the colour in the equivalent slot number.
- L: Toggles the colour lock function.

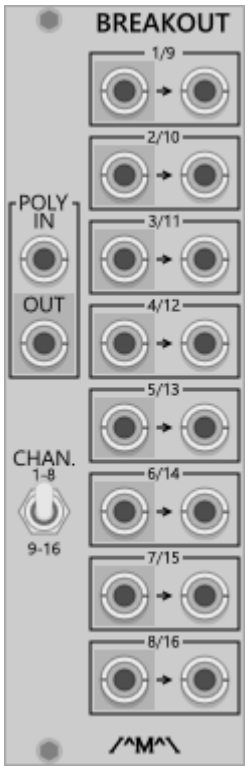
These hotkeys can be made to function without hovering the mouse over the module via the “Hotkeys -> Global” context menu option. Further to this, the hotkeys can be customised via context menu options. The lock hotkey via the module context menu and the colour selection hotkeys via the individual colour button context menus.

Note that the hotkey settings are stored in a global settings file rather than in patch files so they can be set once, and forgotten and induvial preferences are not overwritten when sharing patch files.

Note: only one instance of this module can be used within a patch.

* Although the module is specified for 7 colours, it can handle up to 15 colours for anyone who has manually edited their settings to add more colours.

POLYPHONIC BREAKOUT



An insert module that allows individual channels in a polyphonic signal to be independently processed.

Each available channel in the input is sent to the equivalent monophonic breakout output and returned via the adjacent monophonic input.

POLY CHANCES

A polyphonic voltage-controlled Bernoulli gate that randomly sends gate a gate signal to either one of the two outputs.

The Chance control determines the probability of the given output being selected on each gate transition. With the Chance control fully CCW, the A output is favoured 100% of the time and with the control fully CW the B output is favoured 100% of the time. The Chance affects all channels of a polyphonic signal equally.

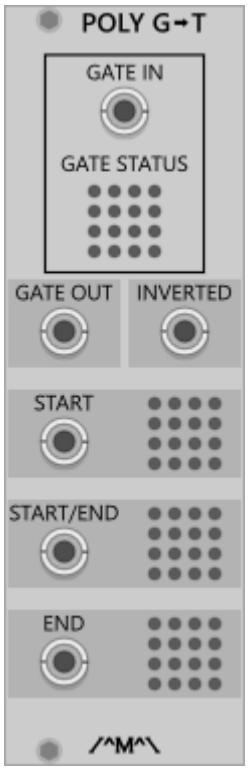
The Chance input value is added to the Chance control value with 0V favouring the A output 100% and 10V favouring the B output 100% when the Chance control is set fully CCW. When a monophonic signal is applied to the Chance input it affects all channels equally however if a polyphonic signal is applied, then each channel of the chance input signal only affects the associated channel on the output.

There are three operational modes:

- Latched (Switch in the up position): The A/B output is selected based on the outcome of the "coin toss" and the selected output latches on until that outcome changes. i.e. either the A or B output will always be high regardless of the current state of the gate input.
- Normal (Switch in the centre position): The A/B output is selected based on the outcome of the "coin toss" and the selected output follows the input gate length.
- Toggle (Switch in the down position): The selection toggles between A and B only if the outcome of the "coin toss" is different to that of the last toss. The selected output follows the input gate length.

The number channels on each output is determined by the number of channels applied to the input. The Chances input channel count has no bearing on the number of channels at the outputs.

POLY G2T GATE CONVERTER



Converts any polyphonic signal into polyphonic gate and trigger signals.

Any of the gate channel outputs will be at 0V unless the voltage for that channel presented at the input is greater than 2.0V in which case the associated channel on the Gate output will be high (10V).

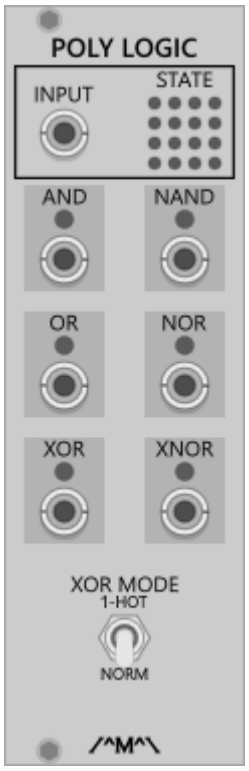
The Inv Gate output functions the other way around, 10V unless the input voltage is over 2.0V in which case the output will be 0V.

The Start trigger output will fire a 10ms pulse at the start or leading edge (i.e. on the transition from low to high) of the generated gate and the End trigger output will fire a 10ms pulse at the end or trailing edge (i.e. on the transition from high to low) of the generated gate.

The Start/End output is a logical OR of the Start and End trigger outputs giving a trigger pulse on both transitions of the generated gate signal.

The Gate status display reflects the result of converting the input signals to gates.

POLY LOGIC



Boolean logic applied across the channels of a polyphonic input.

The AND output is the result of ANDing all input channels together. The output will only be high if all channels of the input are high.

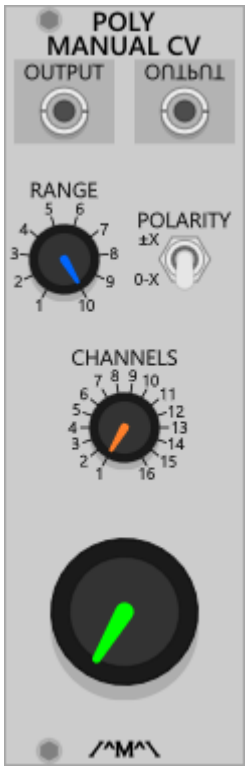
The OR output is the result of ORing all input channels together. The output will be high if any channels of the input are high.

The XOR output is the result of XORing all input channels together. The output depends on the setting of the XOR Mode switch. With the switch in the Norm position, the output will be high if the number of input channels that are high is odd. With the switch in the 1-Hot position, the output will be high if only 1 of the input channels is high.

The NAND/NOR and XNOR outputs are the NOT of the respective AND/OR and XOR outputs.

The State LED matrix indicates the state of the inputs.

POLYPHONIC MANUAL CV



A polyphonic manual/constant CV source.

The Range switch determines the output range from 1 to 10 volts.

The polarity switch sets the output to either unipolar (0-X volts) or bipolar (-X to +X volts).

The number of output channels depends on the setting of the Channels control and all channels receive the same voltage value which is determined by the position of the big knob at the bottom of the module.

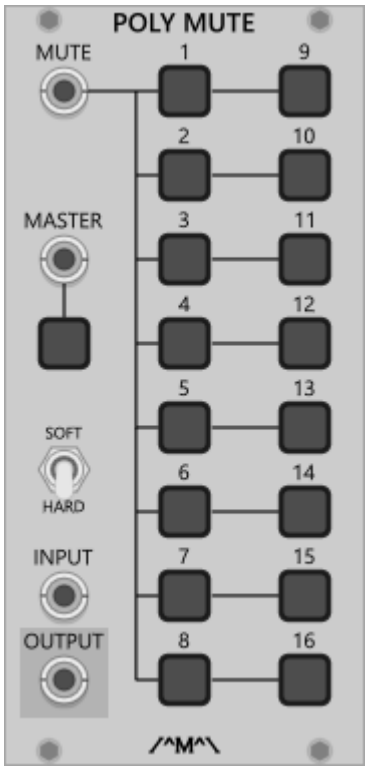
POLYPHONIC MIN/MAX

Calculates the minimum, maximum and mean values from all channels within the input polyphonic signal and outputs them as monophonic signals at the Min, Max and Mean outputs respectively.

The polyphonic signal is also available sorted by voltage magnitude in ascending and descending order at the Asc and Desc outputs.

These can be used for processing highest or lowest notes in a polyphonic patch differently.

POLY MUTE

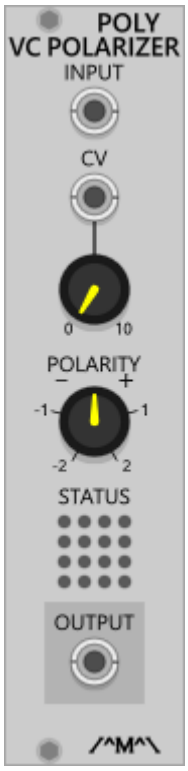


Muting of individual channels within a polyphonic signal with a Master Mute that operates on all channels within the signal and switchable response (hard/soft) for instant processing of control signals or fast but pop free muting of audio signals.

The Mute input accepts a polyphonic gate signal to facilitate voltage control over the muting of each channel.

The Master input is monophonic and accepts a gate signal that mutes all channels when high.

POLY VOLTAGE CONTROLLED POLARIZER



A polyphonic voltage processor that Inverts or “polarizes” the incoming signal under manual/voltage control.

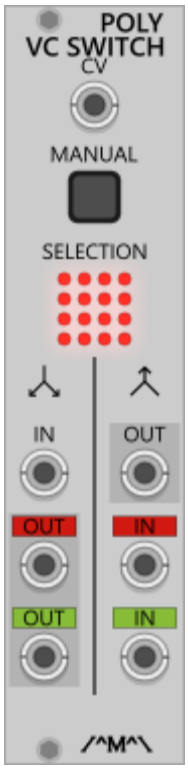
A negative control voltage at the CV input (with the Polarity control at 12:00) will invert the input signal and the amplitude of the CV signal will control the output amplitude. The Polarity amount is applied to all input channels and summed with the channel’s CV amount before being applied. If a monophonic CV is supplied, then that CV is applied to all polyphonic input channels.

This module is also capable of 2 x amplification. Amplification starts when the Polarity control is taken past 1 or -or the CV input level is 100% with a 5V CV applied (i.e. 10V = x 2 amplification).

The status LEDs indicate the polarization status not the incoming signal levels.

Applying audio rates to the CV input may result in aliasing artefacts.

POLY VOLTAGE CONTROLLED SWITCH



A polyphonic voltage-controlled switch.

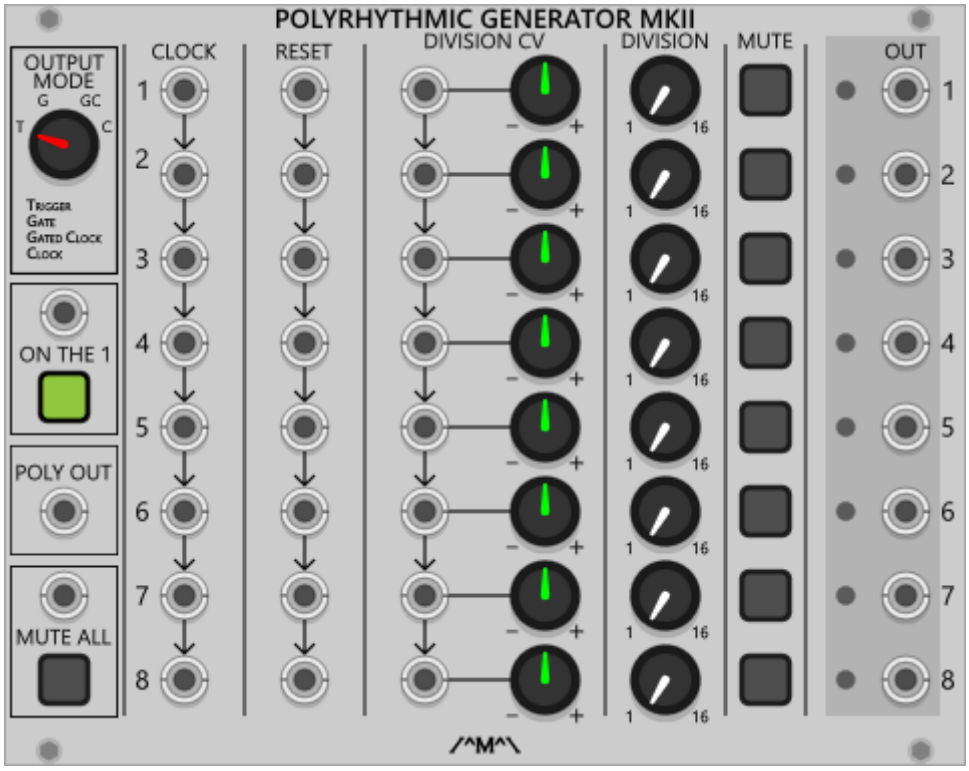
Selects between 2 inputs or routes 1 input to one of two outputs based on the Manual button or the level of the signal at the CV input.

With a cable connected to the CV input, the Manual button has no effect.

If a monophonic signal is applied to the CV input, then the signal will switch all channels of any polyphonic signals at the switch inputs. If a polyphonic signal is applied to the CV input, then each channel of the switch inputs will be switched by the associated CV channel.

The selection status is displayed on the LED array with red indicating input/output 1 and green indicating input/output 2.

POLYRHYTHMIC GENERATOR MKII



A set of 8 voltage-controlled clock dividers that can be used to generate polyrhythms by clocking and/or dividing at different rates. The individual clock, reset and division CV inputs of each channel are normalled to the previous channel allowing for global or segmented/individual control. Plugging a cable into the clock, reset or CV input a given channel will break the normalling input and inputs on subsequent channels from the input on the previous channel. Normalling is applied per input (breaking the CV input does not break the clock normalling for example) so it is possible to have individual CV control over the divisions on each channel whilst maintaining a common clock. Along with a global mute button which also has voltage control, each channel can be manually muted individually.

The outputs can be set globally to one of 4 modes:

- Trigger: A single 10ms trigger pulses for every Nth clock pulse.
- Gate: The gate outputs operate like a binary clock divider where the output is high for the selected number of clock pulses then low for the selected number of clock pulses etc.
- Gated Clock: The input clock is sent to the output for the selected number of divisions then it is muted for the same number of divisions etc.
- Clock: A single clock pulse for every Nth clock pulse.

The "On The 1" beat mode control and associated CV input set whether the generator outputs pulses on the first count of the division or on the first positive going transition of the underlying divided clock). When set to "ON The 1", the first count will send pulses to the output upon reset then every N clock pulse as opposed to only after N/2 clocks have been received then every N clock pulses. The former is considered to be more musical.

This module can generate polyphonic triggers. These are available at the Poly Out jack.

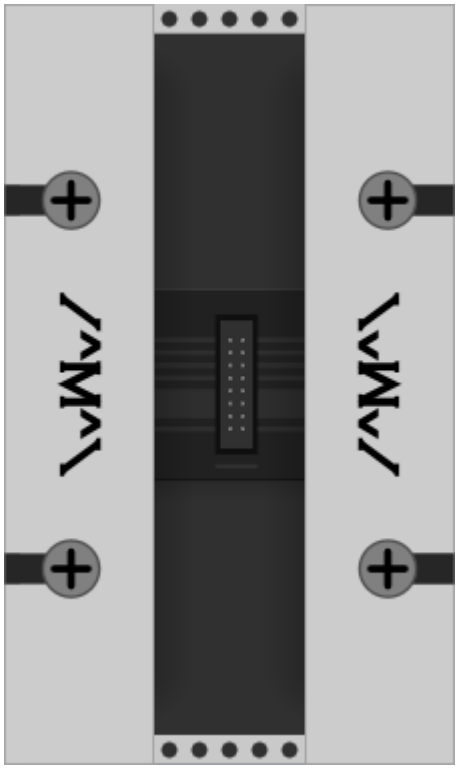
Notes:

The MkII module differs from the original version in two ways:

- It has switches for the division controls rather than the freely adjustable knobs to make it easier to dial in the desired division ratios.
- The correct division ratios including odd divisions are now used (1, 2, 3, 4, 5 etc rather than 1, 2, 4, 6, 8, 10 etc)

For those with old patches requiring the behaviour of the original version or who simply prefer the way it worked, the MkII module can be switched over to "Legacy Mode" via an option in the module context menu. Notes on converting old patches to use the MkII version of this module can be found in the Superseded Module section of this manual.

RACK EARS



A set of decorative blanks modelled after Eurorack mounting brackets.

Several decorative options are available in the context menu. The chosen option can be selected for the current rack ear module only or set as a default for all subsequently added rack ears. Note that both left and right rack ears use the same default setting.

RECTIFIER

A precision rectifier offering full wave, and both positive and negative half wave rectification. The input signals are rectified around a user settable and voltage controllable axis.

A set of inverted outputs for each rectified signal is also available.

This module can process polyphonic signals. All channels are rectified around the same axis.

Note that the rectifier module is highly likely to introduce aliasing artefacts when driven with audio frequencies, but I figure anyone running audio through a rectifier is probably not looking or a high-fidelity experience...

SAMPLE & HOLD

A basic Sample & Hold with optional Pass & Hold and Track & Hold capability.

Operational Modes:

- S: Sample and Hold. A transition to high (2.0 Volt threshold) on the trigger input samples the input and sends it to the output where it us held until the high trigger transition occurs.
- T: Track and Hold. The output follows the input whilst the trigger input is high and holds the last sampled value on the transition of the trigger to a low state.
- P: Pass and Hold. The output follows the input whilst the trigger input is low. A high transition on the trigger input causes the current value to be held until the trigger transitions back to low again.

Voltage control over the mode can be achieved by applying CV to the Mode input with the selection thresholds as follows:

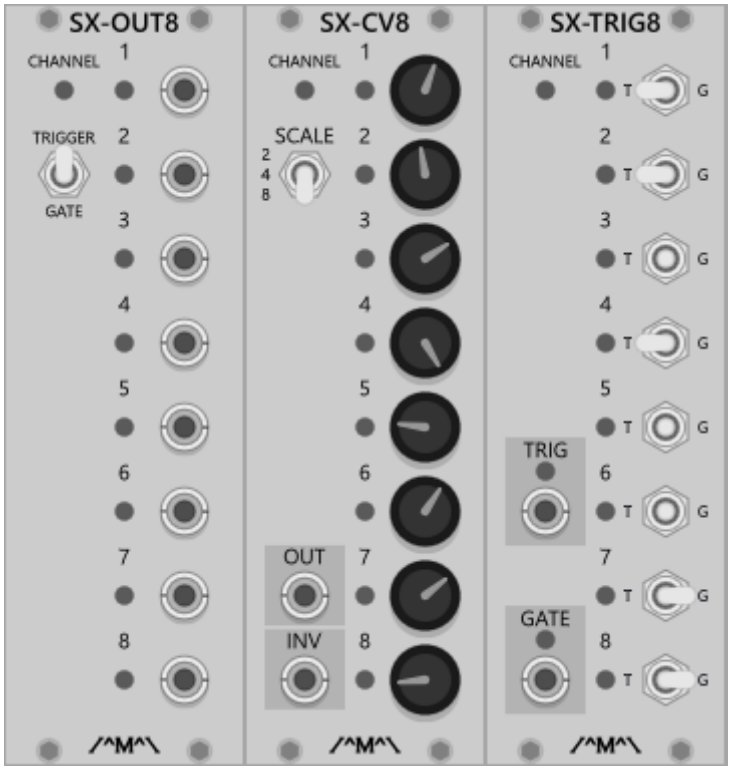
- < 2.0 volts: Sample & Hold
- >= 2.0 and <> 4 Volts: Track & Hold
- >= 4.0 volts: Pass & Hold

With a cable plugged into Mode input, the Mode switch has no effect.

Note: anybody who was selecting the T & H mode via voltage control in plugin version 1.3.0 or earlier may need to attenuate the mode CV to ensure the mode is selected correctly in version 1.4.0 onwards.

This module can process polyphonic signals. All channels are sampled and held with a single trigger.

SEQUENCER EXPANDERS (SX-OUT8, SX-CV8 & SX-TRIG8)



A set of expander modules that add extra channel functionality to certain Count Modula 8 step sequencers.

- SX-OUT8: Adds individual gate outputs for each step. The Trigger/Gate switch determines whether the outputs stay high for the duration of the step (gate) or follow the clock width (trigger)
- SX-CV8: Adds another channel of CV output. This module functions like the CV strip of the Basic Sequencer with Scale switch determining the output scale as 2, 4 or 8 volts.
- SX-TRIG8: Adds another channel of Trigger/Gate output. This module functions like the gate/trigger switch strip on the Basic Sequencer with the switches selecting either of the trigger or gate output or no output at all when the step is active.

Although Designed specifically for the Gated Comparator, the Gated Comparator expanders will work with certain other sequencer modules however their usefulness in this capacity may be limited. For the 8 step sequencers, the modules will simply follow the active steps of the sequencer. When used with the Binary Sequencer, the modules will follow the internal binary count.

These modules use the new expander functionality introduced in Rack V1 so must be placed immediately to the right of a sequencer module in order to function. Multiple expanders can be used by placing each extra expander immediately to the right of an already connected expander and they can be used in any combination and in any order. It should be noted a s sample delay is introduced with each expander.

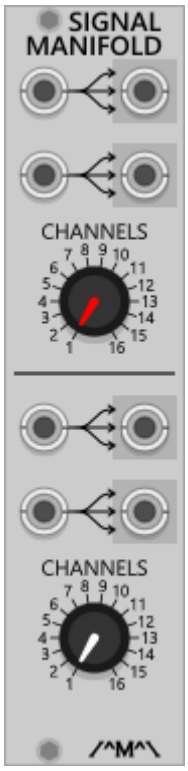
Each expander has a channel indicator light to show which channel of the parent or master sequencer they are associated with and the colour of the indicator will match that of the associated master sequencer channel knobs should that master have multiple channels. Note that the direction, number of steps and the current step of the associated master channel are passed through to the expanders. i.e. If the master channel is set to run in reverse then each expander attached to that channel will also run in reverse.

SHEPARD GENERATOR

Generates a set of 8 ramp and sawtooth signals appropriately phased for generation of Shepard tones (tones that sound like they are continually rising or falling) when coupled with 8 VCOs and VCAs. Slower modulation rates and linear VCAs work best for this effect.

This module can function as a polyphonic controller. The saw and triangle waveforms are available on separate channels within their respective Poly Out jacks.

SIGNAL MANIFOLD



The Signal Manifold replicates a mono/poly input signal into a selected number of channels in a poly output signal. There are two independent sections with two separate, but commonly controlled, inputs and outputs per section.

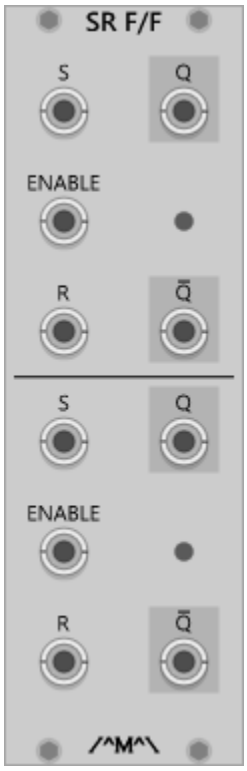
Where the input is a mono input, the input value is simply replicated out to however many channels are specified by the Channel control.

Where the input is a poly signal, the input values are replicated “round robin” style out to however many channels are specified by the Channel control. Where there are more input channels than are selected for output then the number of channels will be truncated at the selected number.

For example, a 2 channel input with a 5 channel setting would result in the following:

Output Channel	Input Channel
1	1
2	2
3	1
4	2
5	1

SR FLIP FLOP (DUAL)



A dual Set/Reset flip flop with optional enable.

A high gate signal at the S input whilst the flip flop is enabled sets the Q output high and the NOTQ output low.

A high gate signal at the R resets the Q output to low and the NOTQ output to high. Both inputs high at the same result in an invalid state causing both outputs to also be high.

With nothing plugged into the enable input, the flip flop is permanently enabled however with a cable plugged in, a high signal must be present at the input in order to set or reset the flip flop.

SR FLIP FLOP (SINGLE)

A single Set/Reset flip flop with optional enable.

A high gate signal at the S input whilst the flip flop is enabled sets the Q output high and the NOTQ output low.

A high gate signal at the R resets the Q output to low and the NOTQ output to high. Both inputs high at the same result in an invalid state causing both outputs to also be high.

With nothing plugged into the enable input, the flip flop is permanently enabled however with a cable plugged in, a high signal must be present at the input to set or reset the flip flop.

STARTUP DELAY

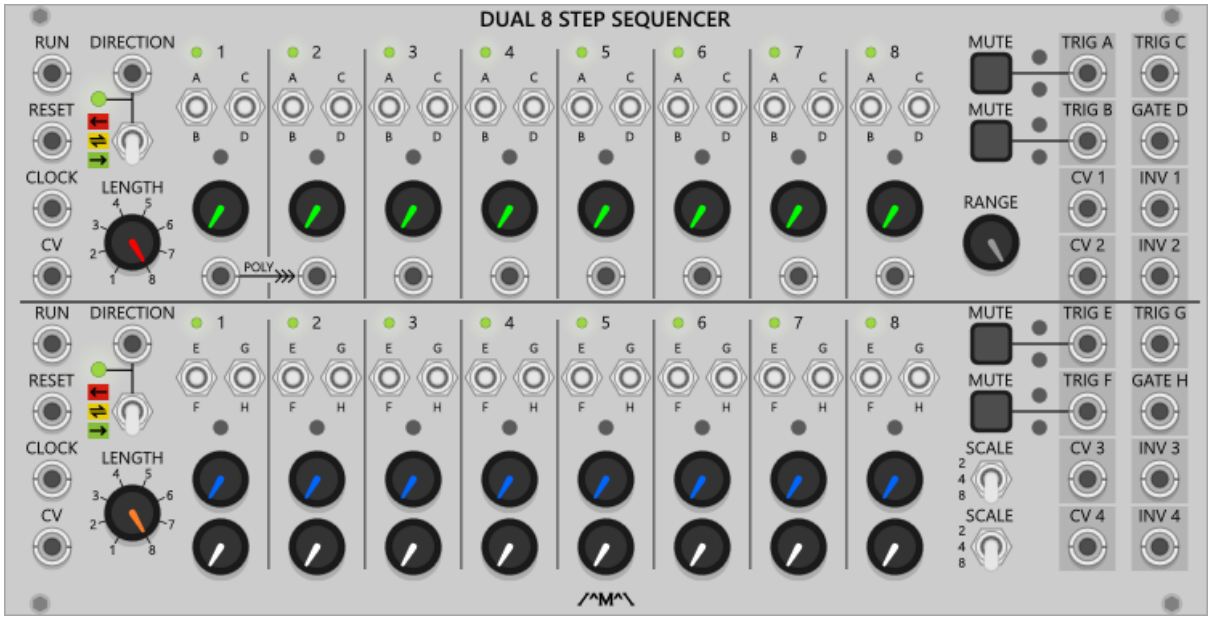
A utility that generates a gate and trigger signal that is delayed with respect to the loading of a patch or the starting of Rack. Can be used to automatically start self-triggering modules such as the Befaco Rampage that require an initial manual trigger to get them cycling. Delay time can be set from 1 - 30 seconds.

Three outputs are available:

- Delay: a gate signal that starts high as soon as Rack is started, or the patch is loaded and remains so until the selected time has elapsed.
- Gate: a gate signal that starts low and transitions to high after the selected time has elapsed since Rack was started or the patch was loaded.
- Trig: a trigger signal that fires after the selected time has elapsed since Rack was started or the patch was loaded.

Note that once the selected time has elapsed and the outputs have been set accordingly, they will not change until the patch is reloaded or Rack is restarted.

DUAL 8 STEP SEQUENCER



A dual 8 step trigger/gate sequencer with voltage control over sequence lengths and direction along with individual inputs for each step on one channel.

The Reset input restarts the sequence at step one on the next clock cycle.

The Run input allows the sequencer to be started and stopped by the application of a gate signal with a low gate inhibiting the sequencer and a high gate enabling it. This functions like a pause button and operation resumes at the next clock cycle.

The Run, Clock and Reset inputs of channel 2 are normalled to channel 1.

With a cable plugged into CV input the Length switch is disabled and control of the sequence length is determined only by the applied voltage. Full sequence length is achieved with a 10V input. The CV inputs are NOT normalled.

The current sequence length is indicated by the small green lights situated next to the step numbers.

Each sequencer can output up to 8 octaves of CV with channel 2 having selectable ranges of 8, 5 and 2 volts on each row via the Range switches and the channel 1 having continuously variable range via the Scale attenuator knob.

Additionally, channel 1 has individual inputs per step for processing of external signals. With no cables plugged in, the CV2 output follows the CV1 output for each step. When a cable is plugged in to a step input, the output when that step is selected will be the input voltage attenuated by the associated knob and channel scale setting.

Note that the knobs for channel 1 are common to the CV1 and CV2 outputs with CV1 reflecting the value of the knob scaled by the Scale control which is also common to both outputs.

The individual input for step 1 has a special feature for polyphonic cables whereby each channel present is spread across the remaining unconnected step inputs allowing the sequencer to step through each channel in turn like an arpeggiator.

Three direction options are available via the direction switch or control voltage applied to the Direction input:

- Forward: The sequence travels from left to right and restart on the left-hand side. When in this mode the direction indicator will be green.
- Pendulum: The sequence travels from left to right then back again before starting over. When in this mode the direction indicator will be yellow.
- Reverse: The sequence travels from right to left then start again on the right-hand side. When in this mode the direction indicator will be red.

With a cable plugged into the direction CV input the direction switch is disabled and control of the direction is determined only by the applied voltage which responds as follows:

- Under 2 Volts: Forward
- 2 Volts to 4 Volts: Pendulum
- Over 4 Volts: Reverse

The direction inputs are not normalled.

Change of direction from forward to reverse or vice-versa occurs on the next clock after the change is made. When changing to pendulum mode the current direction will be maintained until the end (or start) of the sequence is reached at which point the direction will change.

Note that if the sequence length is shortened whilst the sequencer is in the reverse direction and the current step is outside the selected length, the sequence will continue from it's current step rather than jumping to the new end step.

Each channel has 1 gate output and 3 trigger outputs.

The gate outputs stay high for the duration of any selected step. Selecting the gate output for two consecutive steps results in a single gate signal for the duration of both steps. Note that the CV outputs will still change for each step even though the gate does not.

The trigger outputs follow the pulse width of the clock signal.

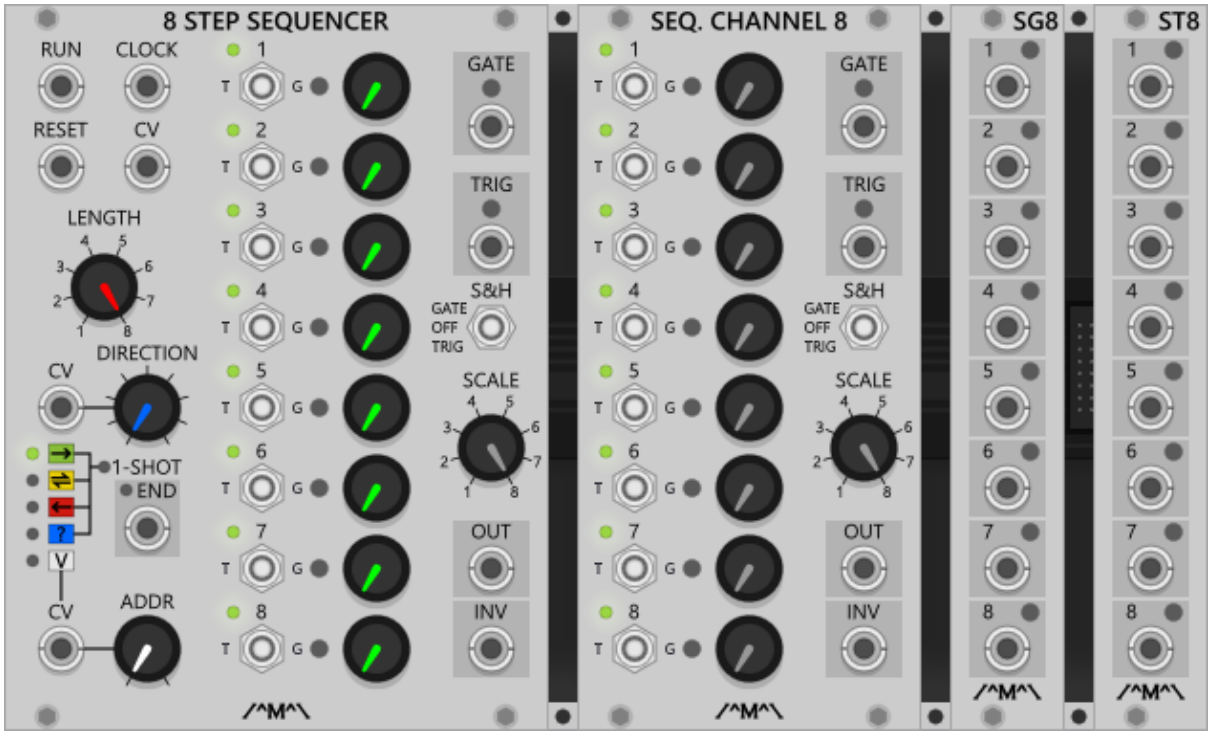
The mute buttons affect both adjacent trigger/gate outputs the same time.

The following context menu options are available to facilitate initialization and randomization of each channel independently:

- *Channel x → Initialize → Entire Channel:* Reset all controls for the given channel to their default values
- *Channel x → Initialize → CV Only:* Reset only the CV knobs for the given channel to their default values
- *Channel x → Initialize → Gates/Triggers Only:* Reset only the gate/trigger selection switches for the given channel to their default values
- *Channel x → Initialize → Entire Channel:* Set all controls for the given channel to random values
- *Channel x → Initialize → CV Only:* Set only the CV knobs for the given channel to random values
- *Channel x → Initialize → Gates/Triggers Only:* Set only the gate/trigger selection switches for the given channel to random values

Extra channels can be added via expander modules. Refer to the appendix for a list of expander modules that are compatible with this module.

8 STEP SEQUENCER + EXPANDERS



An 8-step trigger/gate/CV sequencer with voltage control over sequence length and direction, one-shot mode and built in sample & hold.

The Reset input restarts the sequence at step one on the next clock cycle (when not in Random or Voltage Addressed mode).

The Run input allows the sequencer to be started and stopped by the application of a gate signal with a low gate inhibiting the sequencer and a high gate enabling it. This functions like a pause button and operation resumes at the next clock cycle.

With a cable plugged into CV input, the Length switch is disabled, and control of the sequence length is determined only by the applied voltage. Full sequence length is achieved with a 10V input.

The current sequence length is indicated by the small green lights situated next to the step numbers.

The sequencer has a selectable output range of 1 - 8 volts in 1 volt increments via the Scale knob.

Nine directional modes are available via the Direction knob or control voltage applied to the Direction input:

1. Forward: The sequence travels from top to bottom and restarts at the top.
2. Pendulum: The sequence travels from top to bottom then back again before starting over.
3. Reverse: The sequence travels from bottom to top then starts again at the bottom.
4. Random: The steps are selected randomly with no set pattern or order.
5. Forward 1-Shot: The sequence travels from top to bottom and stops at the end of the last step. In this mode the red 1-shot light will be on.
6. Pendulum 1-Shot: The sequence travels from top to bottom then back again and stops at the end of the last (first) step. In this mode the red 1-shot light will be on.

7. Reverse 1-Shot: The sequence travels from bottom to top and stops at the end of the last (first) step. In this mode the red 1-shot light will be on.
8. Random 1-Shot: The steps are selected randomly with no set pattern or order and the sequencer runs until the last step is selected, stopping at the end of that step. In this mode the red 1-shot light will be on.
9. Voltage Addressed: The active steps are selected by the Addr knob and associated CV input.

In the 1-Shot modes, the sequencer will run for 1 cycle only then stop. At the end of the last step, the End light will turn on and the End gate output will go high.

In the Voltage Addressed directional mode, the value of the Addr knob is used to determine which step is active and this is sampled at the start of each clock pulse. If a cable is connected to the Address CV input, then the Addr knob becomes an attenuator. The addressing voltage is scaled such that 10 volts always equals the last step regardless of the sequence length. 1-Shot mode is not available for this mode.

With a cable plugged into the direction CV input, the direction switch is disabled, and control of the direction is determined only by the applied voltage which responds as follows:

Input Voltage	Direction
< 1.000	Forward
1.000 to 1.999	Pendulum
2.000 to 2.999	Reverse
3.000 to 3.999	Random
4.000 to 4.999	Forward 1-Shot
5.000 to 5.999	Pendulum 1-Shot
6.000 to 6.999	Reverse 1-Shot
7.000 to 7.999	Random 1-Shot
8.000 +	Voltage Addressed

There is 1 gate and 1 trigger output which can be selected via the individual step switches. The trigger outputs follow the pulse width of the clock signal and the gate outputs stay high for the duration of any selected step. Selecting the gate output for two consecutive steps results in a single gate signal for the duration of both steps.

The S & H switch determines how the CV outputs behave:

- Gate: The CV value of any step is sampled and when the gate for that step transitions from low to high and is held until then low-high transition from any other step at which point the value for that step will be sampled and held.
- Off: The CV outputs change on every step regardless of the state of the trigger or gate outputs.
- Trig: The CV at the start of any trigger pulse is held until the next trigger pulse occurs at which point the CV for that step is sampled and held.

The following context menu options are available for initialization and randomization of controls independently:

- *Initialize → CV Only*: Reset only the CV knobs to their default values
- *Initialize → Gates/Triggers Only*: Reset only the gate/trigger selection switches to their default values
- *Initialize → CV/Gates/Triggers Only*: Reset only the CV knobs and gate/trigger selection switches to their default values
- *Randomize → CV Only*: Set only the CV knobs to random values
- *Randomize → Gates/Triggers Only*: Set only the gate/trigger selection switches to random values

- *Randomize → CV/Gates/Triggers Only*: Set only the CV knobs and gate/trigger selection switches to random values

Extra channels can be added via the Sequencer Channel 8 expander. This module is not compatible with any of the other sequencer expanders. Refer to the appendix for a full list of sequencer expander compatibilities.

SEQUENCER CHANNEL 8 EXPANDER

This expander adds extra channels of gate/trigger/CV selection to the 8 Step Sequencer, taking the direction and current step from the master sequencer. It must be placed immediately to the right of the 8 Step Sequencer to work. More channels can be added by placing more expanders immediately to the right of any that are already connected to a sequencer. When connected the pointers on the CV knobs will change from grey to coloured.

The context menus are the same as those on the 8 Step Sequencer except for an additional Channel option. This has no functional purpose other than to allow selection of the knob colour for easier channel identification. If the expander is added from the module browser, the knob colour is automatically selected when the module is joined to a sequencer. Simply change it via the Channel menu if you decide you want a different colour.

This expander will not work with any other sequencers. Refer to the appendix for a list of sequencer expander compatibilities.

SEQUENCER GATE EXPANDER (SG8)

This expander adds individual gate outputs for each sequencer step. The outputs follow the active sequencer steps so output 1 will be high (10 volts) when the sequencer is at step 1, output 2 will be high when the sequencer is at step 2 and so on. The outputs will remain high for the duration of the step and the output state is independent of any gate/trigger switches on the sequencer.

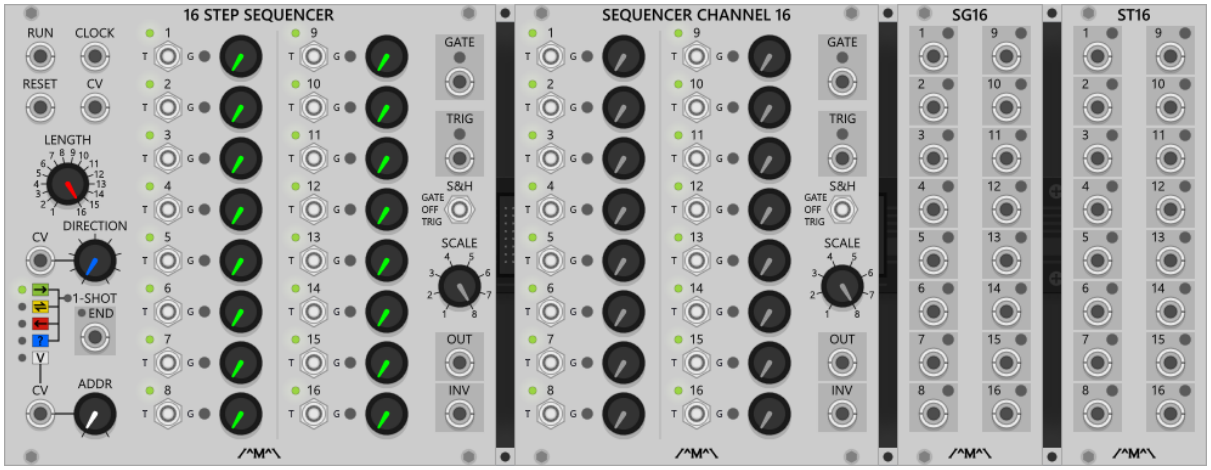
This expander will not work with any other sequencers. Refer to the appendix for a list of sequencer expander compatibilities

SEQUENCER TRIGGER EXPANDER (ST8)

This expander adds individual trigger outputs for each sequencer step. The outputs follow the active sequencer steps so output 1 will go high (10 volts) for the duration of the clock when the sequencer moves to step 1, output 2 will go high for the duration of the clock when the sequencer moves to step 2 and so on. The triggers operate independently of any gate/trigger switches on the sequencer.

This expander will not work with any other sequencers. Refer to the appendix for a list of sequencer expander compatibilities

16 STEP SEQUENCER + EXPANDERS



A 16-step trigger/gate/CV sequencer with voltage control over sequence length and direction, one-shot mode and built in sample & hold.

The Reset input restarts the sequence at step one on the next clock cycle (when not in Random or Voltage Addressed mode).

The Run input allows the sequencer to be started and stopped by the application of a gate signal with a low gate inhibiting the sequencer and a high gate enabling it. This functions like a pause button and operation resumes at the next clock cycle.

With a cable plugged into CV input, the Length switch is disabled, and control of the sequence length is determined only by the applied voltage. Full sequence length is achieved with a 10V input.

The current sequence length is indicated by the small green lights situated next to the step numbers.

The sequencer has a selectable output range of 1 - 8 volts in 1 volt increments via the Scale knob.

Nine directional modes are available via the Direction knob or control voltage applied to the Direction input:

10. Forward: The sequence travels from top to bottom and restarts at the top.
11. Pendulum: The sequence travels from top to bottom then back again before starting over.
12. Reverse: The sequence travels from bottom to top then starts again at the bottom.
13. Random: The steps are selected randomly with no set pattern or order.
14. Forward 1-Shot: The sequence travels from top to bottom and stops at the end of the last step. In this mode the red 1-shot light will be on.
15. Pendulum 1-Shot: The sequence travels from top to bottom then back again and stops at the end of the last (first) step. In this mode the red 1-shot light will be on.
16. Reverse 1-Shot: The sequence travels from bottom to top and stops at the end of the last (first) step. In this mode the red 1-shot light will be on.
17. Random 1-Shot: The steps are selected randomly with no set pattern or order and the sequencer runs until the last step is selected, stopping at the end of that step. In this mode the red 1-shot light will be on.
18. Voltage Addressed: The active steps are selected by the Addr knob and associated CV input.

In the 1-Shot modes, the sequencer will run for 1 cycle only then stop. At the end of the last step, the End light will turn on and the End gate output will go high.

In the Voltage Addressed directional mode, the value of the Addr knob is used to determine which step is active and this is sampled at the start of each clock pulse. If a cable is connected to the Address CV input, then the Addr knob becomes an attenuator. The addressing voltage is scaled such that 10 volts always equals the last step regardless of the sequence length. 1-Shot mode is not available for this mode.

With a cable plugged into the direction CV input, the direction switch is disabled, and control of the direction is determined only by the applied voltage which responds as follows:

Input Voltage	Direction
< 1.000	Forward
1.000 to 1.999	Pendulum
2.000 to 2.999	Reverse
3.000 to 3.999	Random
4.000 to 4.999	Forward 1-Shot
5.000 to 5.999	Pendulum 1-Shot
6.000 to 6.999	Reverse 1-Shot
7.000 to 7.999	Random 1-Shot
8.000 +	Voltage Addressed

There is 1 gate and 1 trigger output which can be selected via the individual step switches. The trigger outputs follow the pulse width of the clock signal and the gate outputs stay high for the duration of any selected step. Selecting the gate output for two consecutive steps results in a single gate signal for the duration of both steps.

The S & H switch determines how the CV outputs behave:

- Gate: The CV value of any step is sampled and when the gate for that step transitions from low to high and is held until then low-high transition from any other step at which point the value for that step will be sampled and held.
- Off: The CV outputs change on every step regardless of the state of the trigger or gate outputs.
- Trig: The CV at the start of any trigger pulse is held until the next trigger pulse occurs at which point the CV for that step is sampled and held.

The following context menu options are available for initialization and randomization of controls independently:

- *Initialize → CV Only*: Reset only the CV knobs to their default values
- *Initialize → Gates/Triggers Only*: Reset only the gate/trigger selection switches to their default values
- *Initialize → CV/Gates/Triggers Only*: Reset only the CV knobs and gate/trigger selection switches to their default values
- *Randomize → CV Only*: Set only the CV knobs to random values
- *Randomize → Gates/Triggers Only*: Set only the gate/trigger selection switches to random values
- *Randomize → CV/Gates/Triggers Only*: Set only the CV knobs and gate/trigger selection switches to random values

Extra channels can be added via the Sequencer Channel 16 expander. This module is not compatible with any of the other sequencer expanders. Refer to the appendix for a full list of sequencer expander compatibilities.

This expander adds extra channels of gate/trigger/CV selection to the 16 Step Sequencer, taking the direction and current step from the master sequencer. It must be placed immediately to the right of the 16 Step Sequencer to work. More channels can be added by placing more expanders immediately to the right of any that are already connected to a sequencer. When connected the pointers on the CV knobs will change from grey to coloured.

The context menus are the same as those on the 16 Step Sequencer except for an additional Channel option. This has no functional purpose other than to allow selection of the knob colour for easier channel identification. If the expander is added from the module browser, the knob colour is automatically selected when the module is joined to a sequencer. Simply change it via the Channel menu if you decide you want a different colour.

This expander will not work with any other sequencers. Refer to the appendix for a list of sequencer expander compatibilities.

SEQUENCER GATE EXPANDER (SG16)

This expander adds individual gate outputs for each sequencer step. The outputs follow the active sequencer steps so output 1 will be high (10 volts) when the sequencer is at step 1, output 2 will be high when the sequencer is at step 2 and so on. The outputs will remain high for the duration of the step and the output state is independent of any gate/trigger switches on the sequencer.

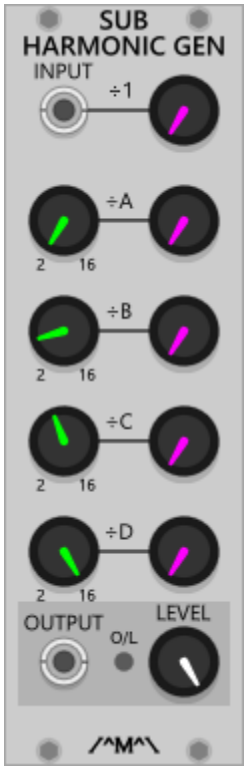
This expander will not work with any other sequencers. Refer to the appendix for a list of sequencer expander compatibilities

SEQUENCER TRIGGER EXPANDER (ST16)

This expander adds individual trigger outputs for each sequencer step. The outputs follow the active sequencer steps so output 1 will go high (10 volts) for the duration of the clock when the sequencer moves to step 1, output 2 will go high for the duration of the clock when the sequencer moves to step 2 and so on. The triggers operate independently of any gate/trigger switches on the sequencer.

This expander will not work with any other sequencers. Refer to the appendix for a list of sequencer expander compatibilities

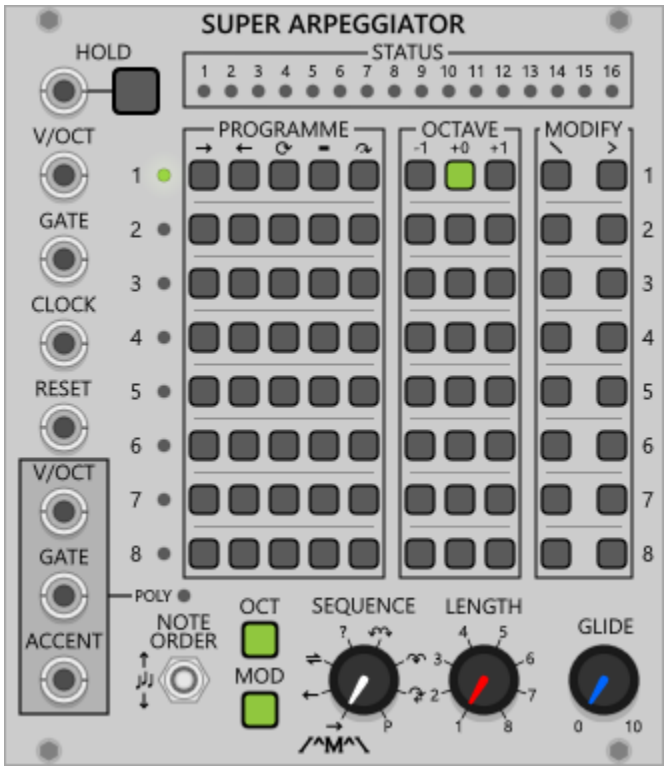
SUB HARMONIC GENERATOR



Accepts a signal from a VCO/LFO and generates a mix of user selectable sub harmonic square waves. This module works best when fed with a square wave but will function with any other waveshape.

Important Note: This module is highly likely to introduce aliasing artefacts. An anti-aliasing mode is planned for a future release.

SUPER ARPEGGIATOR



A complex arpeggiator that accepts polyphonic chord signals from a keyboard or sequencer and applies various patterns to the notes before sending them sequentially to the outputs.

The status indicates how many channels are present at the inputs with blue lights. The currently playing note is indicated by a white light.

The column of green lights next to the Programme section indicates the number of Programme/Octave/Modify steps that will be used, with the currently active row of buttons being indicated by indicated by a red light.

The Programme/Octave/Modify steps operate independently of the note steps and the highlighted row of buttons is applied to the currently playing note. This allows for “phased” sequencing of the octaves/glides to create more complex arpeggiation patterns.

Note that the Gate and CV inputs are only read at the start of every incoming clock pulse.

A QUICK TOUR OF THE CONTROLS

Note Order Switch:

Sets the pre-arpeggiation note sort order.

↑ Notes are sorted from lowest to highest before being arpeggiated.

♩. Notes are not sorted before being arpeggiated (Input order is used).

↓ Notes are sorted from highest to lowest before being arpeggiated.

Sequence Knob:

Selects the arpeggiation sequence.

→ FORWARD: The notes are played forward.

← REVERSE: The notes are played in reverse.

⇌ PENDULUM: The notes are played forward then in reverse (pendulum).

? RANDOM: The notes are played in a random order.

MIDDLE-OUT: Notes are played ping-pong style from the middle out.

OUTSIDE-IN: Notes are played ping-pong style from the outside in.

SKIP-N-BACK: Notes are played in a skip-a -step back-a-step pattern (1-3-2-4-3…).

P PROGRAMME: The notes are played based on the programme button settings.

Glide Knob:

Sets the amount of glide that is applied when a step has glide turned on.

Oct and Mod Buttons:

Turns the Octave and Modify sections on or off. Applies to all Sequence modes.

The Hold Button:

Locks the arpeggiator to the currently playing chord with any changes to the gate or CV inputs being ignored. All other controls remain functional.

THE PROGRAMMING SECTION

Sequence:

Only operational in the Programme (P) mode, this set of buttons determine how the sequence of notes progresses. Click on a button to select the desired sequence operation. Clicking on an illuminated button will return the row to the default (NEXT) operation.

→ NEXT: The next note is played next (note 1 then note 2 for example).

← PREVIOUS: The previous note is played next followed by this one (note 1-2-1-2- 3…).

⟳ REPEAT: This note is repeated before the next note is payed (note 1-2-2-3…).

▁ REST: This note is played as a rest (no gate is output).

↷ SKIP: This note is skipped, and the next note is played instead (note 1-3-4).

Octave:

Only operational if the OCT button is on, this set of buttons sets whether the current note is played as-is or is increased/decreased by an octave (V/Oct). Click on a button to select the desired octave. Clicking on an illuminated button will return the row to the default (+0) operation.

-1 The note is played an octave higher.

+0 Note is played unchanged.

+1 The note is played an octave lower.

Modify:

Only operational when the MOD button is on, these buttons set what note modifiers are active for the current note.

↘ GLIDE: Turns Glide on or off for the note.

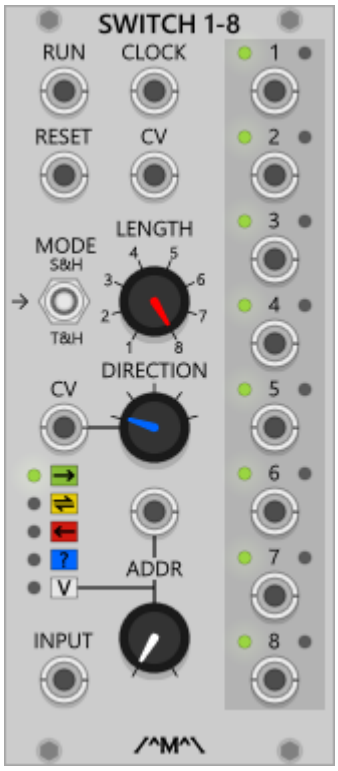
> ACCENT: Turns the Accent output on or off (10 volt gate signal) for the note.

CONTEXT MENU OPTIONS

Polyphonic Outputs:

Selecting this option to changes the CV, Gate and Accent output behaviour from monophonic to polyphonic. In polyphonic mode each note, gate and accent combination is played out of successive channels. There is a “Poly” light above the Note Order switch that indicates which output mode is currently in operation.

SWITCH 1-8



A 1 input to 8 output sequential switch/router. A signal presented to the input is routed to one of eight outputs sequentially, randomly or by voltage address depending on the chosen mode.

The clock input typically takes a clock or gate signal and the leading (rising) edge causes the output selection to advance to the next in the sequence. Other signals can be used to clock the switch and they will be squared up with any voltage over 2.0 volts being considered as a “high” gate.

The Reset input restarts the switch at step one on the next clock cycle (when not in Random or Voltage Addressed mode). Note that on reset, no outputs will be selected until the next clock pulse is received. During this period all outputs will be held at zero volts regardless of the Mode setting (see below for more on the Mode setting).

The Run input allows the switch to be started and stopped by the application of a gate signal with a low gate inhibiting the switch and a high gate enabling it. This functions like a pause button and operation resumes at the next clock cycle.

With a cable plugged into CV input, the Length switch is disabled, and control of the length, or number of outputs, is determined only by the applied voltage. The full number of outputs is achieved with a 10V input.

The current length (number of outputs) is indicated by the small green lights situated next to the step numbers above each output.

Five directional modes are available via the Direction knob or control voltage applied to the Direction input:

1. Forward: Output selection travels from top to bottom and restarts at the top.
2. Pendulum: Output selection travels from top to bottom then back again before starting over.
3. Reverse: Output selection travels from bottom to top then starts again at the bottom.
4. Random: The outputs are selected randomly with no set pattern or order.
5. Voltage Addressed: The outputs are selected by the Addr knob and associated CV input.

In the Voltage Addressed directional mode, the value of the Addr knob is used to determine which output is selected and this is sampled at the start of each clock pulse. If a cable is connected to the Address CV input, then the Addr knob becomes an attenuator. The addressing voltage is scaled such that 10 volts always equals the last step regardless of the selected length.

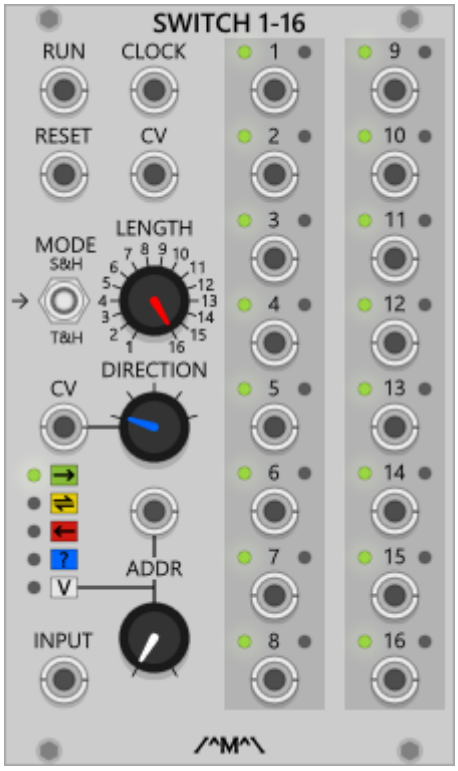
With a cable plugged into the direction CV input, the direction switch is disabled, and control of the direction is determined only by the applied voltage which responds as follows:

Input Voltage	Direction
< 1.000	Forward
1.000 to 1.999	Pendulum
2.000 to 2.999	Reverse
3.000 to 3.999	Random
4.000 +	Voltage Addressed

The Mode switch determines how the outputs behave:

- S&H: Sample & Hold - the input is sampled on the rising edge of the clock and sent to the selected output which is held at that value until the next time it is selected.
- →: Through - the input is directly sent to the selected output for the duration of the step then the output returns to 0V.
- T&H: Track & Hold - operates the same way as the through mode but the output is held at the value of the input when the output selection changes.

SWITCH 1-16



A 1 input to 16 output sequential switch/router. A signal presented to the input is routed to one of eight outputs sequentially, randomly or by voltage address depending on the chosen mode.

The clock input typically takes a clock or gate signal and the leading (rising) edge causes the output selection to advance to the next in the sequence. Other signals can be used to clock the switch and they will be squared up with any voltage over 2.0 volts being considered as a “high” gate.

The Reset input restarts the switch at output one on the next clock cycle (when not in Random or Voltage Addressed mode). Note that on reset, no outputs will be selected until the next clock pulse is received. During this period all outputs will be held at zero volts regardless of the Mode setting (see below for more on the Mode setting).

The Run input allows the switch to be started and stopped by the application of a gate signal with a low gate inhibiting the switch and a high gate enabling it. This functions like a pause button and operation resumes at the next clock cycle.

With a cable plugged into CV input, the Length switch is disabled, and control of the length, or number of outputs, is determined only by the applied voltage. The full number of outputs is achieved with a 10V input.

The current length (number of outputs) is indicated by the small green lights situated next to the step numbers above each output.

Five directional modes are available via the Direction knob or control voltage applied to the Direction input:

1. Forward: Output selection travels from top to bottom and restarts at the top.
2. Pendulum: Output selection travels from top to bottom then back again before starting over.
3. Reverse: Output selection travels from bottom to top then starts again at the bottom.
4. Random: The outputs are selected randomly with no set pattern or order.
5. Voltage Addressed: The outputs are selected by the Addr knob and associated CV input.

In the Voltage Addressed directional mode, the value of the Addr knob is used to determine which output is selected and this is sampled at the start of each clock pulse. If a cable is connected to the Address CV input, then the Addr knob becomes an attenuator. The addressing voltage is scaled such that 10 volts always equals the last step regardless of the selected length.

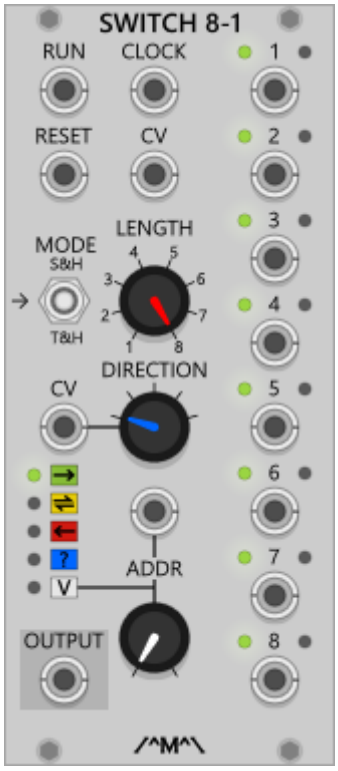
With a cable plugged into the direction CV input, the direction switch is disabled, and control of the direction is determined only by the applied voltage which responds as follows:

Input Voltage	Direction
< 1.000	Forward
1.000 to 1.999	Pendulum
2.000 to 2.999	Reverse
3.000 to 3.999	Random
4.000 +	Voltage Addressed

The Mode switch determines how the outputs behave:

- S&H: Sample & Hold - the input is sampled on the rising edge of the clock and sent to the selected output which is held at that value until the next time it is selected.
- →: Through - the input is directly sent to the selected output for the duration of the step then the output returns to 0V.
- T&H: Track & Hold - operates the same way as the through mode but the output is held at the value of the input when the output selection changes.

SWITCH 8-1



An 8 input to 1 output switch/selector. The signal present at the selected input is routed to the output with the input being selected sequentially, randomly or by voltage address depending on the chosen mode.

The clock input typically takes a clock or gate signal and the leading (rising) edge causes the input selection to advance to the next in the sequence. Other signals can be used to clock the switch and they will be squared up with any voltage over 2.0 volts being considered as a “high” gate.

The Reset input restarts the switch at input one on the next clock cycle (when not in Random or Voltage Addressed mode). Note that on reset, no inputs will be selected until the next clock pulse is received. During this period the output will be held at zero volts regardless of the Mode setting (see below for more on the Mode setting).

The Run input allows the switch to be started and stopped by the application of a gate signal with a low gate inhibiting the switch and a high gate enabling it. This functions like a pause button and operation resumes at the next clock cycle.

With a cable plugged into CV input, the Length switch is disabled, and control of the length, or number of outputs, is determined only by the applied voltage. The full number of outputs is achieved with a 10V input.

The current length (number of outputs) is indicated by the small green lights situated next to the step numbers above each input.

Five directional modes are available via the Direction knob or control voltage applied to the Direction input:

1. Forward: Input selection travels from top to bottom and restarts at the top.
2. Pendulum: Input selection travels from top to bottom then back again before starting over.
3. Reverse: Input selection travels from bottom to top then starts again at the bottom.
4. Random: The inputs are selected randomly with no set pattern or order.
5. Voltage Addressed: The inputs are selected by the Addr knob and associated CV input.

In the Voltage Addressed directional mode, the value of the Addr knob is used to determine which input is selected and this is sampled at the start of each clock pulse. If a cable is connected to the Address CV input, then the Addr knob becomes an attenuator. The addressing voltage is scaled such that 10 volts always equals the last step regardless of the selected length.

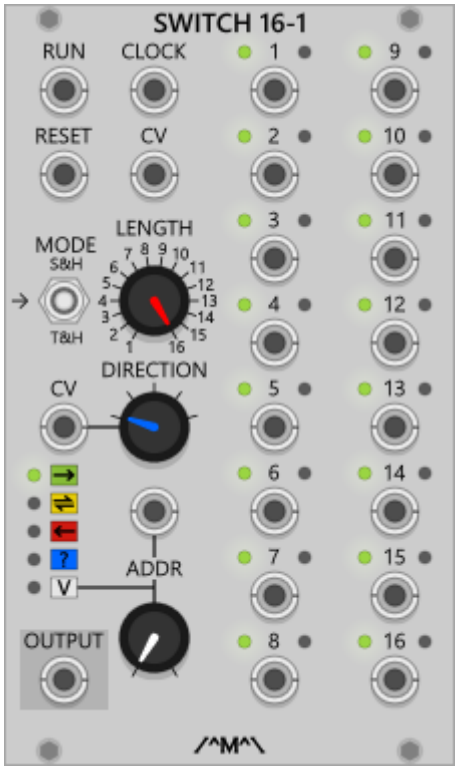
With a cable plugged into the direction CV input, the direction switch is disabled, and control of the direction is determined only by the applied voltage which responds as follows:

Input Voltage	Direction
< 1.000	Forward
1.000 to 1.999	Pendulum
2.000 to 2.999	Reverse
3.000 to 3.999	Random
4.000 +	Voltage Addressed

The Mode switch determines how the output behaves:

- S&H: Sample & Hold - the selected input is sampled on the rising edge of the clock and sent to the output which is held at that value until the next input is selected. If the next selected input is not connected, the output remains as it was at the time of the input change.
- →: Through - the selected input is directly sent to the output until the next input is selected. If the next selected input is not connected, the output will be 0V.
- T&H: Track & Hold - operates the same way as the through mode but when the next selected input is not connected, the output is held at the value it was at the time of the input change.

SWITCH 16-1



A 16 input to 1 output switch/selector. The signal present at the selected input is routed to the output with the input being selected sequentially, randomly or by voltage address depending on the chosen mode.

The clock input typically takes a clock or gate signal and the leading (rising) edge causes the input selection to advance to the next in the sequence. Other signals can be used to clock the switch and they will be squared up with any voltage over 2.0 volts being considered as a “high” gate.

The Reset input restarts the switch at input one on the next clock cycle (when not in Random or Voltage Addressed mode). Note that on reset, no inputs will be selected until the next clock pulse is received. During this period the output will be held at zero volts regardless of the Mode setting (see below for more on the Mode setting).

The Run input allows the switch to be started and stopped by the application of a gate signal with a low gate inhibiting the switch and a high gate enabling it. This functions like a pause button and operation resumes at the next clock cycle.

With a cable plugged into CV input, the Length switch is disabled, and control of the length, or number of outputs, is determined only by the applied voltage. The full number of outputs is achieved with a 10V input.

The current length (number of outputs) is indicated by the small green lights situated next to the step numbers above each input.

Five directional modes are available via the Direction knob or control voltage applied to the Direction input:

1. Forward: Input selection travels from top to bottom and restarts at the top.
2. Pendulum: Input selection travels from top to bottom then back again before starting over.
3. Reverse: Input selection travels from bottom to top then starts again at the bottom.
4. Random: The inputs are selected randomly with no set pattern or order.
5. Voltage Addressed: The inputs are selected by the Addr knob and associated CV input.

In the Voltage Addressed directional mode, the value of the Addr knob is used to determine which input is selected and this is sampled at the start of each clock pulse. If a cable is connected to the Address CV input, then the Addr knob becomes an attenuator. The addressing voltage is scaled such that 10 volts always equals the last step regardless of the selected length.

With a cable plugged into the direction CV input, the direction switch is disabled, and control of the direction is determined only by the applied voltage which responds as follows:

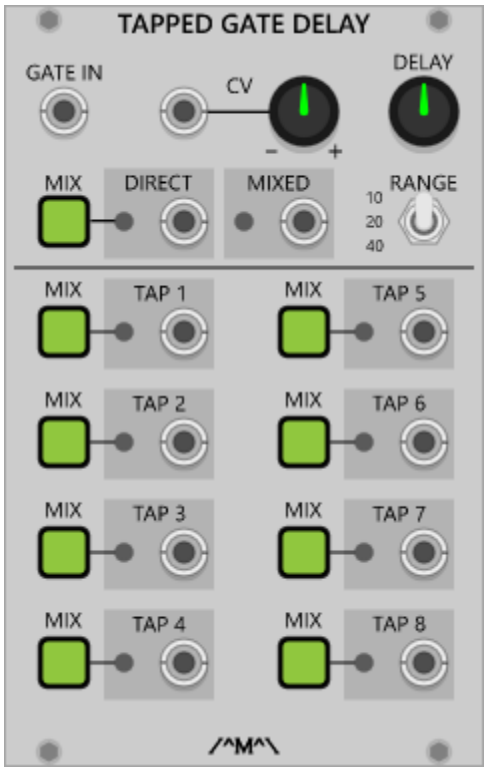
Input Voltage	Direction
< 1.000	Forward
1.000 to 1.999	Pendulum
2.000 to 2.999	Reverse
3.000 to 3.999	Random
4.000 +	Voltage Addressed

The Mode switch determines how the output behaves:

- S&H: Sample & Hold - the selected input is sampled on the rising edge of the clock and sent to the output which is held at that value until the next input is selected. If the next selected input is not connected, the output remains as it was at the time of the input change.
- →: Through - the selected input is directly sent to the output until the next input is selected. If the next selected input is not connected, the output will be 0V.

T&H: Track & Hold - operates the same way as the through mode but when the next selected input is not connected, the output is held at the value it was at the time of the input change.

TAPPED GATE DELAY



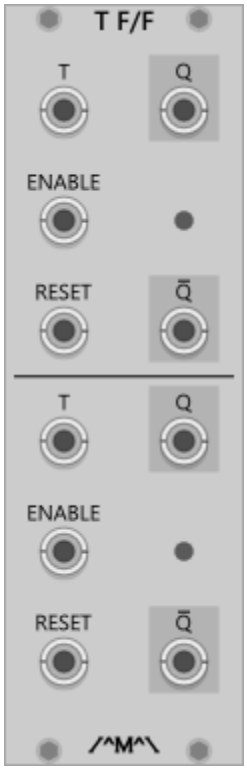
A gate delay that offers up to 40 seconds of delay with tapped outputs at equal intervals along the delay line.

Can be cascaded for even longer delays.

Note that switching from a shorter delay time range to a longer one may introduce time travel artefacts were a gate that has already been output may be output again depending on where it is in the delay line at the time of the change. This is due to the way the delay line functions and is normal behaviour.

The Direct output follows the Gate input whilst the Mixed output provides a user selectable combination of the direct output and the tapped outputs via the Mix buttons.

T (TOGGLE) FLIP FLOP (DUAL)



A dual Toggle (T type) flip flop with optional enable.

A positive going gate signal at the T input whilst the flip flop is enabled alternates the Q output high and low and the NOTQ output between low and high.

A high gate signal at the Reset input resets the Q output to low and the NOTQ output to high.

With nothing plugged into the enable input, the flip flop is permanently enabled however with a cable plugged in, a high signal must be present at the input in order to set or reset the flip flop.

T (TOGGLE) FLIP FLOP (SINGLE)

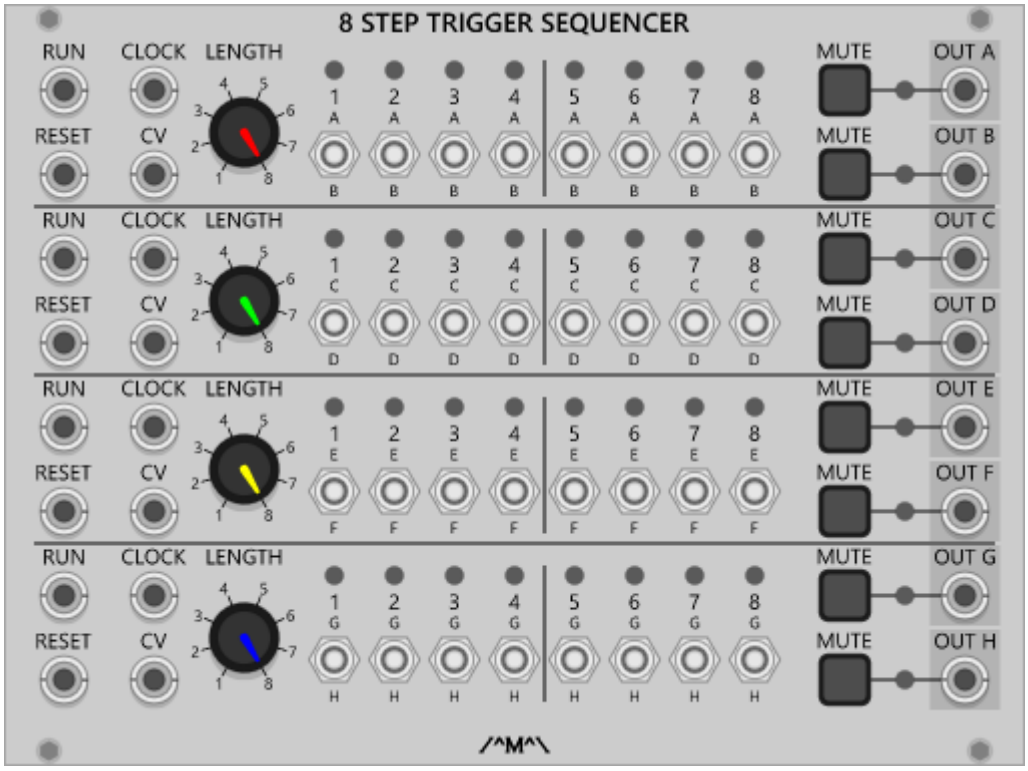
A single Toggle (T type) flip flop with optional enable.

A positive going gate signal at the T input whilst the flip flop is enabled alternates the Q output high and low and the NOTQ output between low and high.

A high gate signal at the Reset input resets the Q output to low and the NOTQ output to high.

With nothing plugged into the enable input, the flip flop is permanently enabled however with a cable plugged in, a high signal must be present at the input in order to set or reset the flip flop.

TRIGGER SEQUENCER – 8 STEP



A set of four 8 Step trigger sequencers in a single panel each with voltage control over the sequence length and two independent outputs.

The Reset input restarts the sequence at step one on the positive edge of the next clock cycle.

The Run input allows the sequencer to be started and stopped by the application of a gate signal with a low gate inhibiting the sequencer and a high gate enabling it. This functions like a pause button and operation resumes at the next clock cycle.

The Run, Clock and Reset inputs of each channel are normalled to the previous channel.

With a cable plugged into CV input, the length switch is disabled and control of the sequence length is determined only by the applied voltage. Full sequence length is achieved with a 10V input. The CV inputs are NOT normalled. The current sequence length is indicated by the small green lights situated next to the step numbers.

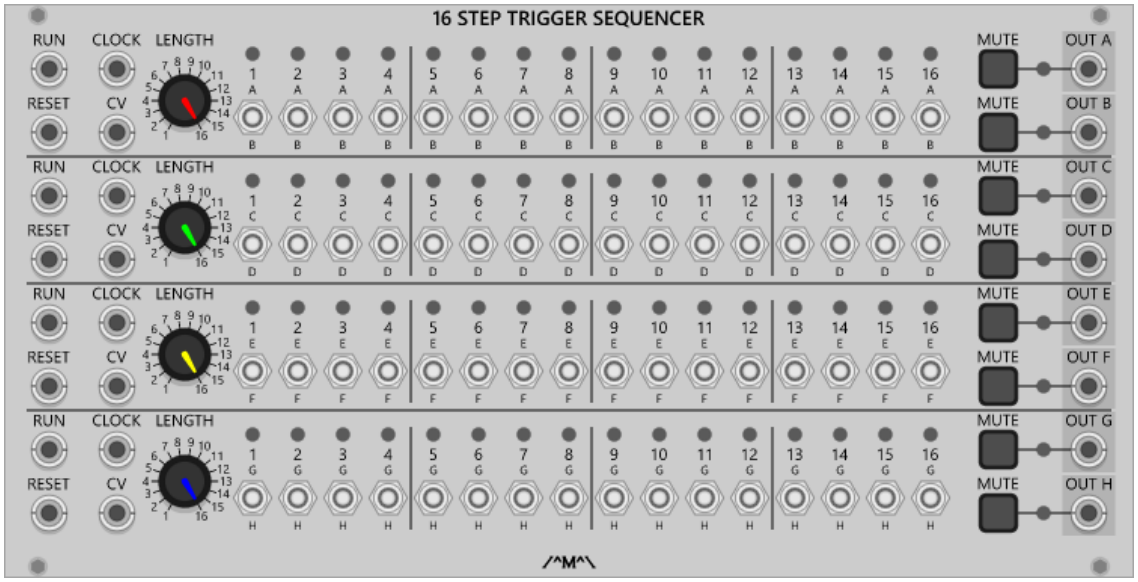
The following context menu options are available to facilitate initialization and randomization of each channel independently:

- *Channel x → Initialize → Entire Channel:* Reset all controls for the given channel to their default values
- *Channel x → Initialize → Gates/Triggers Only:* Reset only the gate/trigger selection switches for the given channel to their default values
- *Channel x → Initialize → Entire Channel:* Set all controls for the given channel to random values
- *Channel x → Initialize → Gates/Triggers Only:* Set only the gate/trigger selection switches for the given channel to random values

The Trigger Sequencer Gate Expander can be used with this module to add a set of 2 gate outputs per channel. The gates follow the trigger outputs except they remain high for the duration of the step rather following the width of the incoming clock.

Refer to the appendix for a list of other expander modules that are compatible with this sequencer.

TRIGGER SEQUENCER - 16 STEP



A set of four 16 Step trigger sequencers in a single panel each with voltage control over the sequence length and two independent outputs.

The Reset input restarts the sequence at step one on the positive edge of the next clock cycle.

The Run input allows the sequencer to be started and stopped by the application of a gate signal with a low gate inhibiting the sequencer and a high gate enabling it. This functions like a pause button and operation resumes at the next clock cycle.

The Run, Clock and Reset inputs of each channel are normalled to the previous channel.

With a cable plugged into CV input, the length switch is disabled and control of the sequence length is determined only by the applied voltage. Full sequence length is achieved with a 10V input. The CV inputs are NOT normalled. The current sequence length is indicated by the small green lights situated next to the step numbers.

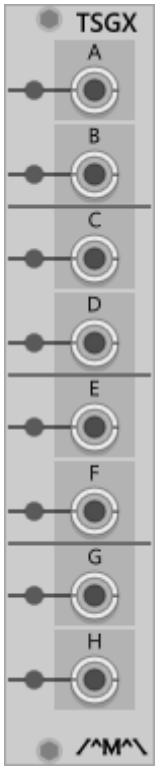
The following context menu options are available to facilitate initialization and randomization of each channel independently:

- *Channel x → Initialize → Entire Channel:* Reset all controls for the given channel to their default values
- *Channel x → Initialize → Gates/Triggers Only:* Reset only the gate/trigger selection switches for the given channel to their default values
- *Channel x → Initialize → Entire Channel:* Set all controls for the given channel to random values
- *Channel x → Initialize → Gates/Triggers Only:* Set only the gate/trigger selection switches for the given channel to random values

The Trigger Sequencer Gate Expander can be used with this module to add a set of 2 gate outputs per channel. The gates follow the trigger outputs except they remain high for the duration of the step rather following the width of the incoming clock.

Refer to the appendix for a list of other expander modules that are compatible with this sequencer.

TRIGGER SEQUENCER GATE EXPANDER (TSGX)



An expander that adds 2 gate outputs for each channel if the 8 and 16 Step Trigger sequencers.

The gates follow the trigger outputs except they remain high for the duration of the step rather following the width of the incoming clock.

Must be placed directly to the right of the trigger sequencer. For the 8 Step Sequencer, any of other expanders can still be used by placing them to the right of the gate expander.

Note this expander will not work with any other sequencers.

VOLTAGE CONTROLLED FREQUENCY DIVIDER MKII

A frequency divider with a variable and voltage controlled division ratio from 1 to around 20.

Can be used with VCOs to create sub octaves or clocks to divide down to lower rates.

Notes:

This module is highly likely to introduce aliasing artefacts when driven with audio frequencies. An anti aliasing mode is planned for a future release.

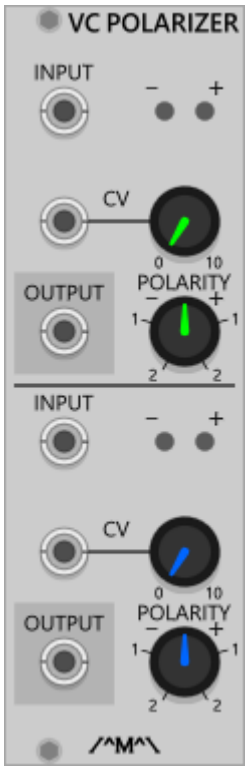
The MkII module differs from the original version in two ways:

- It has switches for the division controls rather than the freely adjustable knobs to make it easier to dial in the desired division ratios.
- The correct division ratios including odd divisions are now used (1, 2, 3, 4, 5 etc rather than 1, 2, 4, 6, 8, 10 etc)

For those with old patches requiring the behaviour of the original version or who simply prefer the way it worked, the MkII module can be switched over to "Legacy Mode" via an option in the module context menu.

Notes on converting old patches to use the MkII version of this module can be found in the Superseded Module section of this manual.

VOLTAGE CONTROLLED POLARIZER



A dual voltage processor that inverts or “polarizes” the incoming signal under manual/voltage control.

A negative control voltage at the CV input (with the Polarity control at 12:00) will invert the input signal and the amplitude of the CV signal will control the output amplitude. The Polarity amount is summed with the CV amount before being applied.

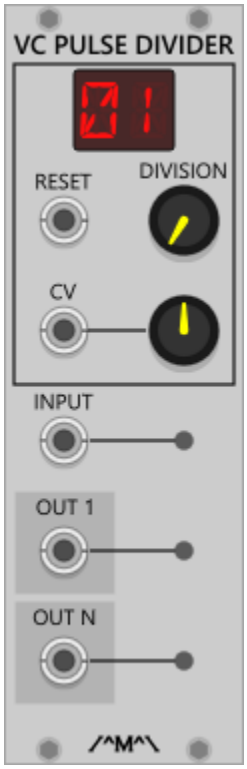
This module is also capable of 2 x amplification. Amplification starts when the Polarity control is taken past 1 or -or the CV input level is 100% with a 5V CV applied (i.e. 10V = x 2 amplification).

The status LEDs indicate the polarization status not the incoming signal levels

This module can process polyphonic signals. All channels are polarized by the same amount.

Applying audio rates to the CV input may result in aliasing artefacts.

VOLTAGE CONTROLLED PULSE DIVIDER



A divider with a variable and voltage controlled division ratio from 1 to 32 that has been designed specifically for clock and gate signals. Whilst the VC Frequency Divider does function with clocks and gates, phase inversions can occur when dividing by odd numbers which may not be desirable in some circumstances. Unlike the frequency divider which outputs a square wave based on the frequency of the incoming signal, the VC Pulse Divider outputs a single pulse for every N pulses it receives with a width the same as the input pulse that is occurring at the selected division.

The "Out 1" output is set on the 1st pulse after a reset pulse is received and then ever N pulses after that.

The "Out N" output is set on the Nth pulse after a reset pulse is received then ever N pulses after that.

When the divisor is reduced, the "out N" output will be set if the current pulse count is greater than, or equal to, the new value.

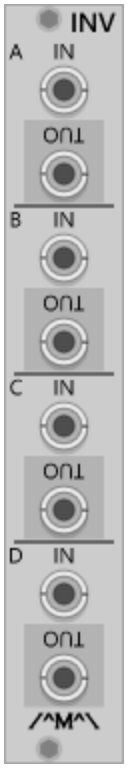
VOLTAGE CONTROLLED SWITCH

Selects between 2 inputs or routes 1 input to one two outputs based on the level of the signal at the CV input.

This module can process polyphonic signals. All channels are switched by the same control voltage.

A fully polyphonic version “Poly VC Switch” is also available.

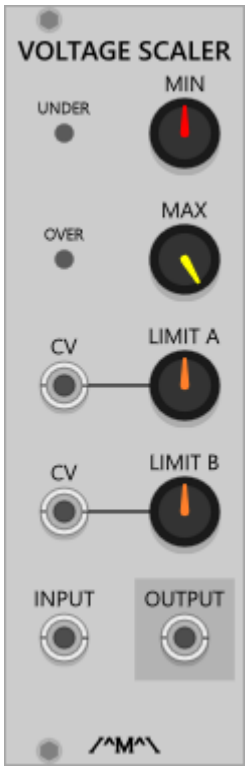
VOLTAGE INVERTER



A quad voltage inverter. Unlike the Boolean Logic Inverter, this module inverts around zero. Positive voltage in become a negative voltage out and vice-versa.

This module can process polyphonic signals.

VOLTAGE SCALER



The Voltage Scaler translates input voltages within a defined range to another voltage-controlled range and can be used to re-scale and/or offset any voltage.

The Min and Max knobs set the expected input voltage range. Any voltages presented to the input that are outside the selected range will be indicated by the under/over LEDs and will be clipped to keep them within range.

Limit A and Limit B determine how the input voltage will be rescaled with the lowest of the two limits defining the output value that a voltage equal to the value set by the Min parameter will map to. The highest of the two limits determine the output voltage that a voltage equal to the Max parameter will map to.

Examples:

MIN	MAX	LIMIT A	LIMIT B	INPUT	OUTPUT
0	10	0	5	0	0
0	10	0	5	5	2.5
0	10	0	5	10	5
0	5	3	10	0	3
0	5	3	10	3	7.2
0	5	3	10	5	10
0	10	-2	2	5	0
0	10	-2	2	7.5	1

When cables are connected to the CV inputs, the knobs become attenuverters.

Note that applying audio rate signals to the CV inputs may introduce aliasing artefacts.

This module can process polyphonic signals. All inputs are processed with the same scale settings.

CGS BASED MODULES

A nod to the genius of Ken Stone, these are some of my favourite CGS designs realised in VCV Rack format.

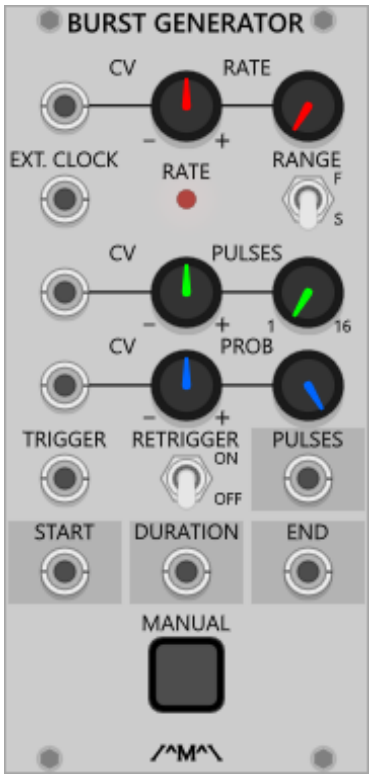
CV SPREADER

This module accepts two CV inputs, "Base" and "Spread" and creates a set of new CV values that are spread either side of the base value by an amount determined by the spread value.

The Odd/Even switch determines whether the spread occurs around the base value (odd spread) or not (even spread).

With the spread value at 0, each output merely reflects the value at the base input however as the spread value increases or decreases, the spread outputs will increase or decrease by 1/5th of the spread value. A 5 volt spread input with a 0 volt base input will produce outputs that are 1 volt apart ranging from -5 to +5 volts.

BURST GENERATOR



This module generates bursts of 1-16 pulses whenever a trigger is received at the trigger input.

The pulses can be generated internally or via an external clock at the Ext. Clock input. Where the internal clock is used, the pulses are synchronised to start when the trigger is received however when using an external clock, the pulses will start at the next rising edge of the incoming clock.

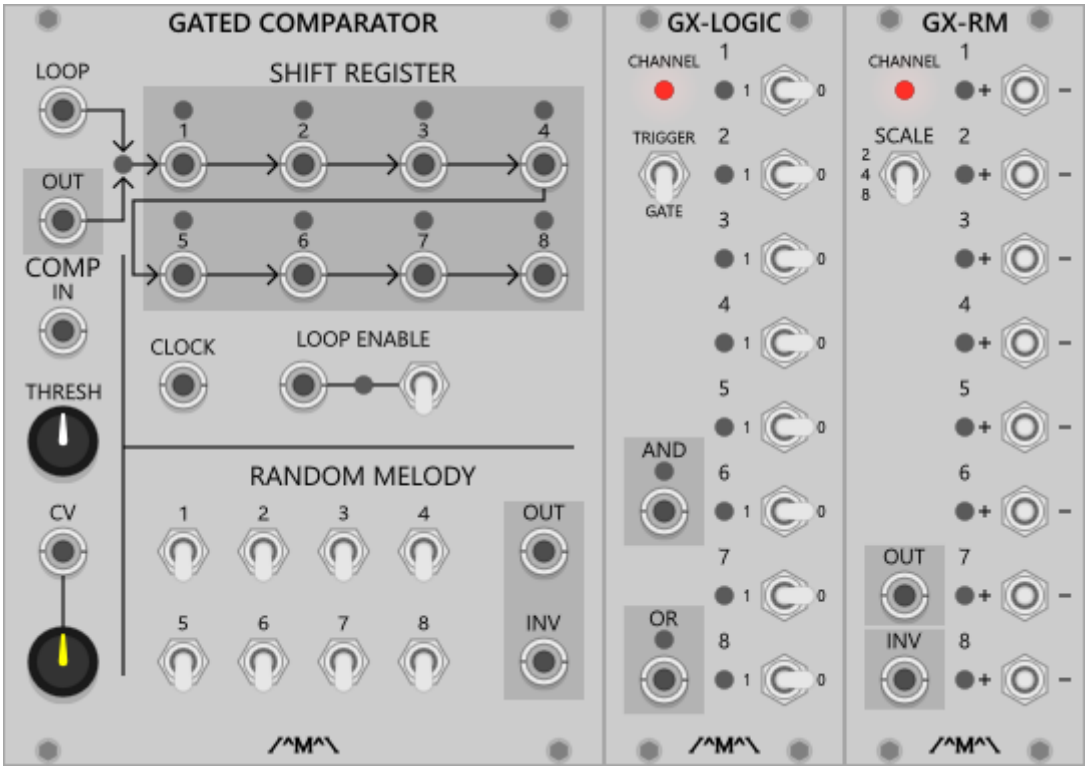
The number of pulses per burst and internal burst rate and can both be independently controlled via CV with the Range switch determining whether the internal burst rate is slow or fast.

The probability of each pulse firing within a burst is determined by the Prob knob and associated input. With the knob fully clockwise, the probability is 100% and every pulse in the burst will fire. As the knob is rotated CCW that probability decreases.

The retrigger switch sets whether the burst generator must wait until the current burst of pulses is complete before it can be triggered again or if it can interrupt the current burst and start again immediately.

Two outputs Start and End, each give a pulse at the start of the burst and end of the burst respectively whilst a third output, Duration, offers a gate signal that lasts for the duration of the burst.

GATED COMPARATOR



The gated comparator is a binary shift register fed by a comparator and coupled to a basic "digital to analogue" converter which can be used to generate Random sequences.

The input section is a fairly standard comparator having a signal input, a threshold control and voltage control over the threshold level. When the input signal is greater than the sum of the manual Threshold and CV threshold amounts, the comparator will output a high gate signal which is also sent to the input of the shift register.

With each positive going clock edge, the values of each of the Shift Register section outputs are "shifted" right to their next adjacent output (or down to row 2 in the case of the 4th output) and the value of the comparator output is "shifted" into position 1.

The shift register features a loop input that allows an external gate signal to fed into the shift register and can be used to chain Gated Comparator module together by connecting the final output of the first module to the Loop Input of the second module with its loop function enabled. The loop input can be enabled/disabled via the Loop Enable switch and Loop Enable input. The input overrides the switch and requires a high gate signal (> 2 Volts) to enable the loop. The last bit will need to be manually connected to the loop input if you wish to recycle the shift register values once they have been loaded.

Note that the loop input is ORed with the output of the comparator section, so it is possible to very quickly fill the register with high values.

The Random Melody section functions as a digital to analogue converted with the switches determining which of the currently active Shift Register bits are used when determining the output voltage which will range from 0 with no active bits to 8V with all bits active. Each switch is binary weighted with switch 1 equating to 1/255th of 8V and switch 8 equating to 128/255ths of 8V.

The following expander modules are available for the Gated Comparator:

- GX-RM: Adds another channel of Random Melody CV output. This module functions like the Random Melody section of the Gated Comparator only with selectable polarity on the CV generated for each bit. It also adds a scale switch to select the maximum CV range to be output.
- GX-LOGIC: Adds logic processing of the shift register bits. The AND output will be high whenever there are "on" shift register bits that match all of the switches that are in the “1” position whilst the OR output will be high whenever there are "on" shift register bits that match any of the switches that are in the “1” position.

Although these expanders will function with other sequencer modules, their usefulness may be limited. Refer to the appendix for a complete list of expander compatible modules.

The Sequencer Expander modules work with the gated comparator however they do function a little bit differently to when they are attached to a sequencer:

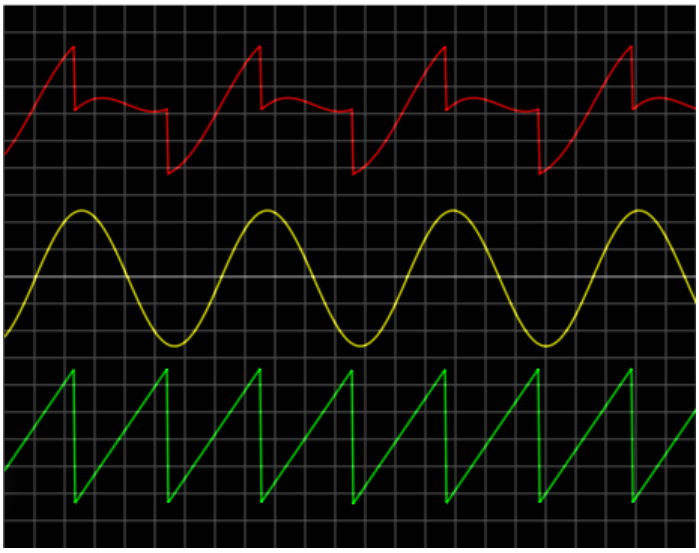
- SX-OUT8: Adds an extra set of outputs that follow the main shift register outputs however they can be set to operate as triggers or gates. The Trigger/Gate switch which determines whether the outputs stay high for the duration of the step (gate) or follow the clock width (trigger)
- SX-CV8: Adds a set of CV outputs that function like the CV strip of the Basic Sequencer except that the active step is addressed by the binary value of the shift register rather than being sequential.
- SX-TRIG8: Adds a set of selectable Gate/Trigger outputs that function like the Gate/Trigger selection strip of the Basic Sequencer except that the active step is addressed by the binary value shift register rather than being sequential.

HYPER MANIACAL LFO AND LFO EXPANDER

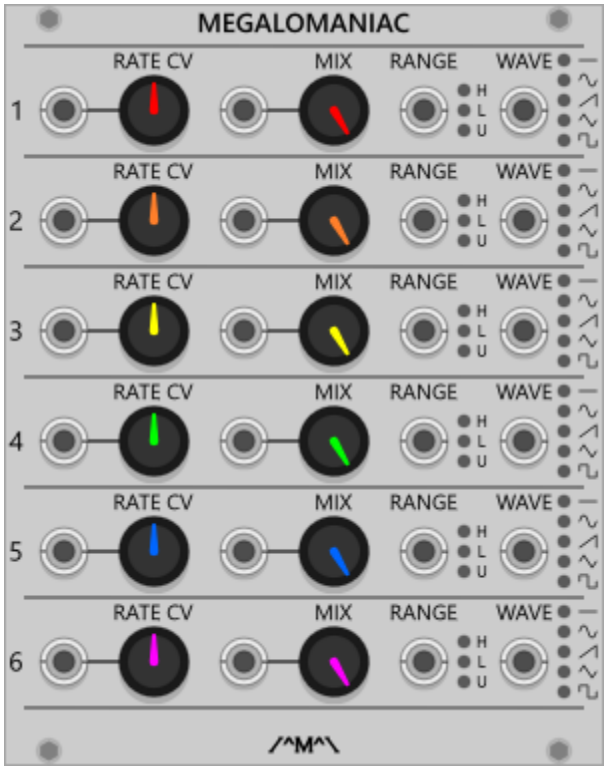
Based on the CGS Super Psycho LFO, this module expands on that concept by adding extra range, extra waveforms and an expander to break out the individual LFO waveforms.

Up to six LFO waveforms are mixed then optionally slewed (glide) to create a single complex LFO waveform. The output can be unipolar or bipolar. The expander is exclusively bipolar and the outputs remain present when the associated LFO switch is in the off position.

The following scope trace shows an example using only LFO 1 and 2 with no slew. The top trace is the HMLFO output, the other two are the constituent waveforms taken from the expander:



MEGALOMANIAC CV CONTROL EXPANDER



The Megalomaniac module adds CV control over the individual LFO settings on the Hyper Maniacal LFO (HMLFO).

The Megalomaniac must be placed to the immediate left of the HMLFO in order to function.

The rate of each LFO can be controlled via the Rate CV input with Rate CV Knob attenuverting the given CV amount before it is added to the Rate knob value on the HMLFO.

The Mix knobs control the amount of the associated LFO that is mixed into the final HMLFO output. With no cable connected to a Mix input, the knob simply acts as a level control for the associated LFO. When a cable is connected to a mix input, the knob acts as an attenuator for the signal which is then used to control the level of the associated LFO. These basically operate like a voltage controlled mixer.

The Range input allows voltage addressed selection of the associated LFO's range (Hi, Low or Ultra-low). With a cable plugged into the Range input, the Range switch on the HMLFO is disabled and selection of the LFO's range is determined only by the applied voltage which responds as follows:

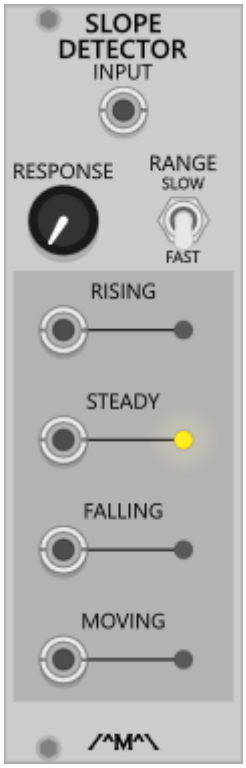
Input Voltage	Range
< 2.000	Ultra Low
2.000 to 3.999	Low
4.000 +	High

The Wave input allows voltage addressed selection of the associated LFO's waveform. With a cable plugged into the Wave input, the Wave switch on the HMLFO is disabled and selection of the LFO's waveform is determined only by the applied voltage which responds as follows:

Input Voltage	Waveform
< 2.000	Off
2.000 to 3.999	Sine
4.000 to 5.999	Saw
6.000 to 7.999	Triangle
8.000 +	Square

One thing to note is that feedback patching to the voltage selection could result in no output if the "Off" voltage range is presented to the input. This can be avoided by offsetting and scaling the feedback voltage accordingly.

SLOPE DETECTOR

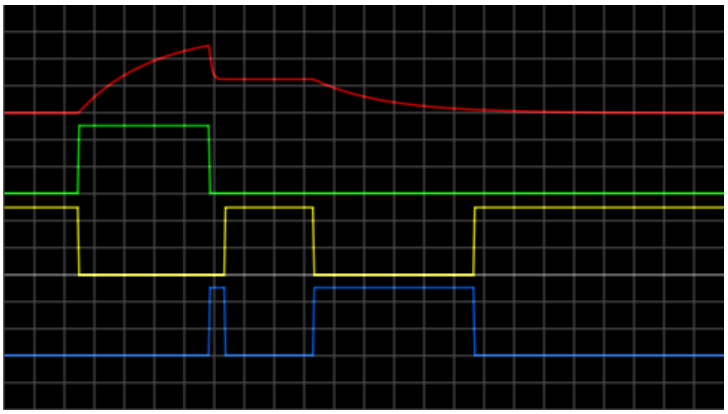


The slope detector generates gate pulses from a CV input based on whether it is rising, falling, steady, or moving.

The Sense control determines how fast it responds to change and the range switch doubles the response time to cater for very slowly changing inputs. This module may generate multiple triggers if a fast response time is used on a slow moving CV input. If this occurs, the response time should be increased until the multiple triggers cease.

NOTE: The detector functions by comparing the input CV signal with a slewed version (the slew is amount set by the Response control) and sets the rising/falling outputs when there is a positive or negative difference between the two voltages that is greater than 10mv. As such, there can be a little bit of lead or lag in the switching of the outputs depending on the chosen response setting and direction (rising/falling) of the input CV.

The following oscilloscope capture shows how the Slope Detector functions when it is fed with an ADSR envelope:



- The red trace shows the CV input.
- The green trace shows that during the Attack stage of the envelope, the Rising output which is high.
- The yellow trace shows that the Steady output is high up until the start of the attack stage, during the Sustain stage and then again as the Release stage approaches zero volts.
- The blue trace shows the Falling output going high during both the Decay and Release stages.

SUPERSEDED MODULES

The modules in this section have been superseded. The information presented here is for the benefit of users opening/converting old patch files to use the replacement versions.

POLYRHYTHMIC GENERATOR (ORIGINAL VERSION)

This version of the Polyrhythmic Generator has a bug in it which means it cannot perform the odd divisions that it was intended to and is dividing by 2, 4, 6, 8 rather than 1, 2 ,3, 4, 5 etc. Unfortunately, there was no way to rectify this without breaking existing patches so this version has been retained for the time being however it is now deprecated and will no longer be supported. Users should convert any existing patches to use the new version ASAP as it is not likely to be ported across to the next incarnation of Rack.

Existing patches can be converted to use the new version using the following method:

1. If not already turned on, turn Parameter Tooltips on from the Rack Main Menu (View->Parameter Tooltips).
2. Add the MkII version module to your patch and duplicate the settings of all but the division controls.
3. Starting at the top channel and working down, hover the mouse over the division control and note the value.
4. Find the row in the table below where the value of the old control fits between the "From" and "To" values and set the equivalent control in the new module to the value in the right-hand column.
5. Repeat for the other seven dividers (or however many you are using in your patch).
6. Drag the inputs/outputs from the old module to the same inputs/outputs on the new module.
7. Finally, set the module into "Legacy Mode" via the module menu and your patch should sound the same as it used to although you may need to tweak the CV controls slightly if the patch does not sound quite right.

Old Module Values		**Mk II Values**
From	To	Use
0.000	0.666	1
0.667	1.333	2
1.334	1.999	3
2.000	2.666	4
2.667	3.333	5
3.334	3.999	6
4.000	4.666	7
4.667	5.333	8
5.334	5.999	9
6.000	6.665	10
6.666	7.331	11
7.332	7.997	12
7.998	8.663	13
8.664	9.329	14
9.330	9.995	15
9.996	10.000	16

VOLTAGE CONTROLLED FREQUENCY DIVIDER (ORIGINAL VERSION)

This version of the Voltage Controlled Frequency Divider has a bug in it which means it cannot perform the odd divisions that it was intended to and is dividing by 2, 4, 6, 8 rather than 1, 2 ,3, 4, 5 etc. Unfortunately, there was no way to rectify this without breaking existing patches so this version has been retained for the time being however it is now deprecated and will no longer be supported. Users should convert any existing patches to use the new version ASAP as it is not likely to be ported across to the next incarnation of Rack.

Existing patches can be converted to use the new version using the following method:

1. If not already turned on, turn Parameter Tooltips on from the Rack Main Menu (View->Parameter Tooltips).
2. Add the MkII version module to your patch and duplicate the settings of the CV control.
3. Hover the mouse over the division control and note the value.
4. Find the row in the table below where the value of the old control fits between the "From" and "To" values and set the division control in the new module to the value in the right-hand column.
5. Drag the inputs/outputs from the old module to the same inputs/outputs on the new module.
6. Finally, set the module into "Legacy Mode" via the module menu and your patch should sound the same as it used to although you may need to tweak the CV control slightly if the patch does not sound quite right.

Old Module Values		**Mk II Values**
From	To	Use
0.000	0.500	1
0.501	0.999	2
1.000	1.499	3
1.500	1.999	4
2.000	2.499	5
2.500	2.999	6
3.000	3.499	7
3.500	3.999	8
4.000	4.499	9
4.500	4.999	10
5.000	5.499	11
5.500	5.999	12
6.000	6.499	13
6.500	6.999	14
7.000	7.499	15
7.500	7.999	16
8.000	8.499	17
8.500	8.999	18
9.000	9.499	19
9.500	9.999	20
10.000	10.000	21

APPENDIX

SEQUENCER/EXPANDER COMPATIBILITY

The table below outlines which expander modules are compatible with which sequencer modules:

	SX-CV8: Sequencer CV Expander	SX-OUT8: Sequencer Output Expander	SX-TRIG8: Sequencer Trigger Expander	GX-RM: Gated Comparator Expander – Random Melody	GX-LOGIC: Gated Comparator Expander - Gate Logic	TSGX: Trigger Sequencer Gate Expander	CRGX-CV: Clocked Random Gate CV Expander	CRGX-LOG: Clocked Random Gate Logic Expander	ESX-CV: Euclidean Sequencer Expander	Seq. Channel 8: 8 Step Sequencer Channel Expander	Seq. Channel 16: 16 Step Sequencer Channel Expander	Seq. Gate Expander (SG8)	Seq. Gate Expander (SG16)	Octet Trigger Sequencer CV Expander
Basic Sequencer	●	●	●	●	●									
Binary Sequencer	●	●	●	●	●									
Dual 8 Step Sequencer	●	●	●	●	●									
8 Step Trigger Sequencer	●	●	●	●	●	●								
Gated Comparator	●	●	●	●	●									
16 Step Trigger Sequencer						●								
Euclidean Sequencer									●					
8 Step Sequencer										●		●		
16 Step Sequencer											●		●	
8 x 8 Gate Sequencer														
8 x 16 Gate Sequencer														
Clocked Random Gates							●	●						
Octet Trigger Sequencer														●

Refer to the manual sections for the specific expanders to determine how the expander will behave when connected to a particular module.

The 8 x8 and 8 x 16 Gate Sequencers are not expandable.