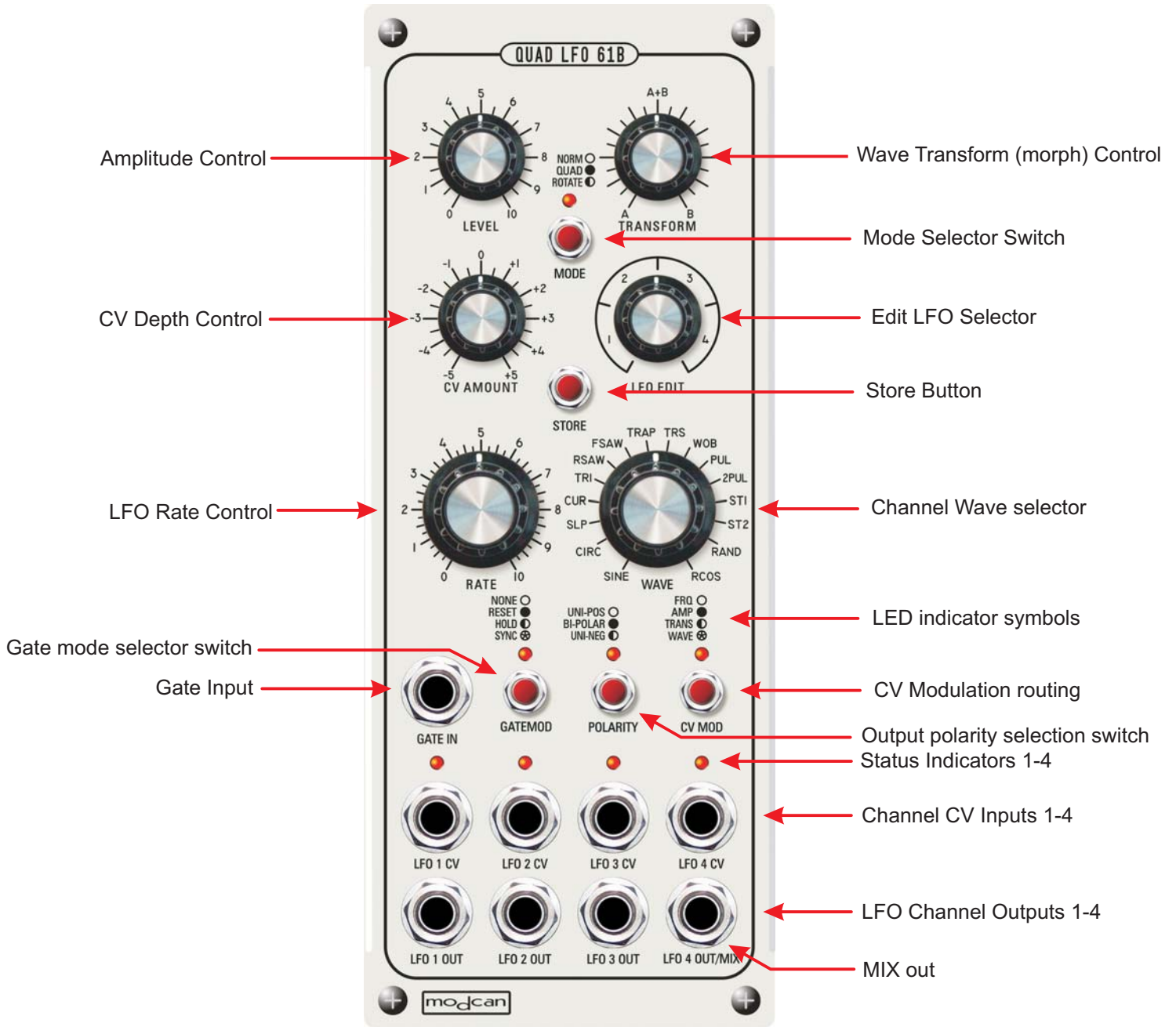


Quad LFO 61B

Panel Control Locations



Quad LFO 61B Section 1

Introduction: 1.1

The Quad LFO is the second in a series of modules that represents a new approach in User Interface design for Modcan modules. The intent is to combine multiple iterations of otherwise single module functions, in this case an LFO, into a high density module with large feature set that maximizes panel space and control hardware. As a result many features may not be readily apparent from the front panel alone. The following sections will attempt to help the user grasp the somewhat complex UI and discover that it is both highly versatile and like any other musical instrument, becomes easier to navigate with practice. It is possible to use the Quad LFO in its simplest modes and still get a lot of functionality. There are a LOT of features built into this module, with a few that may require some reading to implement. Again to use the musical instrument example, a little study will be greatly rewarded with a deeper knowledge of the powerful and unique features that lurk within.

Basic Concepts 1.2

Each of the 4 LFOs share the same panel control knobs and switches for setting parameters. Each LFO has its own output jack and CV input. The GATE IN jack and its functions are applied to each LFO independently but share the same switch and jack.

When first powering up the module the "PATCH" values for knobs and switches are loaded automatically from internal EEPROM, restoring the unit to a previous state from the last time a STORE was completed. The main control for editing patch settings is the LFO EDIT knob. Placing this knob in any of the four quadrants selects the current LFO for edit. Once the LFO to edit has been selected moving the knobs or toggling switches will override the saved values and become "live" for the selected LFO. Depressing the STORE button will write the new edit values to memory if desired otherwise can be used as a temporary edit that will not be saved when powered down. The new edited settings are retained in a temporary buffer allowing the LFO EDIT knob to select another LFO for edit and allowing you to return to the previous LFO to edit again later. Parameters do not need to be STORED between edits but may be good practice in the event of a power glitch.

Knob edit modes: 1.3

There are two knob edit modes available. They are switched by first powering off the module and then depressing and holding the MODE switch button will powering the module on. This will toggle between the two states. Pressing the STORE button will save the chosen state so that it will be the default state next time the module is powered up. No need to depress the MODE switch after this has been done unless you want to switch to the other **knob edit mode**. The modes are explained next.

Instant Edit Mode: In this mode moving the knobs will cause the knobs value to "Jump" from the saved value to the new knob position value the instant the knobs are moved. The pros to this are no need to align the knob to the former value stored in memory before editing can occur. Cons are that you can't make a minor tweak to the value easily when switching between LFOs to edit and no visual feedback from knob regarding previously stored values. **This is the default factory MODE** as it is the one I prefer.

Alignment Edit Mode: In this mode the knob is moved till it aligns with the value stored in memory. Moving the knob will not edit the value till it is in approximately in the same position as the last time it was stored to memory. This is also true if switching between LFOs. Editing LFO 1 and then moving the LFO2 and then back to 1 the knobs will need to be re-aligned to continue editing. The main benefit to this style of editing is no sudden jump to a new value, allowing for minor adjustments to stored values. Also it allows the user to see the knobs previous position when last saved or edited.

The sequence of events for editing: 1.4

- 1/Select LFO to edit using LFO EDIT knob.
- 2/ Change knob settings and switches for selected LFO. Make sure selected LFO is patched to another module so you can hear the effect of changing parameters.
- 3/Press STORE button to save edited values or select another LFO for edit and do 1 and 2 above.

Quad LFO 61B Section 2

Panel KNOB Definitions:

Panel knob settings are assigned to each of the 4 LFOs independently based on EDIT knob position.

AMPLITUDE: Knob sets the initial level or peak to peak amplitude of the LFO waveform output in conjunction with the Polarity switch which sets the +/- polarity of the output for each LFO (see below). With Polarity set to +5V the peak to peak output is 0-5V+, when +/-5V the range is 0V to +/-5V, set to -5V the range is 0 to -5V

CV AMOUNT: Knob sets the amount or depth of CV modulation between the source CV Channel input jack and the modulation destination. Positioning the knob near center results in 0 modulation depth with fully CW rotation adding positive values and CCW subtracting from values initially set with panel controls. i.e. when modulating amplitude it subtracts or adds to the initial value set by the amplitude control knob. The destinations for modulation are set with CV MOD switch and include, WAVE AMPLITUDE, WAVE TRANSFORM, LFO RATE and WAVEFORM SELECTION. See below for more info on the CV MOD switch. Any or all of the above modulation destinations can be assigned with individual CV AMOUNT settings for each destination. There is only one CV jack per channel so it will be shared by all destinations. If no CV is required for a particular destination just set to center 0 position for off.

TRANSFORM: This control has different functions depending on the waveform selected by the WAVE knob. A graphic representation of the waves with their transformed shapes is on last page of this document. For most of the waves the TRANSFORM is like a morph or blend function. It allows two waves to be gradually "transformed" from one to the other shape. For example, with Triangle wave selected the output is a Tri Wave when Transform control is fully CCW and a square wave when fully CW. The in between settings result in a blend of the two wave shapes dependant on knob position. There are no less than 4096 different wave shapes between these two extremes. The transition will sound more gradual than this number implies however as the increments are small. The WAVES named in the wave list are at the fully CCW position of the TRANSFORM Control knob. The waves at the other end of the "MORPH" are not named but are depicted in the TRANSFORM graphics on page 4. The CV AMOUNT and CV input can also be used to transform the waves using external CVs.

LFO EDIT: The LFO Edit knob selects the target LFO for editing. This is a pot not a switch so there are no click stops to reference. For best results place the knob line indicator pointing directly at the numbers in the dial graphics or at least within the approximate centers of the quadrants indicated. Setting the knob for LFO1 makes that LFO "live" for editing using the other panel knobs and switches. Switching to LFO2 stops editing in LFO1 and activates LFO2 for edit. The settings made in LFO1 are not lost and can be returned to for further editing by moving the EDIT control back to LFO1 position. Nothing is saved at this point but pressing the STORE button will commit the edits to EEPROM memory and will be reloaded on next power-up. The EEPROM retention spec. is typically 100 years.

RATE Control: Pretty simple this one. Adjusts the LFO rate or frequency. Exponential curve response with a 19.1 Octave range of .0008 Hz (1 cycle every 20.8 minutes) to 500Hz. The CV AMOUNT and CV input can also be used to modulate the rate using external CVs.

WAVE Control: This knob selects the waveform for each LFO. The numbers, starting at 0 on the dial graphic correspond with the WAVE chart printed on the panel. See page 4 for graphics of waves available. The CV AMOUNT and CV input can also be used for wave selection using external CVs.

Quad LFO 61B Section 3

Panel SWITCH Definitions:

Panel switch settings are assigned to each of the 4 LFOs independently based on EDIT knob position. The MODE switch is a global assignment and applies to all 4 LFOs, not independently. Depressing the MODE switch while powering on the module is used to set the knob edit mode as discussed in Section 1.3

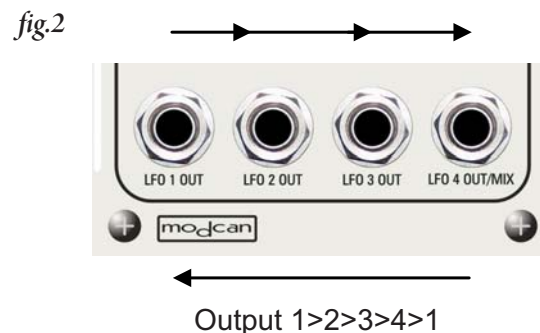
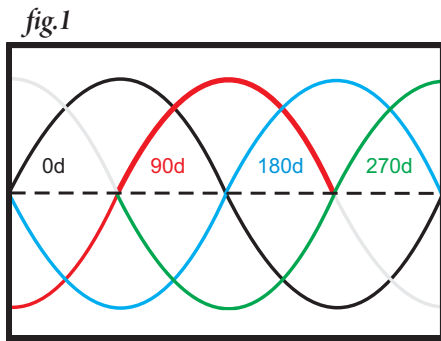
MODE Switch: This switch sets the operation MODE for the module. Each of the three modes applies globally across all 4 LFOs and can have a dramatic effect on the modules function. Depressing the switch increments through the three modes with LED indicator lit according to state.

Mode 1 NORMAL=Mode LED OFF:

In this mode the module functions a 4 independant LFOs with EDIT KNOB used to select the LFO to edit.

Mode 2 QUADRATURE=Mode LED ON:

This mode puts the module into a quadrature state with only settings on channel one applying to all 4 LFOs. Editing the other 3 channels will have no effect. The output waves on channel 1-4 are in quadrature phase with each other. Ch1 = 0 degrees, Ch2 = 90, Ch3 = 180, Ch4 = 270 degrees. See *fig. 1* for illustration of phases on a sine wave. Quadrature mode is useful when patched with the 4VCA module. Each of the 4 outputs can be patched to the CV inputs of the 4VCA to be used for Quad panning in a quadraphonic speaker system. Patching the 4VCA mix out would give you 4way cross-fading. It can also be used to sequence 4 Envelope generators or a variety of other quad patches.



Mode 3 ROTATE=Mode LED BLINK:

This is a unique mode that responds to pulses on the GATE IN jack. The result is that each of the 4 LFOs outputs rotate one jack to the right with each new pulse in. Despite the fact that this is a global MODE each of the 4 LFOs can be edited as in NORMAL mode with all switch, Gate, and knob functions applied to each LFO independently. It is only the ordering of the outputs that are modified in this mode. See *fig.2* The Gate pulse controls the rotate stepping but can also be used with the GATE MOD functions simultaneously if selected by the GATE MOD switch. The **Output 1-4 Status LEDs do not rotate**. This provides some visual feedback if editing the LFOs in this mode. Rotating the LEDs would make it difficult to see what changes are being made by knob edits etc.

Store Button: The Store button is used to save edited parameters to memory for future sessions. All knobs and switch states are saved for all of the 4 LFOs. No need to save each LFO separately. A short depress is all that is required. The 4 Output LEDs will sequence 1-4 once to show that a save has been successful.

Polarity Switch: This Switch controls the peak to peak voltage of the outputs for each channel.

+5V=LED OFF: Output is positive only with peak of 0-5V+ on the selected LFO channel.

+/-5V=LED ON: Peak to Peak is +/-5V

-5V=LED BLINK: The output swings only negative between -5V and 0 or ground.

First select the LFO channel with the EDIT knob, then set the chosen polarity for that channel by incrementing the

Quad LFO 61B Section 4

Panel SWITCH Definitions continued:

CV Modulation Overview.

Each of the 4 LFOs has its own CV jack for external modulation control. There are 4 modulation control destinations that can be assigned using the CV MOD switch. Each destination has a separate Depth set by the CV AMOUNT knob. All of the destinations can be assigned or none. Setting the CV AMOUNT knob to center effectively shuts off the modulation to the selected routing. One LFO can modulate another and is a great way to create a complex patch. An LFO can even modulate itself, leading to unpredictable results but it is possible.

CV MOD Switch: Use this switch to internally assign the routing or destination of the LFO channel CV input jack. This switch has 4 states. Each of the destinations shares one CV input jack. Therefore modulating the frequency and amplitude will be done with the same modulation source. The CV AMOUNT knob sets the level and polarity of modulation for each destination and can be set to differing amounts for each. Rotating the CV AMT right of center adds while left of center subtracts. This helps to compensate for the limitations of sharing one jack for all 4 mod routings. Like all the switches, pressing repeatedly increments the switches state.

Modulation Destinations:

RATE=MOD LED OFF: In this state the CV input is routed to the LFO RATE. If LFO is at maximum frequency no amount of CV will increase the LFO rate. Only subtracting by setting the CV AMT knob left of center will have any effect.

AMP=MOD LED ON: Routes the CV to the AMP(itude) destination. This allows for CV control of output level for each of the LFO channels. This is a great function for changing the depth of vibrato etc.

TRANS=MOD LED BLINK: Sends the CV to the TRANSFORM destination. Shape is the function that allows changes to the waveform shapes as discussed in Section 2.

WAVE=MOD LED Double BLINK: Fast LED blinking indicates CV routing to the WAVE destination. This allows CV control of waveform selection.

GATE MOD Selection Switch:

There are 4 different modes for GATE INPUT jack routing. Only one mode is available at any one time but any of the 4 modes can be applied to Each of the 4 LFOs independently. Set to off position on selected LFO for no GATE effect. The LED updates to show GATE MOD selections for each channel as EDIT selector changes channels.

NONE=GATE MOD LED OFF: Set to this position if no GATE effect is required

RESET= GATE MOD LED ON: In this mode pulses on the GATE IN jack will reset the LFO channel to wave start with each new pulse. This is a good mode if you want to use the LFO wave like an envelope shape to control pitch or filter cutoff etc.

HOLD= GATE MOD LED BLINK: Holding the GATE IN Jack high using a square wave or any +5V source voltage will cause the LFO to freeze in position. The LFO will resume once the GATE IN goes low (0V). This can be useful in Quadrature mode as it allows you to freeze panning position or as an effect for modulation.

SYNC= GATE MOD LED Double BLINK: This is a very unique mode and one you won't find on any other modular LFO. It allows the use of a clock or second LFO to set the RATE or frequency of the selected channel. This can be very useful for synchronizing the LFO rate with a sequence or other timed events. The Staircase waves are very good in this mode to simulate the effects of an arpeggiator. Try setting all channels to SYNC, then using the ROTATE function for sequenced LFOs synchronized to a clock. Changing the clock speed will alter the rate and sequence tempo in step. The range is 600Hz-0.003Hz and is extremely precise (32bit accuracy)

Quad LFO 61B Section 5

I/O Jack definitions:

Gate IN: There is only one jack for gate input signals. The GATE MOD destination switch assigns this jack to the various GATE MOD routings that have been previously covered in Section 4. Gate signals are typically 0-5V+ and are usually a square or pulse shape. On this module they can be any shape and between +3V and +10V when high.

CV INPUTS: Each LFO has its own CV input jack. These are routed to the various CV modulation destinations by the CV MOD Switch. The maximum input level that will be accepted at these jacks is +/-5V. Positive (0-5V+) and negative (0-5V-) can also be used.

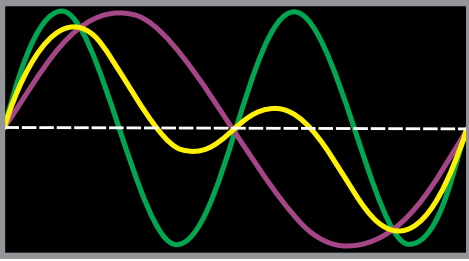
LFO Outputs: These are the main outputs for each of the 4 LFOs, The output amplitude can range between 0V and +/-5V depending on the AMP settings in each LFO setup. These outs can be patched back into the LFO CV inputs to enable modulation between LFOs.

MIX Out: This output is available by using a special INSERT cable. Insert cables have a stereo plug that splits the signal out to two mono cables with tip wired to one, and ring wired to the second cable. Both outputs are available simultaneously from the one jack.

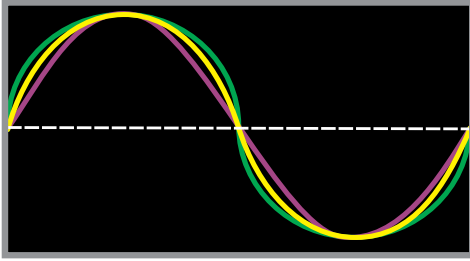
The MIX is available on the RING connection in this case. LFO Output 4 can still be used as normal on the TIP connected cable. The MIX is a sum off all 4 LFOs on one output. The signal has been reduced by half otherwise the output could be as high as +/-15V and clipping would occur. When using this output it is wise to set the individual LFO Amplitude levels to at least half down to reduce clipping and keep the signal from being too hot.

WAVES

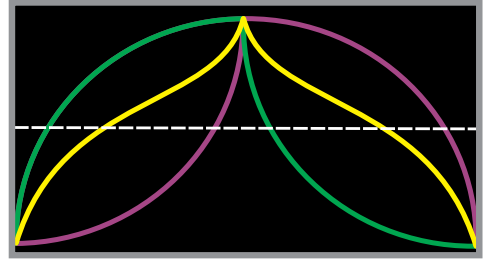
WAVE 0 SINE>DOUBLE SINE



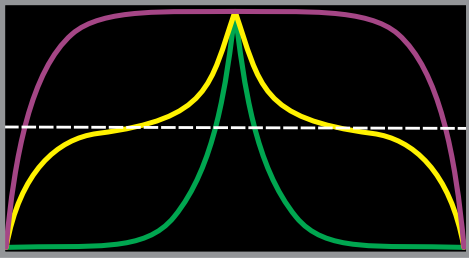
WAVE 1 CIRCLE>SINE



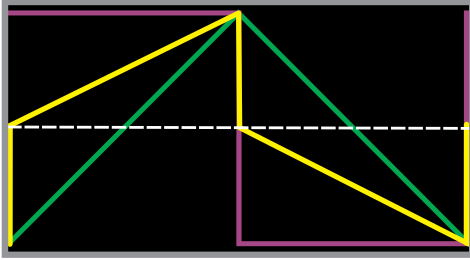
WAVE 2 CURVE L>CURVE R



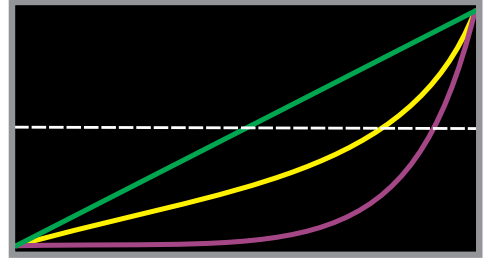
WAVE 3 PEAK(EXPO)>LOG



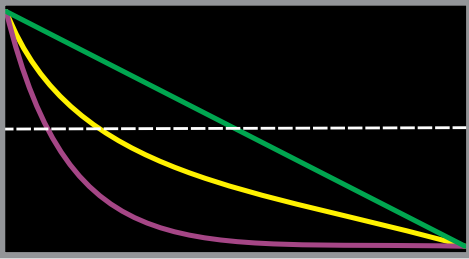
WAVE 4 TRIANGLE>SQUARE



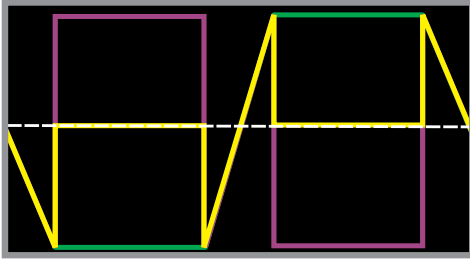
WAVE 5 SAW>EXPO



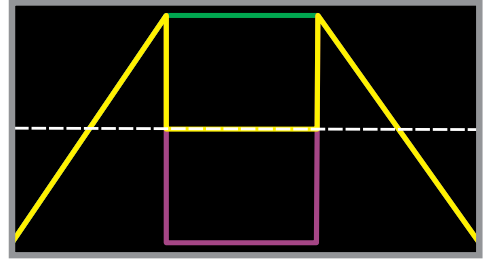
WAVE 6 INVSAW>INVEXPO



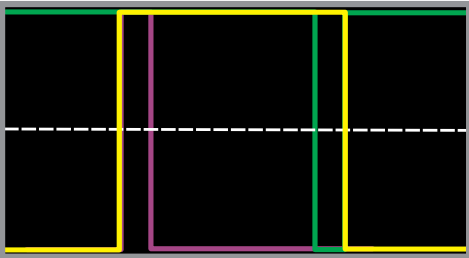
WAVE 7 TRAPAZOID>SLOT



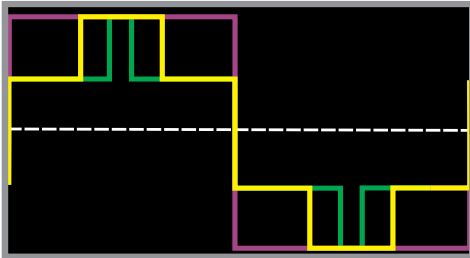
WAVE 8 TRI>SLOT



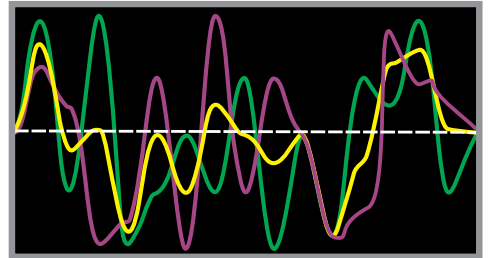
WAVE 9 PULSE with PWM



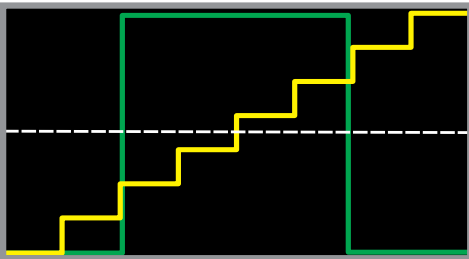
WAVE 10 DOUBLE PULSE with PWM



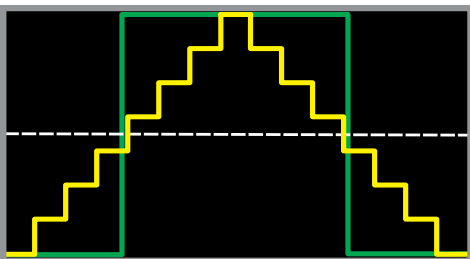
WAVE 11 WOBBLE1>WOBBLE2



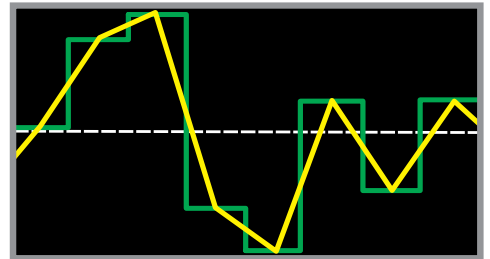
WAVE 12 STAIR UP 1-16 steps



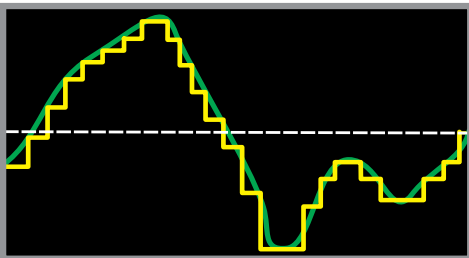
WAVE 13 STAIR UP/DOWN 1-16 steps.



WAVE 14 RANDOM STEP with SLEW



WAVE 15 COSINE RANDOM>smooth and step



- =TRANSFORM KNOB CCW
- =TRANSFORM KNOB CENTER
- =TRANSFORM KNOB CW