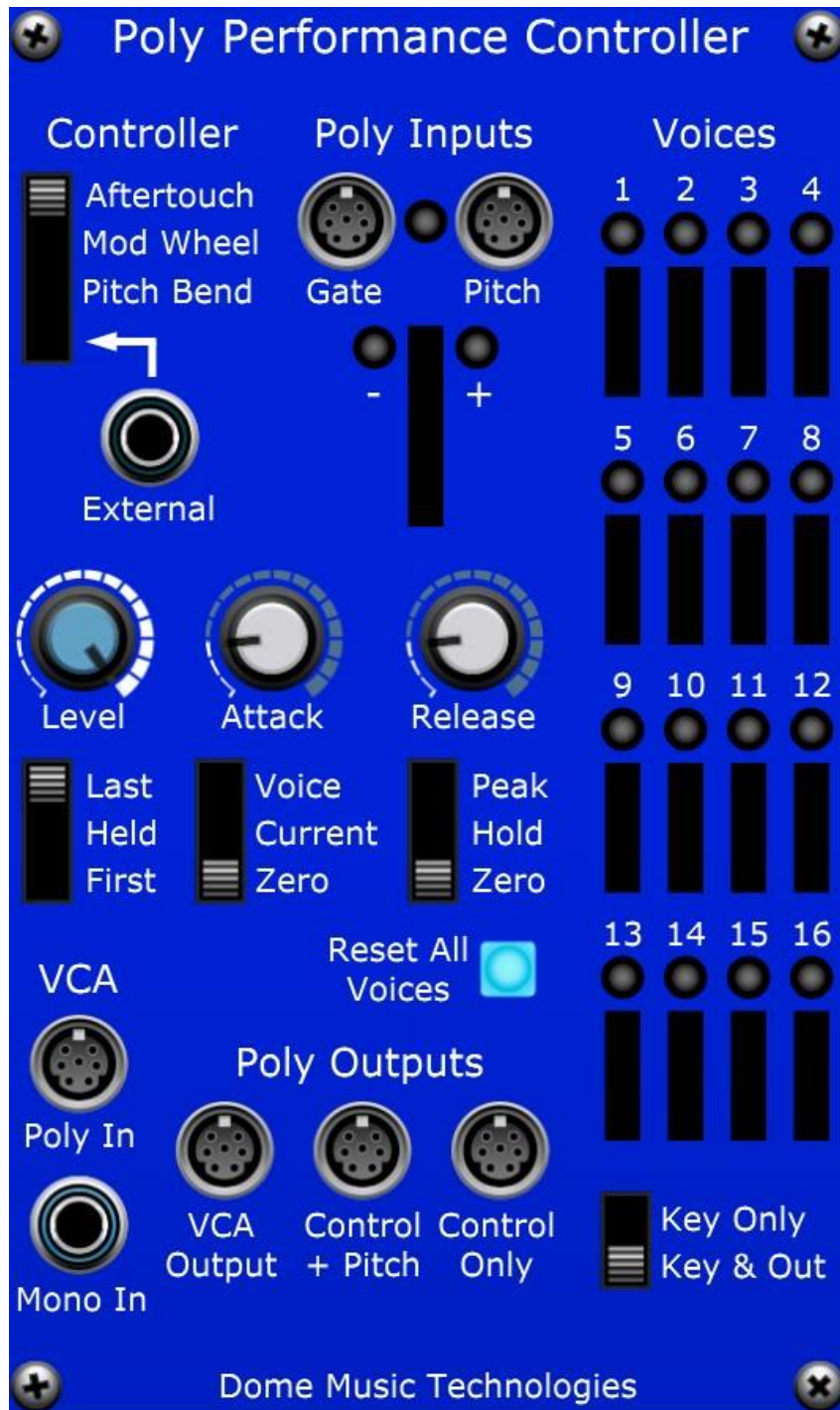# Poly Performance Controller from Dome Music Technologies

The Poly Performance Controller from Dome Music Technologies is a Control Voltage processing module. It was originally designed as a way to derive pseudo-polyphonic aftertouch from a mono-aftertouch MIDI keyboard. However, as the design developed it became clear that there was a lot of mileage left in the concept, and pseudo-poly extensions were made to the pitch-bend wheel, mod wheel or indeed any external monophonic CV input.
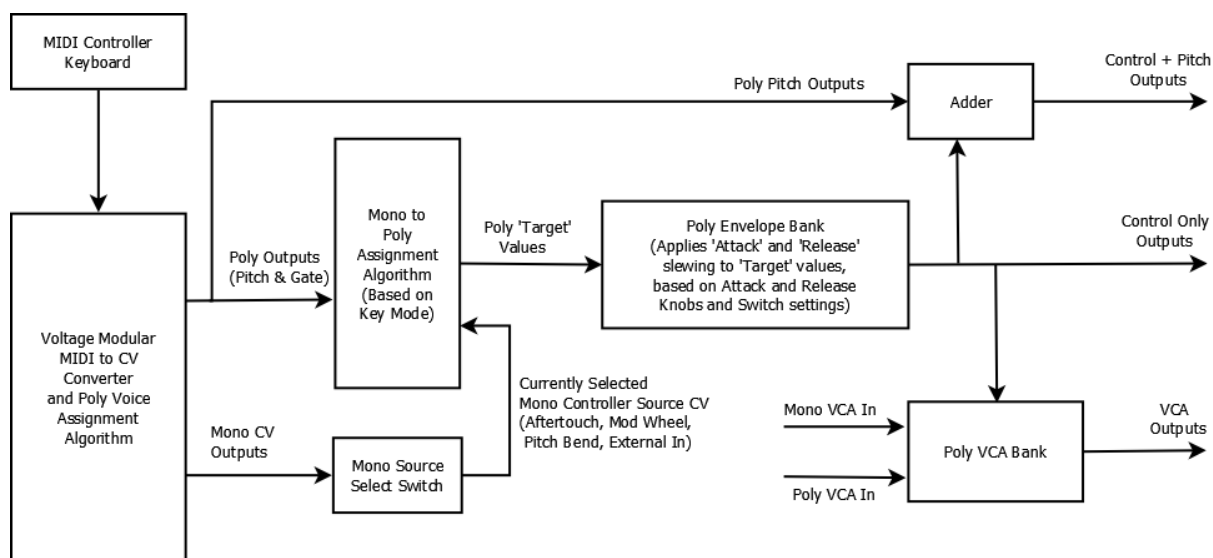
How It Works

Figure 1 - Block Diagram

In order to get the best results from the Poly Performance Controller, it is best to understand how it operates 'under the hood'. Starting at the left-hand side of the diagram, we can see that an external MIDI controller keyboard is plugged into Voltage Modular. The Voltage Modular infrastructure will interpret all key presses and performance controller values, then present them as "CV SOURCES", "POLY SOURCES", and "FROM HOST" MIDI on the I/O Panel:

As shown in the diagram, the module uses the POLY PITCH and POLY GATE signals to determine which notes / voices should be affected by the controller input (Last Note Only, All Held Notes or First Note Only). Once the Poly Assignment Algorithm has executed, it outputs a set of poly 'Target' values – one for each poly voice. These 'Target Values' are then sent on to the Poly Envelope Bank.

Each envelope generator in the Poly Envelope Bank applies a slewing factor to its output based on whether the current output value is lower than or greater than the input 'Target Value'. If the Target Value is **greater than** the Current Value, then the output will **increase** in value at the **Attack Time** setting. Similarly, if the Target Value is **lower than** the Current Value, then the output will **decrease** in value at the **Release Time** setting.

Moving further to the right of the diagram, there are three poly outputs: "Control Only", "Control + Pitch" and "VCA Output". The "Control Only" outputs are the raw voltage outputs of the Poly Envelope Bank. The "Control + Pitch" outputs add the poly pitch values to the "Control Only" values. Finally, the "VCA Output" uses the "Control Only" values to determine the output levels of a bank of Voltage Controlled Attenuators (VCAs). The VCA signal inputs can be Mono (signal applied to all voices), Poly (signals sent to individual voices) or both (Mono and Poly inputs added together).

## Controller Selection Switch and External Input

The Controller Selection Switch allows you to select which monophonic controller source is used to drive the module. Sources can be Aftertouch, Mod Wheel, Pitch Bend or any External mono CV input (for example, using the MIDI CC Converter module to capture Breath Controller or Expression Pedal).

Controller Voltage Monitor Display
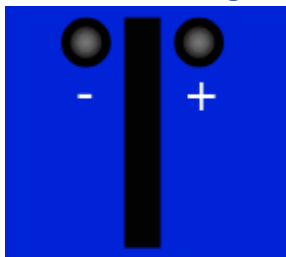
The Controller Voltage Monitor Display shows the current voltage value of the selected controller. The "-" LED will show red if the controller value is negative, while the "+" LED will show green if the value is positive. The level bar in the centre shows the absolute value of the input from 0V at the bottom to +/- 5V at the top.

Poly Inputs
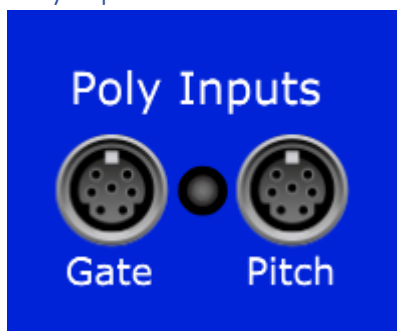
The Poly Inputs allow you to connect poly gate and pitch cables to the module. If no cables are connected, these inputs are 'normalled' to the Poly Pitch and Poly Gate jacks on the Poly Sources panel of Voltage Modular. The blue LED in the centre is illuminated if one or more keys are depressed on the keyboard. It turns off again when all notes are released.

Controller Input Attenuator ("Level") Knob

Performance controllers within the Voltage Modular universe generally operate on a 0 Volts to 5 Volts range (for unipolar devices such as Mod Wheel and Aftertouch) or a -5 Volts to +5V range (for bipolar devices such as the Pitch Bend Wheel). This can be an impractically wide range for some applications, especially pitch bend. The Level Knob allows you to attenuate the selected performance controller down to a more practical range. It is calibrated in semitones, from 0 semitones (7 o'clock position), through 2 semitones (12 o'clock position), up to 60 semitones (5 o'clock position). When adjusting the knob, the tooltip displays both the Semitone amount and the attenuation percentage amount:

Figure 2 - Tooltip Showing Both Semitone Range and Percentage

Semitones	Attenuation %	Attenuation Multiplier	Output @ +5.0 Volts Input
0	0 %	0.000	0.000 V
2	3.333 %	0.033	0.167 V
6	10 %	0.100	0.500 V
7	11.667 %	0.117	0.583 V
12	20 %	0.200	1.000 V
15	25 %	0.250	1.250 V
24	40 %	0.400	2.000 V
30	50%	0.500	2.500 V
45	75 %	0.750	3.750 V
60	100 %	1.000	5.000 V

Envelope Time Knobs

The Envelope Generator Bank has different time constants for slewing the 'Current Output Value', based on the value of the input 'Target Value'. Both knobs have the range of 1 ms / 0.001 sec (at 7 o'clock position), through 1000 ms / 1.0 sec (at 12 o'clock position) up to 20,000 ms / 20.0 sec (at 5 o'clock position).

If the Target Value is **greater than** the Current Value, then the output will **increase** in value at the **Attack Time** setting. Similarly, if the Target Value is **lower than** the Current Value, then the output will **decrease** in value at the **Release Time** setting.
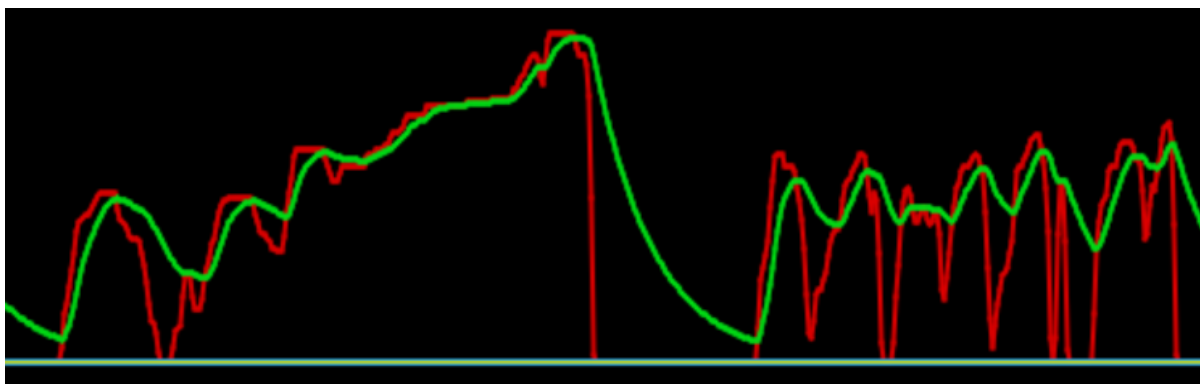

Figure 3 - Smoothing Aftertouch, 1 sec Attack, 5 sec Release

In the image above, aftertouch (shown in red) is being smoothed with an Attack time of 1000ms (1 second) and a Release time of 5000ms (5 seconds).

The Attack and Release curves are based on a physically modelled Resistor – Capacitor charge / discharge circuit. This is the same Real Analogue Transient (RAT) technology that was used to create the RAT Pack Bundle – the very first release from Dome Music Technologies.
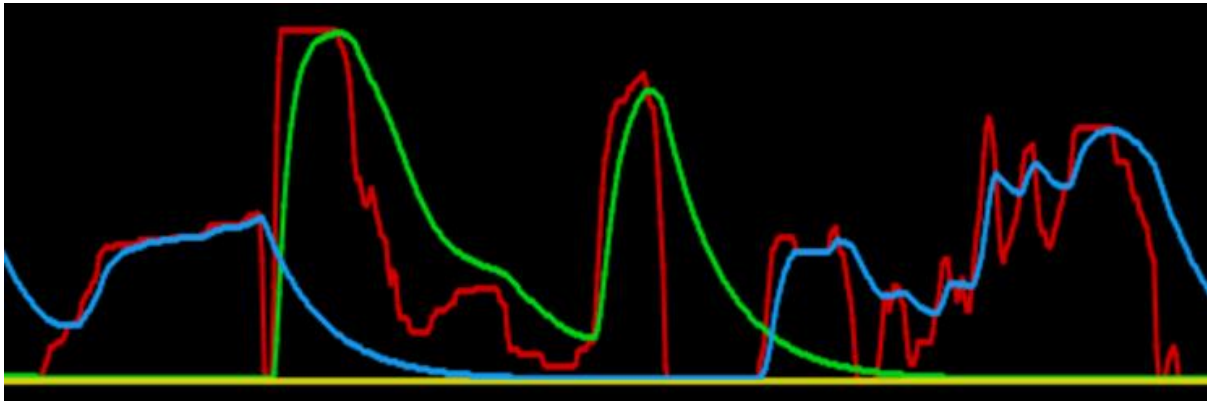
Figure 4- Two Notes Showing Different Aftertouch Profiles Simultaneously.

In the image above, the red trace shows the raw aftertouch voltage. The green and blue traces are the poly "Control Only" outputs for keys C3 and E3 respectively. Note how the green and blue traces can cross each other going in different directions. If standard mono aftertouch was being used here, then both voices would be articulated in an identical fashion.

Key Mode Switch

The Key Mode Switch determines which notes are affected by the selected performance controller. Three modes are available: **Last** Note Only, All **Held** Notes, and **First** Note Only.

Last (Last Note Only Mode)

This mode will only apply the performance controller value to the most recently played note.

Note that if the current 'Last Note' is released while other notes are still held down, then the algorithm will **NOT** select a new 'Last Note' from those remaining held. It is only when another new note is played that it gets assigned as the 'Last Note', and becomes affected by the performance controller. If the previous 'Last Note' key is still held after a new one is played, the previous 'Last Note' voice will go into its Release phase, according to the setting of the Release Mode Switch.

Held (All Held Notes Mode)

This mode will apply the performance controller value to **all** currently held notes.

First (First Note Only Mode)

This mode will only apply the performance controller value to the first note played after all keys have been released. That first note is the only one to be subsequently affected by the performance controller, regardless of how many other keys are held down simultaneously. The 'First Note' remains in force until all keys are released again.

Attack Mode Switch
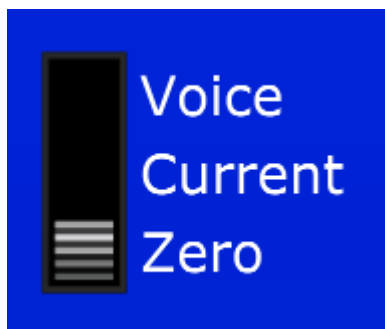
The Attack Mode Switch determines the starting value assigned to a voice on detection of a new 'Key On' event. There are three modes available: Use Previous Voice Output Value, use Current Controller Input Value, and Restart from Zero.

Voice (Previous Voice Output Value)

In this mode, the starting value of the controller curve is set to the previous "Control Only" output value of that voice channel. This mode is particularly useful if you want to 'ride the envelope' when playing the same note staccato several times in succession.

Current (Current Controller Input Value)

In this mode, the starting point of the controller curve is instantly set to the current value of the performance controller. For example, this can be useful if you want to introduce full-scale Mod Wheel intensity at the start of a note.

Zero (Restart from Zero)

In this mode, the starting point of the controller curve is instantly set to zero volts. This tends to be the most useful default behaviour for most applications, particularly when using aftertouch as the source controller.

Release Mode Switch

The Release Mode Switch determines the final 'Target Value' assigned to a voice on detection of a new 'Key Off' event. There are three modes available: Retain **Peak** Output Value, **Hold** at Current Voice Output Value, and Set 'Target Value' to **Zero**.

Peak (Retain Peak Output Level)

In this mode, whenever the Target Value drops below the Current Value, the output remains set at the Current Value. If the Target Value goes higher than the Current Value, then the Current Value starts increasing towards the Target Value at the Attack Time rate. In this way, the Peak value of the controller is tracked for as long as a key is held down.

This is similar to the 'pseudo-velocity sensitivity' system featured on the PPG Wave series of keyboards, which only had (mono) pressure-sensitive keyboards:

> **VF:** A remnant of an earlier version of the Wave synthesizer that is designed to mimic the effect of a velocity-sensitive keyboard from the Wave's pressure-sensitive keyboard. Even numbers turn the effect on; odd turn it off. With the effect on, the first note you play will determine the overall cutoff frequency of the filter. You may or may not hear the first note you play, since it is used as a control signal.

> **VL:** Like VF, VL is an effect designed to get velocity-sensitive effects out of a pressure-sensitive keyboard. Even numbers turn the effect on; odd turn it off. The first note you play and hold will determine the overall loudness of the notes to follow.

Figure 5 - Extract from PPG Wave 2.3 Operations Manual, P32

Be aware that if you combine **Peak** Release Mode with **Voice** Attack Mode, peak values will be retained even if you play a new key on the voice channel and will get progressively higher. You can gracefully 'discharge' peak values by switching the Release Mode to **Zero**. Alternatively, you can press the **Reset All Voices** button to set all voice outputs back to zero instantaneously.

Hold (Hold Current Voice Output Value)

In this mode, when a key is released, the current output value of that voice's Envelope Generator is held until a new key is assigned to that voice channel. This can be particularly useful when applying selective pitch bend.

Zero (Set Target Value to Zero)

In this mode, whenever a key is released, that voice's 'Target Value' is set to 0 Volts, and starts to decay towards 0 at the Release Time setting. This is the best default setting for most uses.

Reset All Voices Button
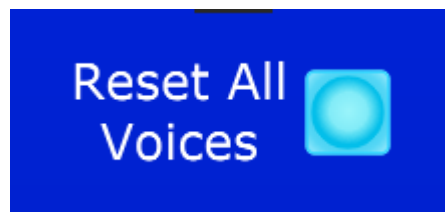
When pressed, this button will instantaneously set all voice outputs to 0 volts. It can be thought of as a sort of 'Panic Button' if the module doesn't behave the way you anticipated. As mentioned previously, the most likely candidate for messy results is when you combine the **Voice** Attack Mode with the **Peak** Release Mode.

Poly Output Sockets
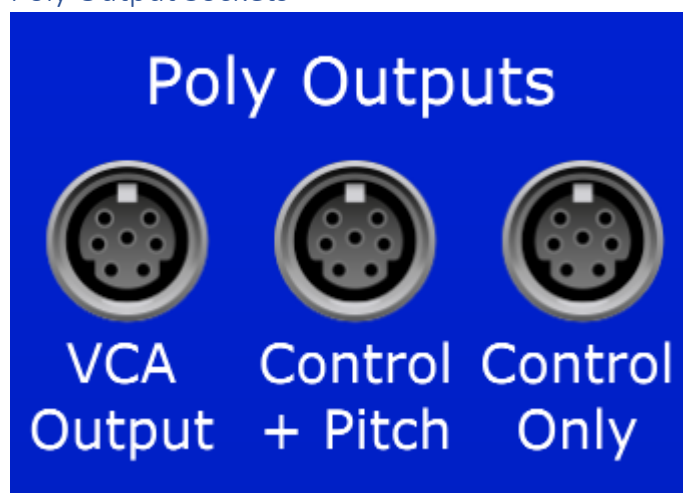
"Control Only" Poly Output

This output provides only the Current Output Values of the Poly Envelope Bank. This is most useful for controlling parameters such as VCA amplitude (volume) or VCF cut-off frequency (brightness). It works particularly well when used with aftertouch as the source performance controller.

"Control + Pitch" Poly Output

This output adds each voice's pitch value to the Current Output Values of the Poly Envelope Bank. This is most useful for applying selective pitch-bend. If you connect this socket directly to the "Pitch CV" or "1V / Oct" input of a polyphonic oscillator module, you can use the Level knob to precisely control the max bend range in semitones.

"VCA Output" Poly Output

This output uses the Current Output Values of the Poly Envelope Bank to attenuate the signals at the VCA Poly In and Mono In inputs. This is very useful for creating dynamic LFO effects, with different modulation depths on different notes. Polyphonic delayed vibrato can be achieved by setting the Attack and Release Time values appropriately.

VCA Input Sockets

There are two input sockets associated with the VCA Output mode of operation. They provide the 'carrier signals' which are then attenuated by the current output values of the Poly Envelope Bank. Note that the VCAs operate in bipolar mode, so negative performance controller values will lead to inverted carrier signals at the output.

VCA "Poly In" Socket

This input allows you to modulate the depths of a set of polyphonic carrier signals (one signal per voice). These carrier signals can be audio rate, so it is possible to, for example, control FM depth dynamically using aftertouch on a per-voice basis.

VCA "Mono In" Socket

This input allows you to modulate the depths of a single carrier signal on a per-voice basis. This can lead to very expressive results if vibrato depth is modulated on a per-voice basis, particularly when the Attack and Decay controls are set to provide 'fade-in' and 'fade-out' durations.

The two VCA input sockets can be used simultaneously. In this case the Mono In signal is simply added to the Poly In signal of each voice before attenuation takes place.

Poly Voice Monitor Area
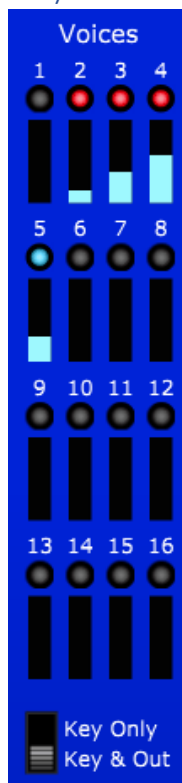
You can monitor the status of each voice channel in the Poly Voice Monitor Area. Each voice has a Key / Gate indicator LED and an Output Level Meter. The number of channels displayed matches the current Polyphony setting in Voltage Modular. In the image above, Polyphony is set to its maximum value of 16 voices.

Key / Gate Monitor LED

The Key / Gate Monitor LED has three states:

Off / Black: This means that the voice channel is currently in its key-off state.

Red: This means that the voice channel is currently in its key-on state.

Blue: This means that the voice channel is currently in its key-on state, AND that this voice channel is the current First or Last note priority voice. This is determined by the setting of the Key Mode switch – in Held mode, only red Key / Gate LEDs are displayed.

Output Level Meter

The Output Level Meter displays a bar showing the absolute output level of each voice channel.

Key Only / Key & Out Switch

When switched to the **Key Only** position, only the Key / Gate LEDs are displayed. Output Level Meters are removed.

When switched to the Key & Out position, Output Level Meters are redisplayed.

Hints and Tips, Limitations and Caveats

This section describes 'best practice' for getting optimum use out of the Poly Performance Controller.

Adapt Your Playing Style

When you combine the Poly Performance Controller with Voltage Modular, you're almost creating a new type of instrument. In order to really make it 'sing', you need to train your fingers to play in a sympathetic way. Now, don't get me wrong - it doesn't take long to get the feel for how to inject expression into the machine. It's a good idea to use the Poly Voice Monitor Area to understand what each voice channel is doing under different playing styles, at least initially.

Adapt Your Compositional Style

The module lets you do things with notes which are impossible, or very difficult to achieve, even with Voltage Modular Core and additional third-party modules. As a concrete example, you can play the notes of a C7 chord in order – C, E, G Bb. Then, by using Last Note Priority with the Pitch Bend controller, you can bend that Bb up to a C, to resolve onto a regular C major chord.

Mix and Match Several Instances of the Module

You might find that you have a patch which uses Last Note Priority to drive filter cut-off frequency. On that same patch, you might want to generate a two-semitone bend for all held notes. To round it all off, you might want to use First Note Priority with the Mod Wheel to generate delayed vibrato on a bass note. There's no way one instance of Poly Performance Controller could handle all these conditions simultaneously, but it *can* easily be achieved with three instances in parallel. In addition, you can specify different Attack and Release times and modes as appropriate.

Don't Treat it Like True Poly Pressure / Aftertouch

While it is possible to create some very convincing CS80-style lead lines with different note evolutions, the module is not a true replacement for a genuine poly-aftertouch equipped keyboard (and sound engine).

Adapt New Playing Styles and Musical Ideas Back into the Monophonic World

You can achieve a lot of the effects of the Poly Performance Controller with the Smol RAT module (available free of charge in the Dome Music Technologies Freebie Collection). In particular, you can simulate the Attack and Release smoothing effects by playing with the Rise and Fall Time knobs. You can also simulate First Note Priority with judicious use of the Hold / Track switch.