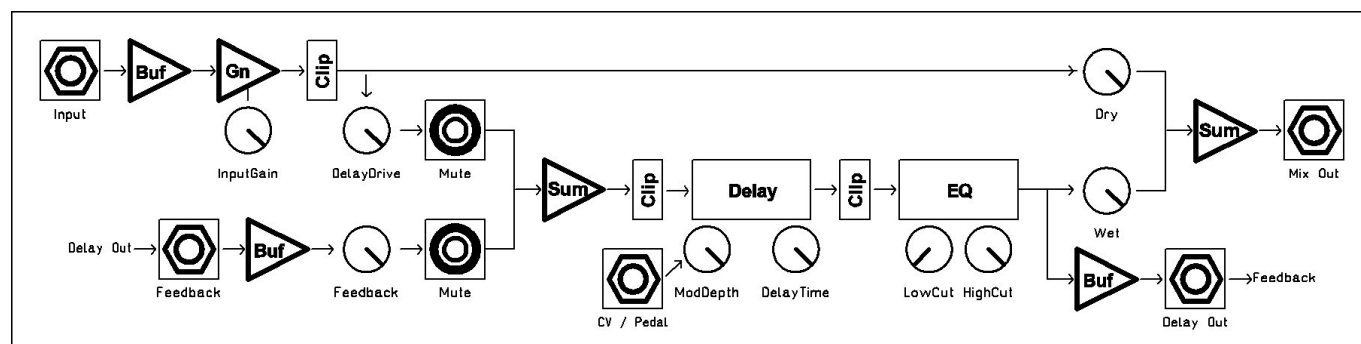The **BugBrand PT Delay Standard** is centred around a Digital Delay chip, the Princeton Technology PT2399. While the chip is digital, its design approaches are already quite analogue and around this core is added highly specific analogue circuitry to create a characterful and tactile delay processor.

Input Section:
The input is on mono unbalanced 1/4" jack and is designed for typical line level signals. A gain stage offers up to x10 amplification to accommodate diverse input signals. This section features the first of three LED saturation / clipping stages (internal – you can't see them!) – these stages have been added so that signal amplitudes can be standardised throughout the unit, thus avoiding dramatic level changes (for example when feedback is overloaded), but they also open up avenues of creative overdrive sounds. Using LEDs for the saturation not only gives gentle and musical distortion, but it also means that the saturation point is approximately 4dBu – ideal for general studio use.
For typical usage, begin by adjusting the Input Gain until clipping starts to occur, then dial the control back a notch to give sufficient clean headroom.

Delay Drive / Feedback:
The conditioned input signal is passed to the Delay core via the Delay Drive control (muteable via button). This control aims to give dub-delay style – instead of all audio passing straight to the delay core, you can just throw occasional sounds in.
As can be seen in the block diagram, the Feedback path is also summed at this stage (normalised from Delay Out socket), again with a Feedback level control and Mute button.
A saturation stage follows the summer so that the Delay chip input is not overloaded (which would give nasty digital clipping).

Delay Core & Control:
The delay time from the PT2399 core is voltage controlled from two sources – the main Delay Time dial combined with any external Control Voltage (CV) via the CV/Pedal input and CV Mod Depth control. Using the Delay Time control alone covers times of approximately 35mS to 3.5seconds . Short, clean delays cover the dial range up to around 1 o'clock (c. 500mS delay time) and beyond this point the delays become increasingly noisy – this is due to 'under-clocking' the delay-chip and is one of the most characteristic areas of the unit. Using external CV can take the delay time well beyond the 3.5sec mark, resulting in even more crunchy digital noises.

The CV input is designed for typical CV signals of up to 10V peak-to-peak (though accepting of great amplitudes and protected against voltages beyond the unit's power rails) and any external modulation is summed with the voltage from the main Delay Time control. Negative voltages will cause shorter delay times, while positive voltages will increase the delay time. Note that the delay time is fairly non-linear – it is certainly not a perfect 1V/Oct response. Details on Pedal control are given below.

There is another saturation stage after the Delay section to tame the otherwise-unruly signals when the chip is under-clocked.

EQ:
Following the delay core is an equalisation section with Low Cut (High Pass) and High Cut (Low Pass) filters to tonally shape the delay signal (and resulting feedback behaviour). This section really adds character to the delay! Sounds can be tonally reshaped as they decay, resulting in sounds somewhat akin to those of tape delays. Some of the digital artefacts of longer delay times can also be tamed if required by cutting some high frequencies.

Note that for no effect / pass-through, Low Cut should be fully counter-clockwise, while High Cut should be fully clockwise as standard.

Outputs:
Post-EQ, the delay signal is split to the Delay Out and to the Output Mix section. The Delay Output (buffered) presents just the delayed signal and also normalises to the Feedback input. This normalisation is broken when a plug is inserted to the Feedback input socket. Typically you would put an external processor (reverb, filter, BugCrusher, etc) in series between these points.

The Mix section allows blending of the Dry signal (post-input-gain) and the Wet (delayed) signals, and provides the output signal on mono unbalanced 1/4" jack at typical line level amplitudes.

CV/Pedal Control:
The CV/Pedal has a +10V bias voltage on the ring connection point.

For normal external CV modulation, the ring connection can be ignored (ie. Just use a standard mono cable), with CV on the tip and Ground on the sleeve.

For foot-pedal operation, the controller should be wired as shown (this should be the standard for pedal controllers) - +10V bias and Ground go to the outer connections of the potentiometer (eg. Inside the foot pedal) and the CV input comes from the pot's wiper. The CV Mod Depth sets how far the pedal modulates the delay time.

'Toggle-time' (a feature from a previous PT Delay which allowed toggling between two different Delay Time settings) can be simulated with an external switch connected between the tip and ring connections as shown. Delay Time 1 is set as standard using the main Delay Time control, while the 2nd time is adjusted by the CV Mod Depth control – when the switch is engaged, the CV Mod Depth pot becomes a variable voltage source ranging from 0 to +10V.
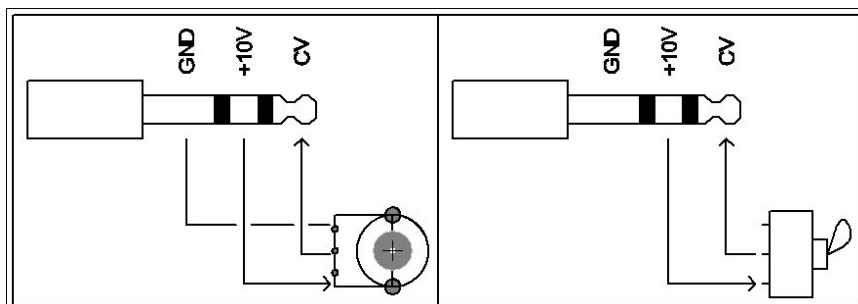
Power:
The unit comes with a universal (90-264V AC) power supply which provides 12VDC @ 500mA on a centre positive 2.1mm DC plug.
An internal DC-DC converter generates a bipolar +/-15VDC supply within the unit. The unit should only be used with the supplied PSU.

Guarantee:
The PT Delay Standard comes with a 2 year 'reasonable' warranty. If any mechanical or electronic failure occurs within the period, I will repair the fault free of charge. This excludes failure from maltreatment or modification and any cosmetic degradation. Contact should first be made via email to discuss the problem. Shipping to return the device is paid by the user and I cover return shipping. Failures that are not covered by this guarantee may be fixed at standard rates.

Enjoy! Tom Bugs – May 2013 – tom@bugbrand.co.uk – www.bugbrand.co.uk