ALMØ34 'Pamela's Pro Workout'

Operation Manual / Version 0.35 / Firmware 128

January 14, 2025

Contents

I INTRODUCTION

'Pamela's PRO Workout' is a compact programmable clocked modulation source for your Euro-rack modular system. It provides 8 highly editable outputs producing various control voltage signals correlated and synced to a BPM based master clock.

Each output can provide everything from simple clocked triggers, complex rhythmic wave-forms, quantised melodic patterns to random chaos with direct and assignable CV control over numerous parameters. These features together with a quick and easy to use interface provide almost limitless synced modulation possibilities in a tiny space.

Building on the original 'Pamela's Workout' & 'Pamela's NEW Workout' the evolved 'PRO' Pam maintains the precursor's form factor and intuitive workflow but improves and adds many new features with upgraded hardware, more CV inputs, a new full colour hi res display and rewrit-ten software adding many new enhancements like micro grid timings and cross output mod-ulations.

Through optional expander modules more CV input and outputs can be added with support for external non euro equipment through Midi and Din Sync outputs.

Please enjoy your next generation PRO workout!

2 FEATURES
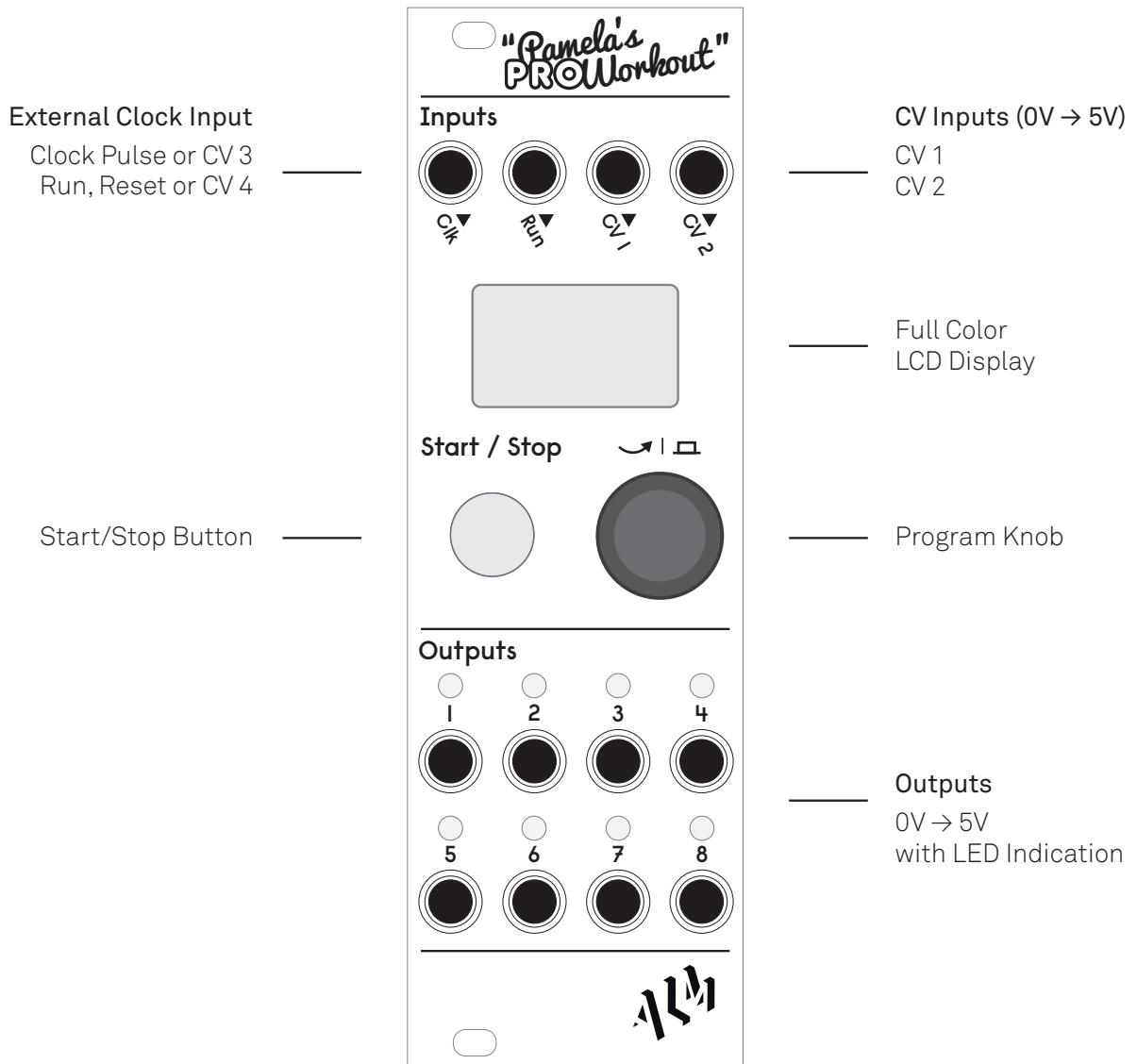
- BPM based clock with tempo rates 10-330BPM.

- Real time intuitive EASY and quick theme-able user interface with full colour high resolution display.

- 8 Clocked voltage outputs each with independent adjustable;

  - Clock divisors and multipliers from /16384 to x192 including various non-integer factors.

  - Numerous waveform types from staples to envelopes to ratchets to random.

  - waveform level, offset, phase and shaping control.

  - Extensive Euclidean, probability and beat based looping for pattern creation.

  - Cross output modulation with numerous operations.

  - Off grid 'Flex' micro timing for swing, human and bouncing ball type timing effects.

- All output parameters assignable up to x4 built in CV inputs with individual offset, attenuation and metering.

- Per output and group saving and loading to 64 banks.

- All settings remain between power cycles.

- Voltage and direct control of clock stop/start, reset and external syncing.

- Support for expander modules for additional CV in and outputs.

- USB-C for quick and easy 'drag and drop' firmware updates and memory bank backup via computer.

- Skiff friendly with reverse power protection.

- Made in England.

2.1 Technical Specifications

- **Size:** 8HP

- **Power:** +12v 60ma / -12v 10ma

- **Depth:** 32mm (approx with power header)

- **Outputs:** 0-5v buffered low impedance. 12 bit res. 3.8khz max update freq.

- **Inputs:** CV 0v-5v / Clock, Run - rising edge 700mV min.

3   CORE OPERATION

3.1   Panel Layout

External Clock Input
Clock Pulse or CV 3
Run, Reset or CV 4

Inputs

CV Inputs (0V → 5V)
CV 1
CV 2

Full Color
LCD Display

Start / Stop

Start/Stop Button

Program Knob

Outputs

1   2   3   4

Outputs
0V → 5V
with LED Indication

5   6   7   8
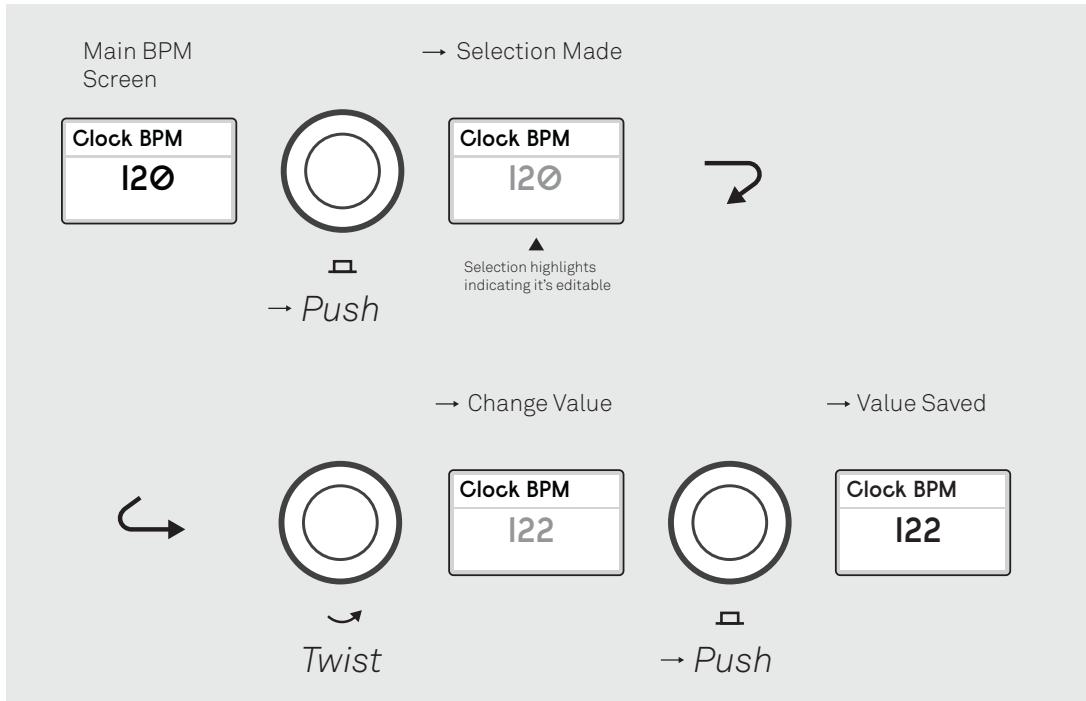
3.2   Getting Started

If you are already acquainted with the original Pamela then usage of the PRO workout will be very familiar but hopefully clearer and much more feature rich.

When initially powered on, Pamela's PRO Workout's display shows the current clock tempo setting in beats per minute (BPM). Clicking and then twisting the main blue program knob highlights and then adjusts this BPM value between its maximum and minimum values when turned. Clicking again deselects.

Clicking the 'Start / Stop' button starts the clock with this selected BPM tempo shown on the display. With the clock now running, synced voltage are sent through each of the output jacks, the level indicated by their relevant green LED's.
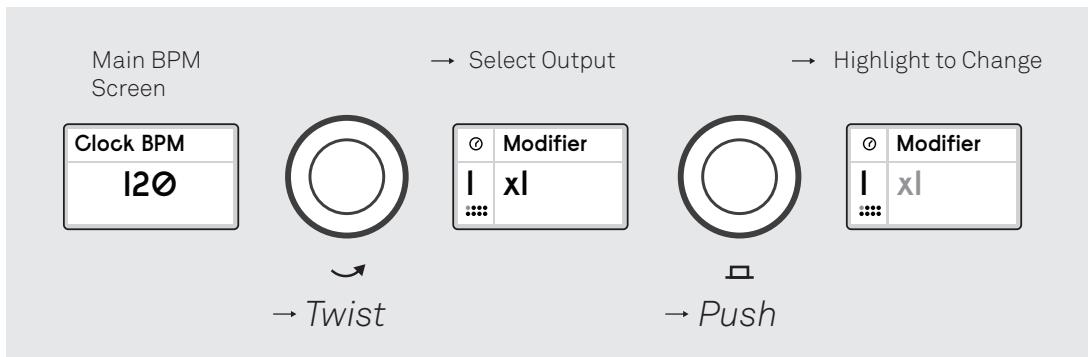
Clicking the 'Start / Stop' button again stops and resets the clock.

3.3   Basic Per Output Modifier Adjustment

The timing of each output can modified to either divisors or multiples of the main clock tempo. For example, a modifier of 'x2' means there will be two steps or output pulses per beat. A modifier of '/2' means a pulse every other beat and a step size of two beats.

Outputs can also be set to stay permanently on or off, to just trigger once at clock start or stop, or be assigned to external control via a CV input – more on these 'utility' outputs later...

To adjust an output modifier from the BPM display (unselected) twisting the program knob will now cycle through each of the eight numbered output 'screens' before returning back to the main BPM screen.

Main BPM Screen → Select Output → Highlight to Change

Clock BPM **120** → Twist → Push

Each output is represented by the output number (on left) together with the current set modifier value for that output. The modifier value is either a multiplier, a divider or a 'utility' value correlated to the set BPM clock speed.

Not all modifier values are integers - some are decimal values for triplet and dotted type timings.

As previously mentioned, there are also 4 special 'utility' types of modifier mainly for working with external devices; GATE - a held high voltage when playing useful for syncing 'run' signals, OFF - no output, START - a single initial start pulse and STOP - a single final pulse fired when the clock stops. The START and STOP pulses are useful for resetting any synced sequencers.

There are also 4 special 'triggered' modifier types which will only start outputing when a trigger is received in an assigned input (and Pam is playing). They basically behave as envelopes. They have time set in beats (combined with width being a fine tune for envelope like wave shapes) and other values made adjustable via a reduced set of relevant parameters.
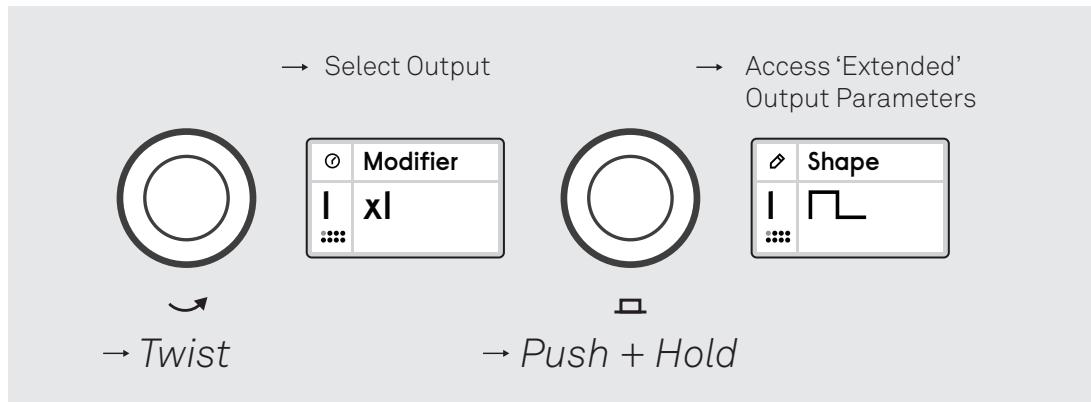
Clicking the program knob will highlight the selected modifier and turning will cycle through the available values. Clicking again will exit.

3.4   Extended Per Trigger Adjustment

Each output can be further adjusted through 'extended parameter settings' allowing for very complex clock synced modulations and rhythmic sequences. These extended parameters can be split into 3 categories; those which alter the output wave shape with respect to the modifier timing, those which algorithmically skip or adjust timing steps (allowing rhythmic patterns to be built) and then saving, loading and reset of an output parameter setup.

Note the extended parameters are not available for the special utility modifier types.

With an output screen selected, pushing and holding the program knob for just over 1 second will access the extended output parameter selection.

The various parameters can be cycled through and edited using the program knob just as when editing output modifiers. To exit back up to the main output modifier screen, click and hold the program knob again for just over 1 second.

Many output parameter values are in percentages of total 'step time'. The step time is derived from the selected trigger modifier. For example a divisor of /2 would have a step time of 2 beats, *4 would be a quarter of a beat.

Any output parameter value can also be assigned to be CV controlled via any of the available CV inputs. See the Voltage control section for more info on this.

Certain parameters will only appear if a 'parent' is enabled. Please see the Output Parameter reference chapter below for info on each of the output parameters.

TIP: *The program knob hold time can be adjusted - see the SETTINGS chapter*

4 OUTPUT PARAMETER REFERENCE

4.1 Shape

Select between various output waveforms. Shaping of the waveforms can be made by altering the width and slew parameters (if available).

waveforms include;
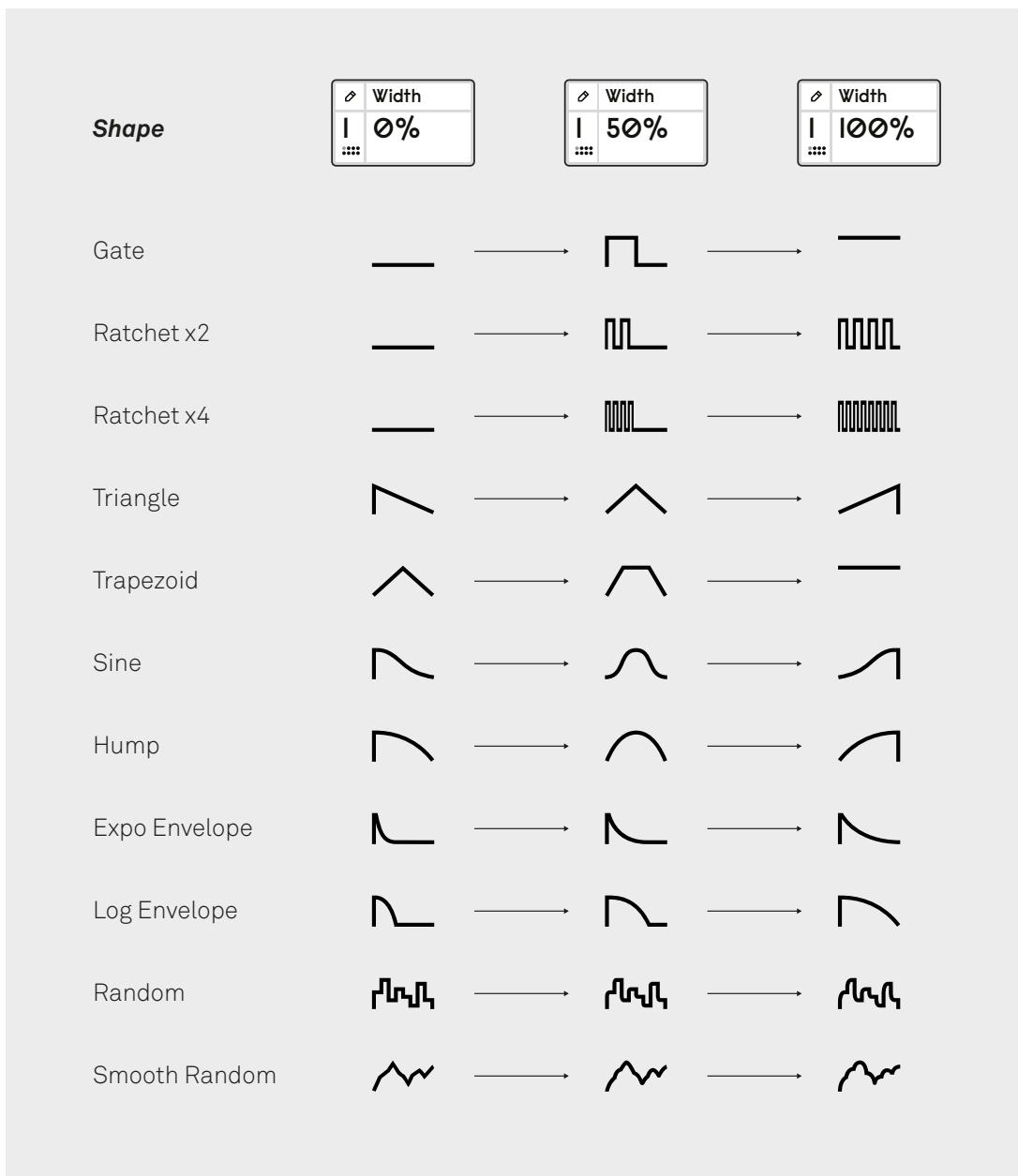
- **Gate/Pulse** - A Pulse/Square wave. Width controls pulse width.

- **Ratchet x2** - A Pulse wave split into quarters. Width makes more pulses available.

- **Ratchet x4** - A Pulse wave split into eighths. Width makes more pulses available.

- **Triangle** - A Triangle wave. Width controls slew (i,e making it more Saw/Envelope like).

- **Trapezoid** - A Triangle wave with a flat top. Width will effectively morph between a pulse to triangle.

- **Sine** - A Sine Wave. Width will 'lean' to either side.

- **Hump** - Half a sine wave / Parabola. Width will 'lean' waveform to either side.

- **Exp Envelope** - A exponential like envelope. Width controls time.

- **Log Envelope** - A logarithmic like envelope. Width controls time.

- **Classic Random** - A Sample & Hold style random wave. Slew smooths the edges of the wave.

- **Smooth Random** - A bouncy 'mario hills' musical kind of random.. Width controls roundness.

A full cycle of a waveform covers a single step. If a step is skipped no voltage will be output (excluding any set offset voltage) or held if the case of a random waveform.

Random waveforms can be looped across a number of beats using the *Loop* parameter. The actual loop (its random 'seed') can also be saved for later recall.

4.2 Width / Slew

The affect of width / slew differs depending on the selected shape. As shown below.

Shape	Width 0%	Width 50%	Width 100%
Gate	—	⌐_	—
Ratchet x2	—	⊓⊓_	⊓⊓⊓⊓
Ratchet x4	—	⊓⊓⊓_	⊓⊓⊓⊓⊓
Triangle	⟍	⋀	⟋
Trapezoid	⋀	⊓	—
Sine	⟍	⌢	⟋
Hump	⟍	⌒	⟋
Expo Envelope	⌐	⌐	⟍
Log Envelope	⌐	⌐	⟍
Random	⌢⌐⌐	⌢⌐⌐	⌢⌐⌐
Smooth Random	⌒⌒	⌒⌒	⌒⌒

For random waveforms an additional slew parameter is made available. This smooths the edges of the random wave.

4.3 Level

This sets the overall maximum voltage level of the output as a percentage of 0-5V.

TIP: *Each 20% is essentially 1 volt.*

4.4 Offset

This sets the initial bias or offset from zero volts as a percentage of 0-5V.

TIP: *By setting an output's Level to 0, Offset can then be used as programmable constant voltage output useful for internal and external modulation and even preset storage.*

4.5 Phase

This allows for the phase shift on a waveform.

TIP: *Keep in mind phase wraps. Shifting a trigger pulse with a greater than 50% width by more than 50% can cause unexpected double triggering.*

4.6 Probability

This is the percentage likelihood a 'step' will occur or be skipped with no effective output.

Random patterns created using this function can be looped across beats (using the *Loop* parameter) and saved.

4.7 Euclidean Patterns

Euclidean rhythms are made from a simple algorithm which takes a numbers of steps and triggers (active steps) and produces a pattern based the on hits being as equidistant from each other as possible. See `https://en.wikipedia.org/wiki/Euclidean_rhythm` for more info.

Pamela is able to map Euclidean patterns to an output and to then skip steps when they are not triggered. This can used to build up rhythmic patterns. The Loop parameter can also be used to 'reset' non 4/4 patterns.

Four parameters are available for setting up a pattern.

The parameters are:

4.7.1 Steps

Sets the number of steps used for a full Euclidean pattern. Steps must be greater than zero for other parameters to appear.

4.7.2 Triggers

Sets the number of 'triggers' or 'hits' for Euclidean pattern generation. Must be more than zero and less than the number of steps to produce a pattern (unless under CV control).

4.7.3 Pad
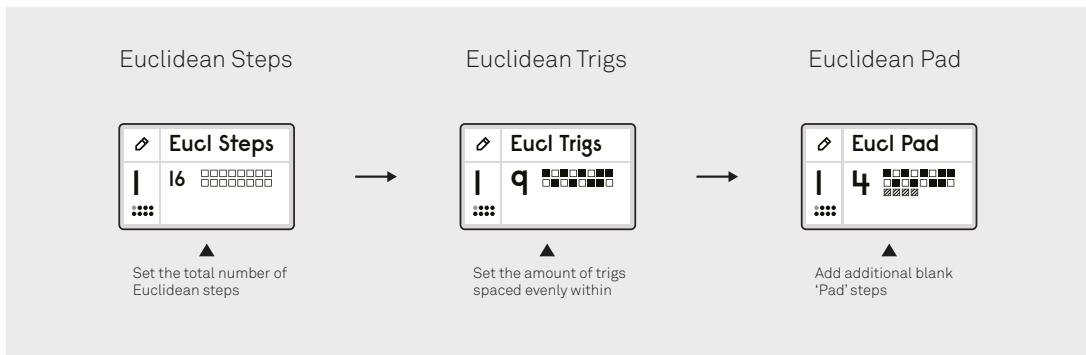
Adds empty padding steps to the end of the generated pattern. This can be useful to break up the regularity of an Euclidean pattern and group triggers to the begin, middle or end of a

looped pattern.

4.7.4 Shift

Rotates the defined Euclidean pattern by the specified number of steps effectively changing the patterns start position.

Across all Euclidean parameters a visual grid shows the created pattern.

Euclidean Steps

Set the total number of
Euclidean steps

Euclidean Trigs

Set the amount of trigs
spaced evenly within

Euclidean Pad

Add additional blank
'Pad' steps

4.8 Loops

Specifies the number of actual beats (*not steps*) at which the output is effectively reset. Loops can be thought of as an inbuilt reset/rewind mechanism for random, flex ops and Euclidean as to build repeating patterns that are more musically structured.

When a Loop is active a couple of other parameters are made available;

4.8.1 Loop Nap

The number of complete loops to 'sleep' the output for - i.e shut off the output.

4.8.2 Loop Wake
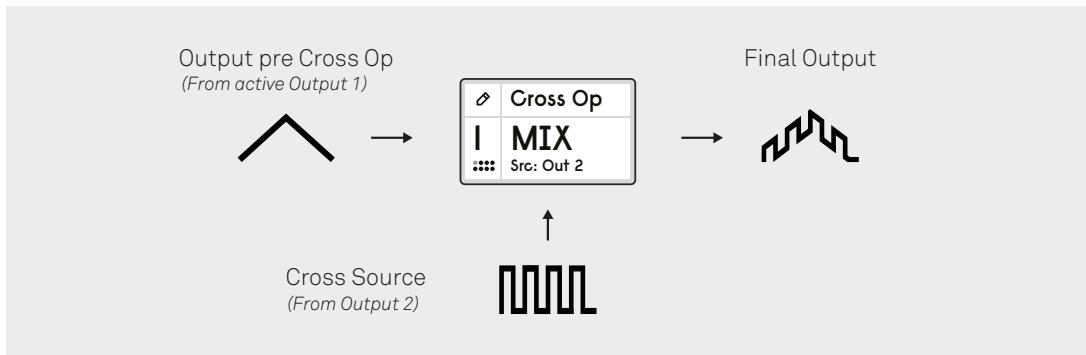
The number of complete loops to run before napping (if any set).

4.8.3 Loop Shift

Offsets (by number of complete loops) the starting point of the Nap/Wake cycle. This parameter lacks CV contol.

4.9 Cross Operations

Cross operations allow for the value of the current selected active output to be influenced by the value of another output or CV input (source) dependant on a selected operation. This could be a simple as mixing two outputs together, a logic operation or something more complex like sample and hold or a parameter reset.

This greatly extends the original Pamela's NEW Workout logic operations (and also includes these).

To activate, the *CROSS OP* parameter is set to a selected operation other than 'None'. A *CROSS SRC* parameter then becomes available to select the cross modulation source.

The cross source '*IN1*' and '*IN2*' options enable the selected cross operation with the actual sampled voltage value at either the CV1 or CV2 inputs (rather than an actual output value). The '*CVx*' option allow for voltage control of the actual cross source output number (i.e 1-8) rather than the sampled CV value.

It should be noted that when combining with a CV input value (i.e *IN1* or *IN2*), the sampled CV is of lower resolution than when combing with an actual output.

The cross source '*Axon A*' and '*Axon b*' options allow for the cross source to be one of the buttons on an Axon 2 expander. A button source will have no value until pressed and then a max value. This can be useful for actions like quickly reseting an outputs randomess (i.e when assigned to SEED - see below) for example.

These Axon options are lowlighted and inactive if an Axon 2 isn't connected or the buttons are not assigned to 'Cross Src' in the Axon button settings.

Cross operations happen prior to any quantisation.

The operations are described as follows;

4.9.1 MIX

Adds both source and active output value and halves total.

4.9.2 MULT

Multiplies the two output values and scales (i.e essentially a ring mod).

4.9.3 ADD

Adds both output values together, clips any overflows.

4.9.4 SUB

Subtracts both output values from one another, clip any overflows.

4.9.5 MIN

The minimum between the two output values.

4.9.6 MAX

The maximum between the two output values.

4.9.7 HOLD

If source output value is greater than zero the active output value is frozen with its last value.

4.9.8 S&H

A rising trigger on source will cause the current destination output value to be 'sampled' and held at that value until next trigger.

4.9.9 MASK

If the source output value is zero then the active output value is too. See 'NOT' for the inverse of this.

4.9.10 NOT

If source output value is greater than zero then active output value is zero.

4.9.11 OR

A basic boolean logic OR operation of both output values. Will only output max or zero volts (i.e like CMOS logic gates).

4.9.12 XOR

A basic boolean logic logic XOR operation of both output values. Will only output max or zero volts (i.e like CMOS logic gates).

4.9.13 AND

A basic boolean logic AND operation of both output values. Will only output max or zero volts (i.e like CMOS logic gates).

4.9.14 BitOR

Bit wise (over basic boolean) logic OR operation of both output values. The final value is dependant on all set bits of the output value rather than just a simple on/off.

4.9.15 BitXOR

Bit wise logic XOR operation of both output values.

4.9.16 BitAND

Bit wise logic AND operation of both output values.

4.9.17 SEED

A rising trigger will reset any random seeds on the active output. Useful for 'Krell' type patches.

4.10   FLEX Operations

Flex operation can be thought of 'micro timings' or off grid blips which can lead to chaos at extremes.

As well as selecting the Flex operation, you can also select an amount percentage value which increases the intensity of the timing effect to extremes.

The RAMP & HUMP operations exponentially change timings for 'bouncing ball' type effects. A desired effect is likely also dependant on the initial output modifier setting and may well take some experimentation.

4.10.1 HUMAN

Introduces human like random timing errors.

(Previously known as 'Slop' on PNW.)

4.10.2 SWING

Delays each alternate step by the set amount for a swing or shuffle like timing effect.

4.10.3 RAMP UP

Gradually increases the step time causing any modulations to accelerate depending on the set amount.

You can use the *Loop* parameter to reset the timing factor back to its original timing.

4.10.4 RAMP DOWN

Gradually decreases the step time causing any modulations to de-accelerate depending on the set amount.

You can use the *Loop* parameter to reset the timing factor back to its original timing.

4.10.5 HUMP

Repeatedly increases and then decreases the step time based on the set Flex Amount. You can use *Loop* to reset the timing factor back to its original timing.

4.10.6 DELAY

Delays any output of a single step waveform cycle by the specified percentage essentially shifting and potentially cropping the waveform end. To shift the waveform without cropping see the top level 'Phase' parameter.

(This previously was the 'Delay' parameter behaviour on PNW.)

4.10.7 PWR2

Depending on the amount % the step time is increased by a power of 2 (i.e continuously doubled). This is intended for ratchet like effects with the amount parameter being CV controlled.

TIP: *Modulated flex operations on random waveforms and patterns can produce some very unique results*

4.11 Invert

Inverts the final output value.

4.12 Quantiser

Quantises the final output value as to fit in a selected musical scale or mode with the 1V/octave standard.

4.12.1 Saving custom scales

Its possible to save up to 3 different user scales which are saved across power cycles.

To do so; With selection mode active and a User scale selected, a long hold on the program knob will enter edit mode where a custom mode can be edited. Rotating and clicking the program knob will toggle notes used in the scale. Long holding the program knob again will exit.

4.13 Scope

Displays a visual representation of the output waveform updated in real-time.

Selecting (i.e clicking the program knob) toggle a full screen view of the scope.

Turning the program knob zooms in and out.

4.14 Load, Save and Reset

Allows the loading and saving of an output and its parameters for later recall.

Reset allows you to reset all output parameters to their default simple 50% pulse like state or Reset the random 'seed'. Reseting the Seed will cause any loop Random parameters (i.e probably , waveform) to have new random values.

TIP: *Load/Save can also be used to 'copy/paste' an output to another.*

4.15   Key Shortcuts

There are a couple of key 'shortcuts' or combos which can be useful when editing parameters. They are:

- With an output parameter screen active, holding start/stop button down and turning the program knob will quickly move between the same parameter for different outputs.

- Holding start/stop and clicking the program knob will toggle mute the current active output.

5   EXTERNAL CV MODULATION

As well as direct user control, Pamela's clock and outputs can be assigned to external voltage control via 4 upper external signal inputs - 'Clk', 'Run', 'CV 1' & 'CV 2'. To use 'Clk' & 'Run' as CV inputs you must set them to expect CV (see Setting section below) otherwise they will appear as greyed out options.
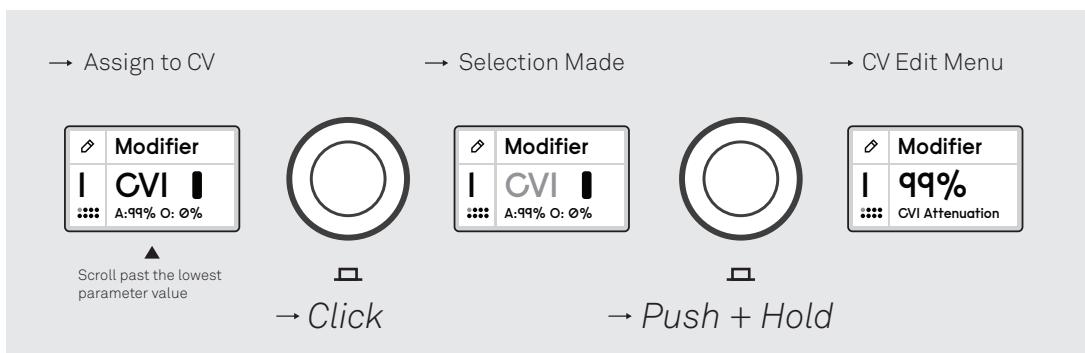
5.1   CV Assigning

An output modifier and many of its extended parameters can be externally voltage controlled by assigning its parameter value to any of the enabled CV inputs.

All CVs respond to voltages between 0 and 5v. Voltages input outside of this range are safe but will be ignored.

5.2   CV Attenuation and Offset

With a value assigned to a CV input, it can be further controlled by setting a per parameter attenuation and offset value to the incoming CV value. Pushing and holding the program knob knob whilst a parameter CV option is highlighted (in selection) will access sub screens to set these values as well as provide the ability to visually monitor the applied CV value.

The set attenuation value can be either positive or negative which in effect inverts the CV value (i.e just like an attenuverter)

Multiple parameters can be assigned to the same CV input and each parameter has its own attenuation and offset parameters. Multiple CVs can not be assigned to the same parameter.

5.3   Axon-1 & Axon-2

The optional Axon expander modules provide additional CV inputs for the PRO. To assign an additional input to a parameter, press the associated 'assign' button on the expander or assign via expanded parameter CV menu list.

See Appendix III for setup and connection info. Only a single Axon is supported per Pam module.

6   SETTINGS

By long holding the program knob on the BPM screen this allow you to access various setting parameter screens. These include:

6.1   Input: Clk

Defines the action of the 'Clk' Input. It can be set too;

- *CLOCK* sets the input to receive an external regular pulsed signal of which to sync to. The PPQN (see below) setting must match that of the extrenal clock.

- *CV* Sets the 'Clk' input as an additional CV input that can be assigned to various output parameters

- *NEXT BANK* Will load the next numbered bank when 'Clk' receives a trigger. When the last bank is reached it will cycle back to the first.

6.1.1   EXT Clock PPQN

Defines the expected 'Pulses Per Quarter Note' for external clocking. It is recommended you keep this value at the default 24 and that the external clock is also set to 24.

6.2   Input: Run

Defines the action of the 'Run' Input. It can be set too;

- *RUN* expects a gate like signal which sets the clock running when high, stopped when low. Recommended you use this when syncing as gives Pam a chance to 'pre sync' - connect to the Din Sync or (converted) MIDI clock run signal.

- *RESET* Resets a running Pam to initial step when a trigger pulse is received. Will also cause Pam to automatically start and stop when an external clock is detected (at least 2 pulses before starting).

- *CV* Sets the 'Run' input as an additional CV input that can be assigned to various output parameters

- *PREV BANK* Will load the previous numbered bank when 'Run' receives a trigger. Will cycle to the last bank when the first bank is active.

- *ROTATE* When this option is selected a trigger into the run input will rotate a range of outputs. Two new settings screens will appear - '*Rotate Start*' & '*Rotate End*'. These allow the output range and direction to be set (directly and by CV). When clock is running, rotated outputs are non editable. When the clock is stopped they will move back to there original position.

6.3   UI Theme

Allows you to select a visual theme for the user interface.

6.4   Enc Hold Time

Sets the time for a 'held' program knob to be registered.

6.5   Load Bank

Loads an entire bank (all 8 outputs) and current bpm.

6.6   Save Bank

Saves an entire bank (all 8 outputs) and saved bpm.

6.7   Reset All

Resets all outputs to their initial state.

7 EXTERNAL CLOCK SYNCING

Pamela can be driven by, and thus sync to, an external clock. This could be something simple like a square wave LFO or something slightly more complex like a Din Sync or convert MIDI clock signal from external hardware patched into the 'Clk' and run inputs. You can also control the tempo directly with just a voltage level.

For syncing to work, Pam needs to know the external clock's number of ticks (i.e clock pulses) to a quarter note (i.e beat) - this is known as the Pulses Per Quarter Note (PPQN) value. A mismatched PPQN value will cause Pam to report a very different BPM value to the external clock - usually much lower. 24 is the **recommended** PPQN value to sync Pam with. Lower PPQNs will not sync as accurately.

Pam also needs to know if it should start the clock automatically when an external clock signal is detected or wait for an external gate signal via the 'Run' input to indicate the clock state (high clock playing, low stopped). Its much better to use a Run signal as Pam can 'pre sync' and doesn't have to guess when a clock has stopped.

By default Pam is setup to follow a standard Din Sync like clock. A Din Sync clock is just a clock signal with a 24 PPQN and a simple gate (into Run) which is high when the clock is playing, low otherwise. It was used by various Roland drum machines and the like. Its really the only standard 'analogue' syncing protocol - thus the default for Pam and recommended way to sync.

7.1 Syncing tips

- **Always use a 24 PPQN clock and a Run signal** Pam does not work like a simple analogue style sequence where it simply advances a step on each incoming clock trigger, it has to further divide the clock the down so a high resolution clock is critical for this. This is what 24 PPQN provides. A 'RUN" signal allows for 'pre-syncing' and avoids need to guess when external clock has stopped.

- Modern MIDI clocking from a computer/hardware sequencer is generally fine assuming;

  - Your computer/device OS and DAW is up to date.

  - Your MIDI interface is from a reputable well supported brand.

  - You dedicate the physical MIDI line to only sending clock data. Sending note, program change and other MIDI data on the same line can soon saturate the available MIDI bandwidth and cause the clock to hiccup.

  - Your MIDI to 'analogue' clock module or utility supports outputting a Din Sync like clock. We strongly recommend our mmMidi (`https://busycircuits.com/alm023`) module for this will which will provide a Din Sync like signal out of the box with no configuration.

- You can also use an audio based clock from a DAW. This can work well but usually requires a more complex setup. Its also recommended you set up for a Din Sync style clock with 24 PPQN and using a run signal.

- The ALM-UT001 (`https://busycircuits.com/alm-ut001/`) adaptor cable can be used to breakout Din Sync signals from din cables (via older XoX style hardware for example) and patch into Pam.

- Two Pams can be synced together by patching one x24 pulse output to the clock input of another, and one output set to 'GATE' (or 'On') to the Run input. An expander can also be used to save outputs.

- Displayed BPMs between Pam and a synced device may slightly differ (+/- 1). This doesn't mean the two are out of sync. If it sounds in sync it is!

- Excessive jitter of the displayed BPM value could well indicate a slightly unstable external clock. This shouldn't matter syncing-wise however.

8 LIMITED WARRANTY

From the date of manufacture this device is guaranteed for a period of 2 years against any manufacturing or material defects. Any such defects will be repaired or replaced at the discretion of ALM. This does not apply to;

- Physical damage arising for mistreatment (i,e dropping, submerging etc).

- Damage caused by incorrect power connections.

- Overexposure to heat or direct sunlight.

- Damage caused by inappropriate or misuse including physical 'modding'.

- Use of incorrect or non-official firmware

- Third party modifications or repairs performed by unauthorised persons.

No responsibility is implied or accepted for harm to person or apparatus caused through operation of this product. By using this product you agree to these terms.

9   SUPPORT

For the latest news, additional info, downloads and firmware updates please visit the ALM website at `http://busycircuits.com` and follow @busycircuits on twitter and instagram.

Questions? please visit `http://busycircuits.com/support` .

10 APPENDIX

10.1 I. Factory Reset

Whilst powering, hold down the program knob and wait for the bar to fill. This will clear all saved data back to factory state.

10.2 II. Firmware Update and Data Backup

With the unit unpowered, connect a USB cable from the port at the left side of the PCB to a computer. Pam will then appear as a standard removable storage device on your computer. Copy a valid firmware file to the root directory to update. When complete, Pam will automatically eject once the update completed and is ready to use powered normally (any 'unmount' errors from the computer can be safely ignored).

To back up all outputs, again connect Pam to a computer (the same as performing a firmware update). Copy the 'PPWDATA.BAK' file from the PAM root directory to the desired back up location on your computers drive. A previous backup may be copied back to PAM to replace the existing output patterns stored in the memory.

NOTE: Mac OS Ventura may have an issue copying to the Pam drive and present an error when using the finder to do so. The workaround is to use 'Terminal' program and copy the file via typing in the follow command and pressing return.

```
rsync ~/Downloads/alm034-v116.fw /Volumes/PAM/
```

You may need to replace 'alm034-v116.fw' with the name of the firmware file you downloaded. Note this issue should now be fixed in very latest Ventura updates.

10.3   III Expander Modules

10.3.1   PPEXXP1 & PPEXP2

Both of these expanders plug into the small vertical 'MIDI-EX' 5 pin connector on the top right of the rear of the module. **DO NOT PLUG INTO THE HORIZONTAL 6 PIN 'EXPAND' HEADER! DOING SO WILL CAUSE CATASTROPHIC DAMAGE!**

Both expanders provide Din Sync and MIDI Clock outputs as well as extra fixed factor pulse outputs for the PPEXP1 (x1, x2, x4, /4, /16 & 'stop').

The 'Stop' trigger output if fired when the clock stops and is intended to be patch into sequencer reset inputs.

The ALM-UT001 (`https://busycircuits.com/alm-ut001/`) adaptor cable can be used to combine the x24 and gate outputs to a Din Sync plug.

The ALM-UT002 (`https://busycircuits.com/alm-ut002/`) (or similar) 3.5mm Stereo mini jack to Din adaptor can be used to break out the MIDI jack connections to a Din cable. The switch on the rear of the module should match the cable type (ALM UT002 is Type B). The PPEXP1 includes an ALM adapter cable.

Only a single connected PPEX1 or PPEXP2 is supported. The PEXP1 & PEXP2 expanders for 'Pamela's NEW Workout' are not currently supported.

10.3.2   AXON-1

The Axon-1 plugs into the small horizontal 6 pin connector marked 'EXPAND' on the rear of the module (below the power header). This will add 4 extra CV inputs.

Only a single connected AXON (1 or 2) is supported.

10.3.3   AXON-2

The Axon-2 plugs into the small horizontal 6 pin connector marked 'EXPAND' on the rear of the module (below the power header). Like the Axon-1, this will add 4 extra CV inputs but with additional offset controls and 2 assignable buttons.

The function of each button is define-able via two extra Settings screens that will be accessible when the Axon 2 is connected.
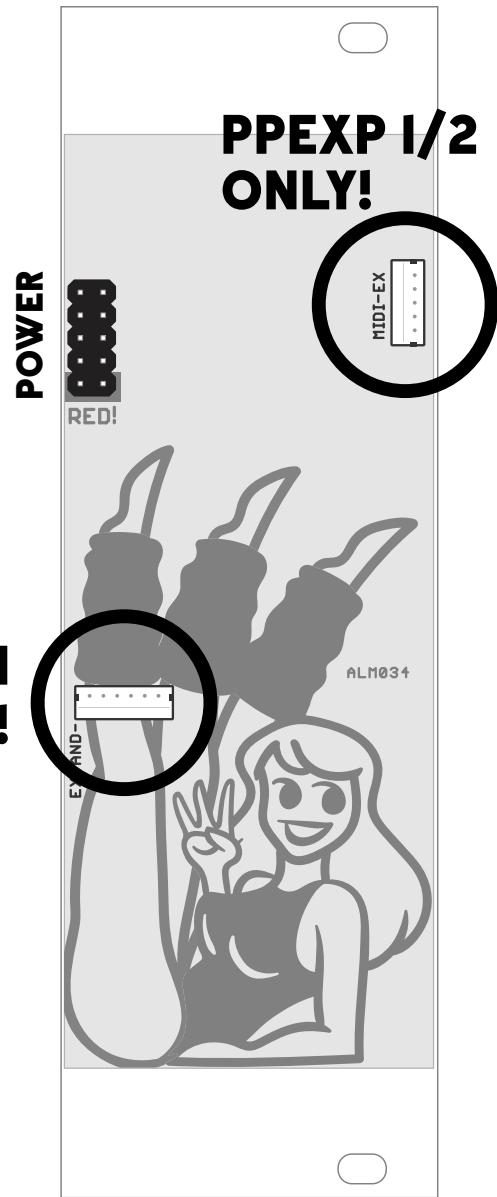
The available functions for each button can be set as follows:

- *Menu* Changes between modifier / extended parameter pages (i.e like holding the Encoder)

- *Previous Output* Navigates UI to the previous output remaining on the same parameter page.

- *Next output* Navigates UI to the next output remaining on the same parameter page

- *Mute* Mutes/unmutes the presently selected output.

- *Tap Tempo* Sets the master BPM via at least 2 subsequent taps of the button.

- *Next Bank* Loads the next numbered bank.

- *Previous Bank* Loads the previous numbered bank.

- *Cross Src* Make the button available as 'Cross operation' source.

Only a single connected AXON (1 or 2) is supported. Firmware v120 or later is required for Axon-2 supprt.

10.3.4 Expander connections

PPEXPs & Axons connect to the rear of Pam as follows:

10.4   IV VCV Rack Version.

'VCV Rack' is an open-source cross-platform software based virual modular environment. A fully featured emulation of the PRO workout is now available for purchase via the VCV Rack store: `https://library.vcvrack.com/ALM034/`

The emulation runs identical core code and has the same user interface as the physical module. A fully functional 'AXON-2' CV expander is provided for even more modulation opportunity and the module offers additional features like keyboard and mouse shortcuts, preset saving and multiple instances.

Please note that the PRO (and all Pamelas) output 5V and similarly the VCV Rack PPW will do the same. The CV inputs can be configured to allow 10V or 5V input.

10.4.1   Keyboard controls:

The following keys can be used to control the PPW. (Note the cursor must be hovering over the module).

Key	Function
[	Left encoder turn
]	Right encoder turn
=	Encoder click
-	Encoder long hold (for menu movement)
SPACE	Start/Stop clock

10.4.2   Context menu controls:

Accessed by right-clicking module, the context menu allows for quick and immediate access to multiple internal functions. These include jumping the screen to different outputs and quick changing the BPM or a selected output's Modifier parameter. Keyboard shortcuts may also be disabled by unchecking them in the menu and the input range of the CV inputs can be selected between 10V and 5V.

Right clicking the encoder opens a small context menu for basic encoder functions like long press or resetting a selected parameter.

Initialize will fully reset a PPW, including clearing all saved data like Banks or CV options.

With the release of version 123.2, the new context menu options "Export backup" and "Import backup" are available. These act like the standard presets in VCV but can be loaded from a hardware Pamela's Pro Workout and used to restore state from a VCV project onto a physical Pam or vice-versa. 8 slots are provided and are located in the Rack2 user folder under ALM034/BACKUPS. To load onto a Pam simply connect via USB (see Appendix II above) and copy the desired .bak file onto the drive. Only the most recently added .bak will be recognised by Pam. Note the hardware Pam and VCV Pam major firmware versions (i.e 123) **must** match! Its also advised you back up your hardware PPWDATA.BAK file up first.

10.4.3 AXON-2 Expander

The virtual 'AXON-2' offers 4 additional CV inputs and two user assignable buttons. Place an AXON-2 directly at the right side of a PPW to connect the 2 modules. (They will not connect if positioned elsewhere).

From a parameter page press any of the 4 AXON buttons to assign control via the associated CV input. CV may also be assigned by scrolling past the minimum parameter value on any setting that can be CV'd.

10.5 V Improvements over PNW

The PRO workout contains the following improvements over 'Pamela's NEW Workout'

- Large, colour and higher res display with much improved clearer theme-able UI.

- Faster CPU with dual core processing.

- Outputs all now 12 bit resolution (over 10 prior Bit).

- Higher resolution internal clock.

- Run and Clock inputs can now be reassigned an 2 extra CV inputs.

- New faster multipliers / bigger divisions.

- Supports Axon-1 expander for 4 extra CV inputs.

- Instant Saving and loading of output settings and banks.

- Clock does not need to be stopped for current parameters to be saved across power cycles.

- Improved Euclidean patterns - pattern display, 'padding' option.

- Improved quantiser with definable user scales.

- New waveforms - Ratchets, Slewed random, Hump, trapezoid, Log envelope.

- Loop snooze and wake options.

- Cross output operations combine output values in various ways (extending logic ops).

- Flex micro timing mode for swing, humanise, bouncing ball type 'off grid' timings.

- Invert option.

- Scope display for monitoring signals.

- Easier firmware updates via usb-c disk.

- Stored banks backup and restore via usb-c disk.

- Adjustable program knob hold time.

- VCV Support.