

# 4ms Dual Looping Delay

## Firmware Version 5

### Release Notes

August, 2016

Version 5 firmware for the Dual Looping Delay is a major update that adds very significant new capabilities to the unit, as well as refinements to the features previously existing. Please take some time to read through these notes to help you get the most out of your new and improved DLD, and avoid any confusions caused by changes to operations.

#### Updating to Version 5

As for previous updates, use the Audio Bootloader to install the Version 5 update, delivered as an audio wav file. You can download this file from the 4ms web site here:

<http://4mspedals.com/DLD/firmware/DLD-firmware-v5.wav>

#### Preparation

1. Turn off system power. Connect audio output from computer, smart phone (remove the phone case to ensure the cable can connect), tablet, etc. to the **In B** jack with a mono or stereo (either is fine) cable.
2. For audio monitoring, connect the **Out B** jack to an amp/speaker. Set a low initial volume, as the audio data file is LOUD!
3. Set the output level of the computer or phone, and also that of your audio software to 100% volume. Turn off all audio and vibrate notifications, and close applications such as Facebook that use audio notification. Any disruption in the audio will ruin the process.

#### Updating

4. To enter the **Audio Bootloader** mode, depress both **Reverse** buttons (**A** and **B**) and the **Ping** button while powering on the DLD. When you see the **Channel A Hold** button turn on (or blink), the DLD is ready to receive firmware. Release all the buttons.
5. Begin playing the v5 audio wav file. Immediately you should see red **Channel A Loop** LED blink. The blue light will flash from time to time as well. Do not interrupt the process! You can monitor the audio by listening to the **Out B** jack.

#### Completing the Update

6. The audio data file for the v5 update is approximately 2 minutes in length. Just before audio finishes playing, you will see the 3 lamps (Ping, Inf Hold A & B) flash a couple to times before the unit comes up to its normal operation. Congratulations!

The **Audio Bootloading** process is very reliable, but any interruption or glitch in the audio stream will cause it to fail. If audio stops before the end of the file and/or the lights stop blinking, an error has occurred and you should try again.

First verify that the cable is not loose, that all sounds/vibrate/notifications are off, and that you have downloaded the audio file completely (avoid streaming or playing from the browser).

Then check that volume is at 100% throughout. Stop the audio file, reset it back to the start, and tap **Reverse A** button to reset. The **Hold A** button should light up. Play the file from the beginning again.

### **Factory Reset after Update (recommended)**

Because Version 5 makes very extensive changes in the operation of the DLD firmware, we recommend that you execute the **Factory Reset** procedure following the update.

Take care to note any **System Settings** that you care about, as the **Reset** procedure will return all settings to their factory defaults.

#### **To perform a factory reset:**

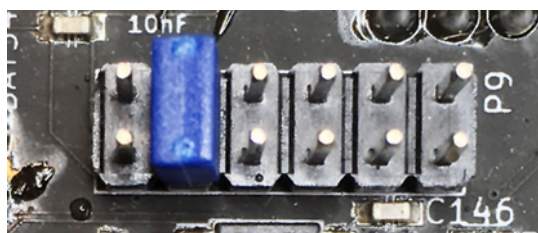
1. Unplug all cables.
2. Power off the DLD.
3. Flip **Time A** down, **Time B** up.
4. Hold down **Infinite A**, **Infinite B**, and **Reverse B**.
5. Power the DLD on. Release the buttons, the four **Reverse/Infinite** buttons will flash.
6. Now, flip **Time A** up, **Time B** down.
7. Hold down all five buttons (**Rev A**, **Inf A**, **Rev B**, **Inf B**, **Ping**) for 10 seconds.
8. Release the buttons when you see the lights make a chase sequence.
9. Power off, and power back on.

The DLD has now been reset to its factory default settings.

## **New Features and Enhancements**

### **New Feature! High Resolution Audio: 24-bit Audio Operation**

The DLD can now operate with superb full **24-bit** audio by installing a jumper on the back of the module in the position 2 shown in the photo makes it run in **24-bit** mode. The jumper goes on the 2x6 header (labeled P9 in tiny lettering). (Jumper position 1 is the left-most jumper, closest to the BUS CLK jumpers Jumper position 2 is the next one to the right.)

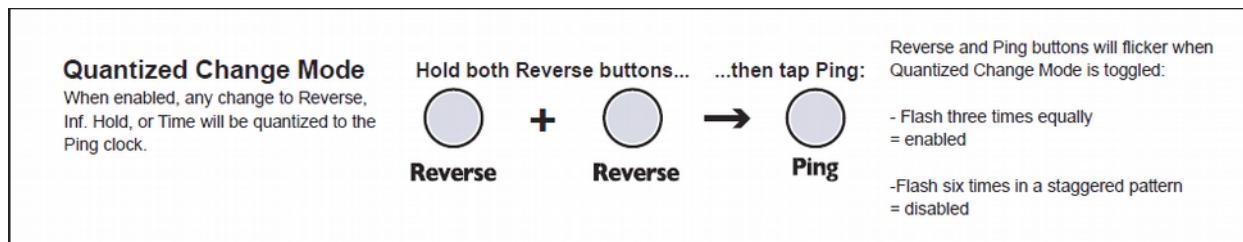


When the jumper is on, the DLD will power up with a tap tempo pre-set to half the speed than if the jumper is off, indicating the new hi-resolution mode. Audio delay capacity in 24-bit mode is one-half that of 16-bit mode. Sample rate in all modes is 48 kHz.

## New Advanced Operational Features

### Quantized Change Mode: Modulation 'on the beat'

'Normally', the DLD controls of **Time**, **Reverse A/B**, and **Infinite Hold A/B** operate as you would expect in most any device. Changes to the control take effect immediately, no matter when they occur. In the **Quantized Change Mode** (or '**QCM**'), any change to these parameters (on both channels) will be delayed until the next pulse of the **Ping Clock**. This has great implications for working in synch with rhythm devices and complex patches.



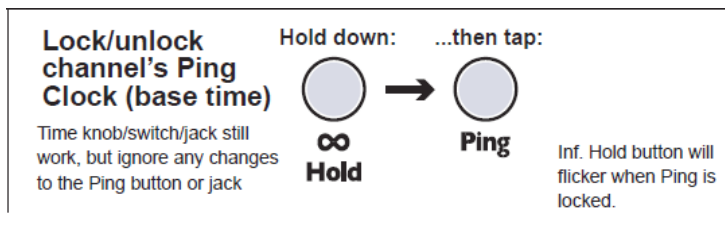
The factory default setting for **QCM** is 'off'. To enter **QCM**, hold down both of the **Reverse** buttons and tap the **Ping** button once. The two **Reverse** lamps will flash 3 times evenly to show entry into **QCM**. Exit **QCM** with the same procedure, in which case the same lamps flash 6 times in a staggered pattern.

**QCM** is best explored with a rhythmic patch, sequencer, or drum unit locked with the DLD clock (DLD can be master of slave). Asynchronous modulations and triggers can be used freely, since they will be 'force synch'd' to the **Ping** clock. In this sense, **QCM** might be thought of as a kind 'Sample and Hold' that locks modulation sources with the fundamental time. Go ahead, experiment! It can be addicting.

One note in passing is that 'free modulating' the **Reverse** in this mode can lead to quite a lot of 'Memory Scraps' that come back at surprising times, especially when the Reverse switching continues after input source is killed. This can be a real plus (as well as a real surprise) as these bits and pieces will remain locked to the clock. If it gets out of hand, you can use the **Memory Clear** function, or discontinue triggers to Reverse so that the 'scraps' eventually clear themselves out.

You can save **QCM** as your default power-up state by switching it 'on' and entering **System Mode** and saving as described later and in the full DLD manual.

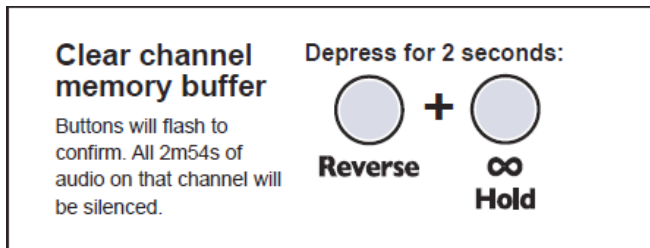
### Lock Channel Ping Time: Resonant Delay Melody and Echo at the same time



In firmware version 5, either channel's response to the **Ping** clock can be locked at its current value. The procedure is to hold down the **Inf Hold** button of the channel you want to 'lock' and tap the **Ping** button once. Use the same procedure to restore normal operation. The setting is not saved, and the unit will always power up responding normally to **Ping** clock on both channels

An example application for **Locking Channel Ping** is when you want to use one channel for short-delay resonance effects whose pitch is modulated by a fast clock on the **Ping** input. Locking the opposite channels' **Ping** time allows for use of that channel for standard delay effects, on the resonant channel's output or any other source.

## Clear Channel Buffer (from Version 4)



This feature is not new in Version 5, but is re-documented here as one of the 'special' functions that can be executed during normal operation. And it is very, very useful.

To delete the contents of audio memory for either channel, just hold down the **Reverse** and **Inf Hold** buttons of that channel for about 3 seconds. Both lights will flash to indicate successful clearing of memory. The other channel will not be affected.

## New System Settings

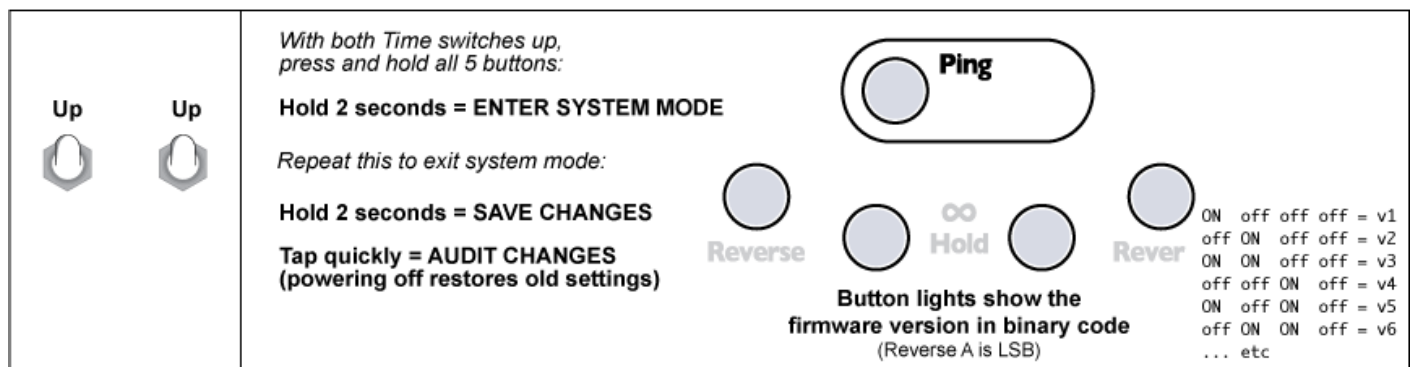
In Version 5, the application of the **System Settings** mode has been extended to address requests from users and new possibilities that we became aware of in course of development. Also, the operation of the System Setting mode itself has been smoothed and enhanced for greater ease of use

In entering, and using the **System Settings** mode, the position of the channel toggle switches (upper left and upper right) determines what happens. With that in mind, the function available in **System Settings** are here organized into groups according to the position of these two switches.

Many of the **System Settings** functions are inherited from Version 4. These are included here for completeness (and, maybe, to make it easier to get your head around these various operations)

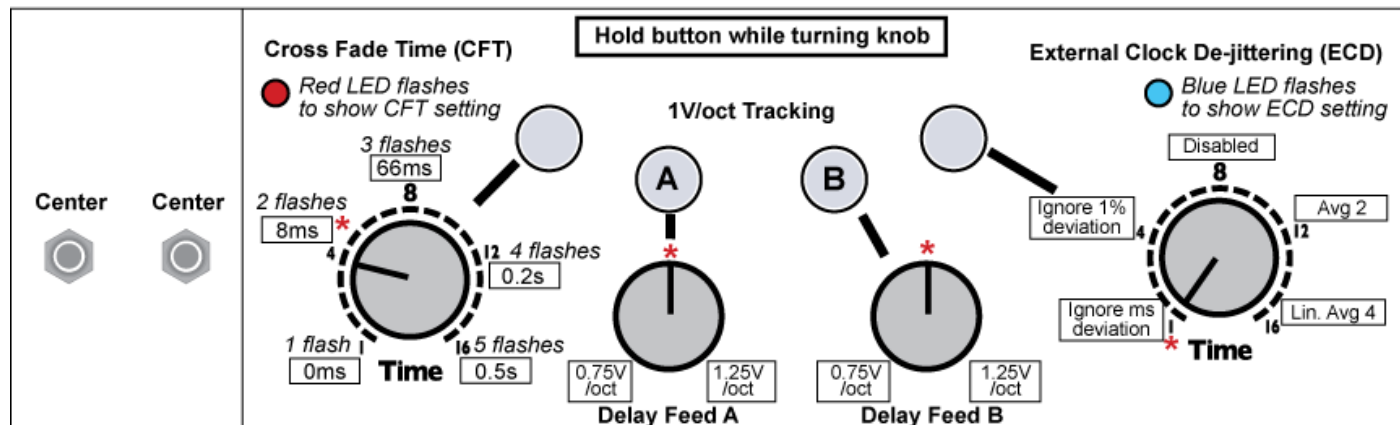
## Entering System Settings Mode

To prepare to enter the **System Settings** mode, flip both of the channel toggle switches to the **up** position. Then hold down all 5 of the lighted pushbuttons (yes, it's a little bit awkward) for about 2 seconds and release.



On entering **System Settings** mode, the 4 lower button lights indicate the firmware version in binary code (lsb first). For Version 5, this means that the **Reverse A** and **Inf Hold B** lights are lit.

## Systems Settings: the 'Center-Center' Group



### Variable Splice Cross Fade Time (CFT) - NEW FEATURE!

When changing delay time, entering **Reverse** or **Hold**, etc., the natural behavior of a fixed-clock audio delay line such as the DLD is a discontinuity (click) in audio. The DLD suppresses these by performing a cross-fade between the points before and after the change. By default, the time of this cross-fade is set at 8 milliseconds. Generally that is enough to ameliorate artifacts of change but not to audibly affect operation.

In firmware **Version 5**, the time of this crossfade can be adjusted by the user, from 0 milliseconds (instant response, but liable to clicking) to 500 milliseconds, which is quite noticeable and may be too much when delay times are short.

To adjust the **CFT** of the systems, enter the **System Settings** mode, set both toggle switches to the center position, hold down the Reverse A button and adjust the **Time A** control, The red led next to **Time A** flashes to indicate the approximate value of the CFT

The **CFT** will be stored when you exit the System Settings mode, and will affect all operations. You might like to experiment to see what effects you can obtain with settings other than the default. For general use, however, we recommend the **factory default setting of 8 ms**

### Volt/Octave Tracking Compensation A and B (from Version 4)

The tracking of the **Time CV** jack when the channel is in **Unquantized Time Mode** (See **Owners Manual** for details on this mode) can be adjusted to compensate for keyboards or sequencers that are not accurate, or to provide alternate tunings. See the earlier section for a discussion on **Unquantized Time Mode** and Resonant Delay patch ideas. When you flip both the switches to center, the DLD will automatically set the Delay Feed parameter to 100%, so that the **Delay Feed** knobs are free to adjust tracking. Also, the DLD will automatically enter **Unquantized Time** mode. To calibrate, you should input a clock or VCO of about 50Hz - 100Hz into the Ping jack (the Ping and loop lights will not flash, that's OK!), turn the **Time** and adjust **Feedback** until you hear a resonant sound. Input a 1V/octave CV signal into the **Time CV** jack (i.e. from a sequencer or a keyboard).

- Adjust tracking for **Time A CV** jack: Press and hold **Infinite Hold A** while turning the **Delay Feed A** knob
- Adjust tracking for **Time B CV** jack: Press and hold **Infinite Hold B** while turning the **Delay Feed B** knob

Releasing the button will temporarily lock in the value of the knob (this prevents accidentally bumping the knob while testing the setting). With the **Delay Feed** knob at center, the tracking is 1.00V/octave, at minimum it's 0.75V/octave, and at maximum it's 1.25V/octave.

## External Clock De-jittering settings – NEW FEATURE!

The DLD uses sophisticated technology so that the unit can follow an external **Ping** clock accurately. In most situations, the default method of the DLD will work fine without issues, and you do not need to adjust this parameter unless you are experiencing sync issues with an external clock. The first thing to try is to use the DLD as a master clock. This is the easiest solution, but it is not always possible.

When syncing an external clock that contains some jitter or drift to the DLD, the optimum algorithm for tracking depends upon the application. A very accurate time-lock requires that the input responds slowly to changes, and this can be a detriment when tracking of tempo changes is desired. Likewise, a very accurate lock may produce audible phasing when used with analog VCOs (which inherently drift in phase). Tracking behavior also depends very much on the characteristics of the incoming clock. Many clock signals in modular systems have a measurable amount of jitter or drift, and must be processed to allow sync for the DLD audio.

The DLD has five different approaches to clock de-jitter algorithms, and any of these can be chosen in the **System Settings** mode. Certain settings will work better with certain external clocks, in certain types of patches. It's easy to try all five clock modes, and experimenting is typically the quickest way to find the optimal setting for your situation. To experiment with these settings, enter the **System Settings** mode, set toggle switches both to center position. Then, hold down the **Reverse B** button while adjusting **Time B** (see the diagram above for how to set Time B).

**Note: These settings only change how the DLD processes external clocks patched into the Ping jack. They do not change how the Ping button works, or how the DLD works as a master clock (using the Clock Out or Loop Out jacks)**

**Ignore 0.2ms deviation, and Ignore 1% deviation:** These two settings lock onto a clock and ignore any small changes in the tempo. The former ignores timing changes greater than a flat number of microseconds, and the latter ignores timing changes greater than a percentage of the current tempo. These methods are suited for syncing to clocks that have a small amount of jitter and no drift, where tiny differences in clock speed don't matter but you want the DLD to respond quickly to large changes in tempo. Locking to a drum loop that changes tempo (from 120BPM to 90BPM, for example) is an example where you may want to use these settings.

**ECD Disabled (one-to-one):** This method simply makes the DLD's ping time equal to the time between the last two clock pulses. Thus the DLD will always be lagging by one clock period, but will respond instantly to every clock pulse. This is suited if you want to track small changes in an external clock or if you don't want the DLD to try to process the external clock. Example uses might be clocking the DLD with a stable VCO to get resonant delay sounds.

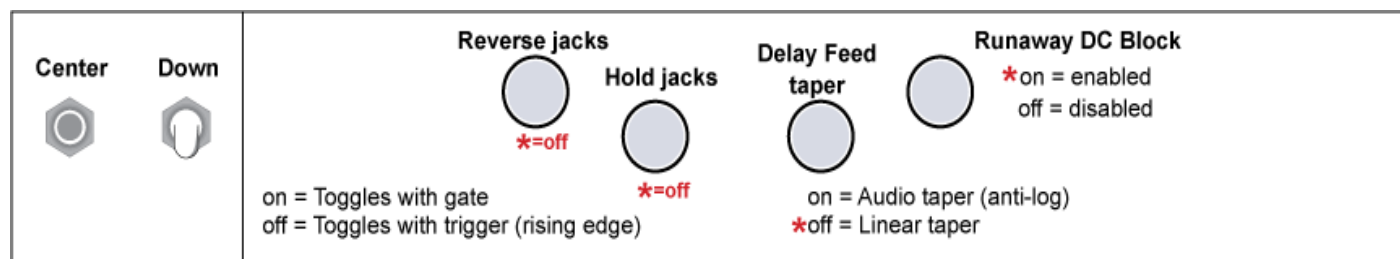
**Moving Average of 2:** This algorithm looks at the last two clock periods and uses the average value to determine the current ping value. Thus, this method responds to any change in the external tempo, but takes longer to “catch-up” than if ECD was disabled. Its advantage is that small amounts of jitter will cancel themselves out, so this makes for a decent compromise between tracking and ignoring jittery clocks.

**Linear Average of 4:** This method looks at the previous 4 clocks and updates the ping time to their average. However, it's not a “moving average” so it only updates the ping every 4 clocks. Thus, of all the algorithms, this method responds the slowest to changes in tempo. However it also has the highest stability if you are using a fixed external tempo. Example usages would be clocking the DLD with a drum sequencer at a fixed BPM. Changing the tempo will take 4 – 8 clock pulses for the DLD to catch up, but after the catch-up period, the DLD will stay locked even if the external clock drifts in tempo. This is the recommended setting for syncing to external analog drum machines (analog clocks are prone to drift), or in any situation where the tempo is fixed.

*Note: The Linear Average of 4 technique is essentially the same as running the external clock into a clock divider and patching the /4 output jack into the DLD's Ping input jack (and then using the Time settings to compensate for the slowed down clock). Using clock divider such as the RCD is a good de-jitter technique, and bigger divider outputs (/8, /24, etc) can be used to create an average of a larger group of pings.*

Please note that the very best way to ensure complete synchronization without artifacts is to use the DLD as the clock master.

### System Settings: the 'Center-Down' Group - NEW FEATURES!



### Reverse and Hold Inputs Gate/Trigger Mode - NEW FEATURE!

In all previous firmware versions, the *Reverse* and (Inf) *Hold* jack inputs toggle the state of their respective features on the leading edge of a trigger or gate. One trigger turns it on, one trigger turns it off.

In Version 5, there is a new option to change the response of the *Reverse* and *Hold* jacks so that the state toggles on the *leading* and *trailing* edge of a Gate signal. Essentially, this turns *Reverse* and *Hold* into gated, rather than toggled functions.

When the DLD is in Systems Setting mod and the left toggle switch is a center position and the right toggle switch is in the down position, the action of the *Reverse* and the *Hold* jacks is set separately and independently, as shown in the figure. Note that the settings apply to *both* audio channels.

A very interesting application of this with regard to reverse is use a variable PW pulse wave as the gating source. It does time-stretching easily, with some really interesting time-stretching that can make sounds slow down or even go backwards.

Note that the limits of this effect heavily depend on the Cross-fade time (described below). Some recommended settings for initial experimentation.

- Cross-fade time set to 8ms (factory default value)
- Reverse jack set to toggle on gate.
- QCM mode 'off'
  
- Input a loop, maybe 2 or 3 seconds long (not important). Try a vocal sample for example
- Enter **Infinite Hold** mode to capture the loop, and patch in a variable-width pulse wave into the Reverse jack.
- Run the pulse wave in the range of 10Hz to around 80-100Hz.  
Varying the pulse width makes some excellent sounds. At something like 51%-49% duty cycle we get a nice slow roll through the sample.

### Delay Feed Pot and CV Taper - NEW FEATURE!

**Audio Taper** vs **Linear Taper** is a distinction often brought up regarding pots for guitar volume knobs and effect pedals, but it applies to synth circuits and the DLD as well. In both cases, the Delay Feed knob goes from 0% to 100%, but in **Audio Taper** the curve between 0 and 100 follows the way the human ear naturally perceives

loudness (logarithmically). That is to say, with Audio Taper, if the Delay Feed knob is at 50% then the audio level will be 10% (which the ear perceives as half as loud).

In **Linear Taper**, if the knob is at 50% then the audio level will be 50%.

Previous firmware version had the **Delay Feed** knob work with an **Audio Taper**, because that's preferred for most audio volume knobs since it follows the ear's natural way of perceiving loudness. However with variable **Feedback**, **Wet/Dry Mix**, and multiple channels mixing together, the idea of "natural perception" is out the window. We got some feedback from users that **Delay Feed** seemed to make things too quiet too quickly, so the use of **Linear Taper** compensates for that. In Version 5, **Linear Taper** is not the default but can be changed by the user.

With **Linear Taper**, if you have a very hot input signal you should keep **Delay Feed** below 50% so that it doesn't saturate

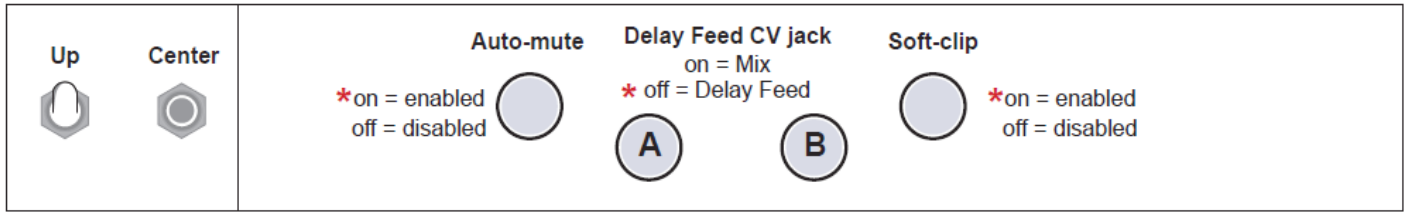
### **Runaway DC Blocking - NEW FEATURE!**

Hardware on the DLD inputs eliminates most **DC offset**, but it's still possible for a small amount of offset to come into the systems and problems can occur internally when high feedback magnifies this offset until it causes the whole output signal to drift up or down and hitting the rails, causing grave distortion

**Runaway DC Block** protects against this toxic situation, The default is set to 'on' and we recommend not adjusting this unless you are using the DLD for recording CV sequences with Feedback at or near 0%.



## System Settings: The 'Up-Center' Group (Version 4 legacy)



### Auto Muting

*Auto Mute* is a noise gate that silences the input when a signal less than 5mVpp is detected on any input. This prevents runaway feedback if **Feedback** is turned up and the DLD is allowed to run for a long time with no input signal. In most cases, it is not necessary to turn off the Auto-mute, since a 5mVpp signal is extremely quiet.

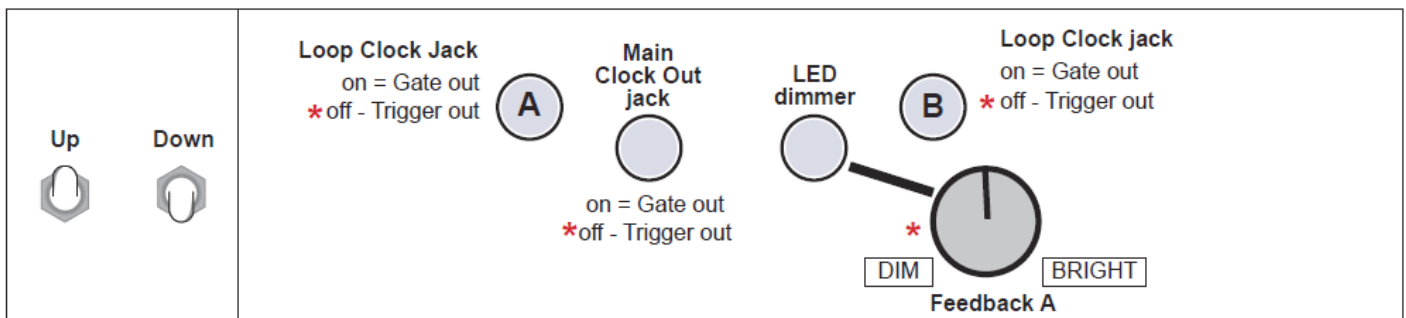
### Delay Feed CV Assignment

*Mix CV*, when enabled, re-assigns the **Delay Feed CV** jack to control the **Mix (Dry/Wet)** amount

### Soft-Clipping

*Soft Clipping* enables limiting (compression) when the output signal exceeds 75% of the clipping point. Below this point, the signal is unaffected. This saturation distortion sounds is often more pleasing to hear versus harsh clipping. In most cases, it is not necessary to disable soft clipping.

## System Settings: The 'Up-Down' Group (Version 4 legacy)



### Loop and Main Clock Output Duty Cycle


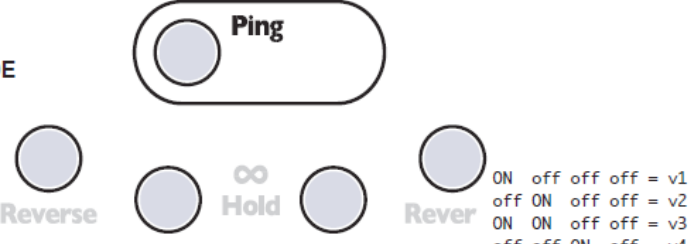
The clock output jacks can output gates or triggers (22ms pulse width). In this mode, the loop lights and Ping light will each blink once in sequence. A short flicker means the associated jack is in trigger mode, and a longer blink means it's in gate mode. The associated button will also be lit to indicate gate mode, or unlit to indicate trigger mode.

### LED Brightness Control

The red and blue Loop LEDs can be dimmed: Hold **Infinite Hold B** while turning the **Feedback A** knob (In firmware v3 and earlier, it's not necessary to press **Infinite Hold B**)

## Exiting the System Settings Mode

To leave the **Systems Setting** mode, flip both toggle switches once again to the **up** position. Then hold down all 5 pushbuttons. If you hold for 2 seconds or more, all changes (as well as the current state of **QCM**) will be stored to memory. A brief tap of the buttons will allow you to audition changes without saving.

 <p>Up      Up</p>	<p><i>With both Time switches up, press and hold all 5 buttons:</i></p> <p><b>Hold 2 seconds = ENTER SYSTEM MODE</b></p> <p><i>Repeat this to exit system mode:</i></p> <p><b>Hold 2 seconds = SAVE CHANGES</b></p> <p><b>Tap quickly = AUDIT CHANGES (powering off restores old settings)</b></p> <div data-bbox="812 388 1502 703"><p><b>Button lights show the firmware version in binary code</b> (Reverse A is LSB)</p><table data-bbox="1299 556 1502 703"><tr><td>ON</td><td>off</td><td>off</td><td>off</td><td>= v1</td></tr><tr><td>off</td><td>ON</td><td>off</td><td>off</td><td>= v2</td></tr><tr><td>ON</td><td>ON</td><td>off</td><td>off</td><td>= v3</td></tr><tr><td>off</td><td>off</td><td>ON</td><td>off</td><td>= v4</td></tr><tr><td>ON</td><td>off</td><td>ON</td><td>off</td><td>= v5</td></tr><tr><td>off</td><td>ON</td><td>ON</td><td>off</td><td>= v6</td></tr><tr><td>...</td><td>etc</td><td></td><td></td><td></td></tr></table></div>	ON	off	off	off	= v1	off	ON	off	off	= v2	ON	ON	off	off	= v3	off	off	ON	off	= v4	ON	off	ON	off	= v5	off	ON	ON	off	= v6	...	etc			
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It's a good idea to form the habit of putting your toggle switches back to their desired positions for operation as soon as you exit **System** Settings mode. Otherwise, you can forget and find yourself with a much longer delay time than you expected!

Want to know more? The completely updated version 5 User Manual for the DLD contains more discussion and example patches. Download it here by clicking on Manuals/Firmware:

<http://4mscompany.com/dld.php>