Tremolo

Optical Tremolo pedal

User Manual
v1.03 • November 17, 2009

INTRODUCTION

Thank you for purchasing the Diamond Tremolo pedal. The Tremolo represents a new circuit architecture for Diamond, combining a 100% analog signal path with a micro-processor to provide an unprecedented level of control without converting the audio to digital at any point in the circuit.

Like amp tremolo circuits of the 1960's, the Diamond Tremolo employs an opto-isolator (also known as a *light dependent resistor* or *photo coupler)* at the heart of the circuit to provide the familiar characteristic tremolo sound. However, the integration of digital control however allows us to manipulate the classic sound of opto-isolator tremolo in new and exciting ways. We've also added a special JFET-based 'chop' circuit that provides ultra-fast, duty cycle controllable, complete chop-out of the effected signal for a unique mode of trem operation.

We hope you'll enjoy using this pedal as much as we have enjoyed designing it.

Remember to protect your hearing and wear appropriate hearing protection when playing loud…

DESIGN BACKGROUND

We first began work on a tremolo pedal in the fall of 2008, and predates that if you include the trem and autopan circuitry originally intended for the stereo vibrato pedal that itself eventually morphed into today's Diamond Vibrato. We focused on combining an all-analog signal path based on the proven Diamond Compressor signal path, and sophisticated micro-controller based control to produce a design with advanced yet musical features. Particular emphasis was placed on the design of the user interface, with the goal to provide an ideal combination of simplicity and flexibility.

The first prototype units were displayed and demonstrated at the 2009 Winter NAMM trade show. Initial feedback was extremely positive and a number of suggestions from players inspired us to make various circuit and control changes. As the feature set grew, so did the challenge of implementing features while maintaining a simple the user interface grew. This final revision represents months of challenges and hard work on circuit design and software programming.

FEATURES

- Vactrol opto-isolator variable resistance path as used in many classic amplifier circuits of the 1960's
- Tremolo speed adjustable via tap tempo footswitch or front panel knob
- User selectable waveforms including 'Sharkfin', S ine, Square and 'Chop'
- Smooth ramping when changing speeds
- Front panel control of volume for easily matching dry and effected sound
- Premium audio components, including 2% Panasonic polypropylene capacitors and 1% metal film resistors
- Bi-color LEDs provides visual indication of speeds and waveform selection
- True Bypass operation

A NOTE ABOUT POWERING THE TREMOLO

The Diamond Tremolo is designed to be powered from either a 9V battery (included), standard 9V negative tip DC power adapter or from a multi pedal power supply.

QUICK START GUIDE

To get started quickly using the Diamond Tremolo, simply turn the unit on, make sure the mode knob on the far right is set to the ♩ symbol and adjust the SPEED, DEPTH and VOL to taste.

Note- You can set the desired tremolo speed by adjusting the SPEED knob directly or by tapping the desired speed using the TAP/DBL footswitch.

Once you have the desired speed, depth and volume settings, experiment with the various waveforms to get a feel for how each of them sounds. To easily toggle through the four waveforms, simply push the central toggle switch upwards. You'll note the LED on the left will change color to indicate the current waveform. For more detail on the various waveforms, the associated LED color and the resulting sound, please see the WAVEFORMS section in this manual.

Now that you've got the basics of the pedal down, read on to uncover the advanced features of the Tremolo.

DIAMOND TREMOLO CONTROLS IN DEPTH

As you can see in the previous Quick Start Guide, using the basic features of the Tremolo is quite easy. In this section we'll delve into the function of the various controls and you'll begin to understand how the powerful combination of analog and digital can be used to create a variety of musical and unique sounds.

ON/OFF
The ON/OFF footswitch is used to engage or bypass the effect. The Diamond Tremolo is true bypass.

SPEED
Along with VOL, the SPEED knob is the easiest control to understand but also has the most powerful effect on the Tremolo sound. By adjusting the SPEED control, you are adjusting the rate of the amplitude modulation. At lower settings the control provides a slow throb or on/off while at the highest speeds, the effect begins to create a more extreme effect akin to a ring modulator.

Note that the right side LED flashes at the current tempo to provide visual indication of the speed.

DEPTH
The DEPTH knob controls how extreme the modulation of the volume is, from a gentle wavering of the volume to a more extreme 'throb'. The DEPTH knob also has a very special and unique function when the CHOP waveform is selected. For more on the CHOP waveform and how it interacts with the DEPTH control, see the next section of this manual.

WAVEFORM Switch **(∼)**

This toggle switch allows you to toggle through the choice of 4 different waveforms. Each waveform produces a different feel to the tremolo effect, and is represented visually by different LED colors above the TAP/DBL switch. You may need to adjust the volume control to perceptually match bypass and trem levels - shorter on-time waveforms like the shark fin and sine have perceptually lower volumes than square and chop, and all are somewhat perceptually volume dependent on the trem speed.

> **GREEN LED: "Shark Fin"**- this waveform is based on the waveforms of classic '60s tube-based trems. Asymmetrical in shape, the 'sharkfin' models the classic tube trem sound with its lopsided on-time characteristics. This is the default waveform on power-up.

> **ORANGE LED: Sine**- the Sine wave produces a smooth, symmetrical sounding amplitude modulation. Has a bit less 'on-time' than the Shark Fin resulting in a slightly deeper pulsing feel.

RED LED: Square- the square waveform produces a more dramatic, harder edged tremolo effect. Interestingly, the response time of the opto-isolator influences the shape of the square wave, resulting in sloped rather than straight sides and rounding off the hard corners.

'**ALTERNATING GREEN AND RED LED: 'Chop'**'- the hard on/off of the chop waveform produces a very staccato tremolo effect, much like a kill switch or flipping the toggle switch on a LP with one pickup turned all the way down.

Selecting the 'Chop' waveform also changes the behavior of the DEPTH control- adjusting the DEPTH will change the duty cycle of the chop waveform, modifying the ratio of 'on' time to 'off time'.

With the DEPTH control centered, the on and off times will be equal. Turning the knob counterclockwise shortens the 'off' time while lengthening the 'on' time producing short bursts of signal dropout. Turning the knob clockwise has the reverse effect, lengthening the 'off' time and shortening the 'on' time.

In combination with the DEPTH control (as well as the mode knob) the chop waveform allows for some very unique and unorthodox sounds, either alone or in combination with other effects pedals. Be sure to try the 'CHOP' waveform in combination with setting 'C' on the mode knob- strange and amazing results can be achieved.

VOL

The VOL knob determines the overall output when the pedal is engaged. Use this control to balance your dry and effect levels and note that higher depth settings generally require a higher VOL setting.

Using the Tremolo pedal as a clean boost- While not designed as a booster, the high quality buffer amplifier in the Tremolo can be used to achieve a clean level boost for solos or overdriving your amplifier. Simply turn the depth control to minimum while using the Sine or Triangle waveforms and set the VOL control for the desired amount of clean boost.

TAP/DBL

The left footswitch provides several functions. The footswitch can be tapped in 5 of the 6 modes (see MODE below) to set the speed of the tremolo. The footswitch can also be held down to double the current speed (a RED left LED indicates double speed) or held to switch back to 'normal' speed (a GREEN left LED indicates normal speed).

Important note on tapping: the Diamond Tremolo uses a weighted averaging system that gives the highest weight to the last tap you enter while entering a series of taps. Once you

begin tapping, the trem will continually average all entries, giving the most weight to the most current tap, and lesser weight progressively back to the first in the series. This averaging period will timeout after approximately 2 seconds of no taps, after which you can begin a new series of averaged taps. This timeout period is approximately indicated by the TapView™ tempo flashing on the ON/OFF LED - when the ON/OFF LED turns solid again after tapping ceases, the timeout period is over. The TapView™ feature is described further later on in this manual.

The TAP/DBL footswitch also performs a special function when mode 'M' (Manual) is selected. In Manual mode, the footswitch acts as a 'soft' on/off for the effect allowing for easy accenting of ringing chords with a standard tremolo effect or in combination with the 'CHOP' waveform, allowing the footswitch to function as a manual 'kill switch', muting the guitar signal when the pedal is depressed.

MODE

The knob located on the right side of the pedal controls the mode of the pedal. This is the most powerful and unique control on the Tremolo. The six modes and their unique effect on both the operation of the pedal are summarized below. The first five modes (quarter note, eighth note, triplet, rhythmic and chaos) primarily alter the timebase of current speed, while the sixth mode is a special 'manual' mode that reuses the 'tap' switch for unique foot controllable waveform control and synchronization functions.

Mode 1: Quarter Note - This is the most basic mode, with a standard 1:1 quarter note timing of the trem speed (tapped or speed knob).

Mode 2: Eighth Note - In non-DBL speed, this mode has a level emphasized ONE-two-ONE-two 2/4 time signature feel at twice the speed of the quarter note mode. With DBL speed set, it changes to quadruple the quarter note speed, with a ONE-two-three-four 4/4 time signature feel. A small note on depth - as you decrease the depth control, the depth distance between emphasized and non-emphasized notes will decrease as you approach minimum depth. With the chop waveform, since it has no 'depth', we instead slightly emphasize the on duty cycle on the emphasized notes.

Mode 3: Triplet - In non-DBL speed, this mode has a level emphasis triplet (3 notes over a half note rate) ONE-two-three-ONE-two-three 3/4 time signature feel. With DBL speed set, it changes to a 6/8 time signature feel with ONE-two-three-four-five-six emphasis. A small note on depth - as you decrease the depth control, the depth distance between emphasized and non-emphasized notes will decrease as you approach minimum depth. With the chop waveform, since it has no 'depth', we instead slightly emphasize the on duty cycle on the emphasized notes.

Mode 4: (R)hythmic- In non-DBL speed, this mode has a repeating eighth-eighth-quarter note rhythm, while in DBL speed, changes to a repeating sixteenth-sixteenth-sixteenth-sixteenth-eighth-eighth rhythm.

Mode 5: (C)haotic - In this mode, the trem speed varies chaotically, but centered around the current set speed. Gives a cool 'broken trem' effect, try it for solos...

Mode 6: (M)anual - This is a unique mode that is set apart from the first five timebase modes. With shark fin, sine or square waves, there is no trem effect heard until you hold down the TAP/DBL footswitch, at which time the trem effect begins with the LFO synchronized to the start of the TAP/DBL depression. The speed of the trem in this mode can be set either by speed knob directly, or tapped in another mode before switching to manual mode (tapping no longer operates once you enter manual mode, but the quarter note (and whether its DBL or not) speed is preserved). With the chop waveform, the TAP/DBL footswitch acts as a temporary 'off' button, allowing you to manually chop the incoming signal via the footswitch.

INTERFACE DESIGN CONSIDERATIONS

The Diamond Tremolo has been designed to be as intuitive as possible even with a large number of waveform, speed and rhythmic possibilities. We've followed some important design considerations while designing the pedals user interface:

'Orthogonal' user interface - We've separated access to different features through 3 simple to use (and remember) controls - waveform, mode (timebase), and DBL (double-speed). The hold-to-enable DBL footswitch is kind of like a keyboards 'shift' key - it doubles the current trem rate in most modes, but in some it also accesses slightly different rhythmic or emphasis patterns.

Seamless tap vs speed knob entry - Designed to be seamless, speed can be entered either via tapping or the speed knob, allowing the user to go back and forth between the two entry methods whenever desired. Once a tapped value is entered, there is a slight amount of hysteresis on the speed knob so that slight movements of the knob don't change the current tapped value - just move the speed knob about 1/10 of its travel to enter a new speed knob value. The Trem on power-up defaults to the current speed knob setting.

Consistent 'double speed (DBL)' control - Holding the TAP/DBL footswitch down for 300 ms or more will toggle the trem back and forth between DBL and non-DBL speed settings, doubling the trem rate in DBL speed mode. The ON/OFF LED turns red to indicate DBL speed, and turns back green when returning to regular non-DBL rates. The DBL speed control in some timing modes also slightly changes the emphasis or rhythm characteristics, please see further details in the MODE descriptions later on in the user manual for more details. When

changing between DBL and non-DBL speeds, the trem speed ramps up and down to the new speed - if you let go of the TAP/DBL footswitch before it hits its final target speed, it will stay at that speed until you depress it again for 300 ms or more, where it will change speed directions and return back to the speed it began.

Important note: DBL speed ramping stops as soon as you let your foot off the TAP/DBL footswitch - to ensure that you've reached double speed (or the original speed, if returning), hold TAP/DBL down until TapView™ stops flashing (approximately 2.5 seconds). The ability to control 'partial ramping' by pulling your foot off before speed ramping is complete allows for additional creative control of speed changes.

TapView™ - With our rate LED hidden under foot while tapping, TapView™ temporarily displays the rate on the ON/OFF LED while either tapping or holding tap to change DBL speed modes. When tapping, TapView™ also lets you know by flashing the ON/OFF LED that taps are still being averaged - if you stop tapping and the LED turns solid, any new taps will begin a new series of tap averages. Similarly, when holding down for DBL speed changes, TapView™ stays flashing while the speed ramps up or down.

Rate hold between modes - This key UI element allows the user to set the basic underlying trem rate via knob or tap in any of the first five modes, then transfer it to other modes seamlessly just by turning the mode knob. That basic quarter note underlying rate is then translated to the timebase of the current mode selected.

OTHER FUNCTIONALITY

A few notes on 'non-audio' functionality...

POWER-ON LED SEQUENCE
Let's you know everything is A-OK when the pedal is powered on, and to be honest, was just a heck of a lot of fun to program!

LOW BATTERY INDICATOR
Although we recommend running the Diamond Tremolo from a standard 9V negative tip power supply, the Trem runs out of the box with an included standard 9V battery, with battery life of approximately 10-15 hours. Low battery life is indicated by both Trem LED's glowing constant orange, and occurs when the battery voltage output falls to the 6.5 to 7 V range. Prior to the double orange LED's state, you may notice needing to turn DEPTH up slightly to get the same amount of trem depth as the battery wears down - this is normal operation when using batteries, and will not be experienced using an adapter supply.