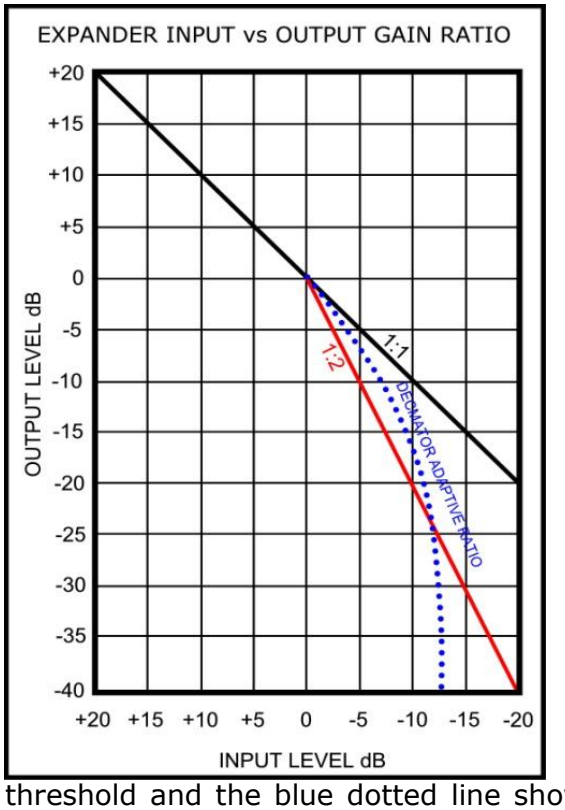
Decimator Technology / Time Vector Processing White Paper

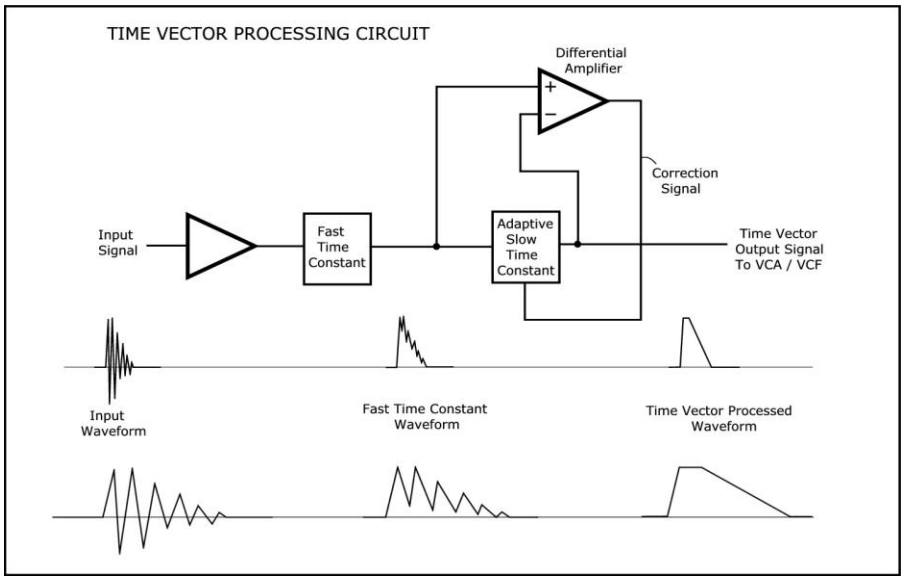
Players frequently ask what the difference is between the three different rack mount Decimators and also between the original Decimator pedal and the new Decimator G-String pedal. This white paper will give the background on these units and provide a better understanding which system is best for your application.

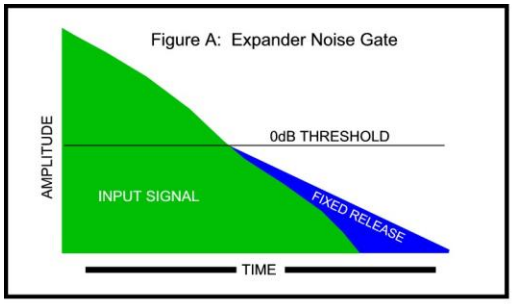
Noise Reduction background

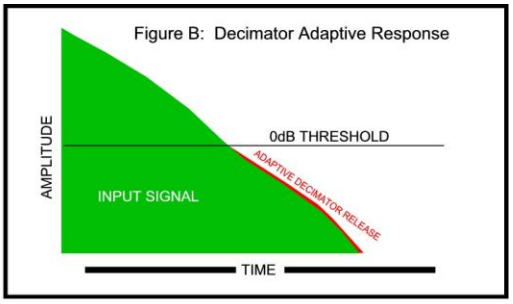
The most simplified noise reduction system is a noise gate. A noise gate works by simply switching the signal path open or closed so the signal is either on or off. The threshold is set so as to allow the desired signals to pass and to open the gate so no signal passes when the signal level decays to the point where the noise becomes undesirable. Most players find this undesirable since the gate will pop open and closed as the signal of the guitar gets near the threshold set point. For years downward expansion has been used as an alternative method of noise reduction and most professional studio noise gates actually use a method of downward expansion instead of a simplified noise gate. The typical professional studio noise gate will have an attack time allowing you to set how fast the expander opens and a release time or rate that determines how fast the expander attenuates after the single drops below the threshold point. This may provide acceptable performance in many applications such as a gate on drums where a single drum is fed through a gate to control the attack and release of a drum with a definable and repeatable waveform. The problem becomes evident when you try to apply this technology to a guitar signal, which can change hundreds of times in any given song. The guitarist is changing from staccato short fast playing to long sustained notes and everything in between and a pre-defined release of a gate or expander is a compromise at best. The Decimator is a single ended noise reduction system, not a noise gate, or a simple expander. All of the Decimator systems are based on ISP Technologies patented Time Vector Processing™ technology to control the release characteristics of the downward expander providing a fully adaptive processing control circuit. First, the Time Vector Processing utilizes a variable ratio circuit that increases the expansion ratio the farther the signal drops below the user defined threshold. As shown in the graph a typical downward expander will have a fixed below threshold ratio. You can see in the graph to the left the red line shows a fixed 1:2 ratio below threshold and the blue dotted line shows the variable adaptive ratio of the Decimator downward expander.

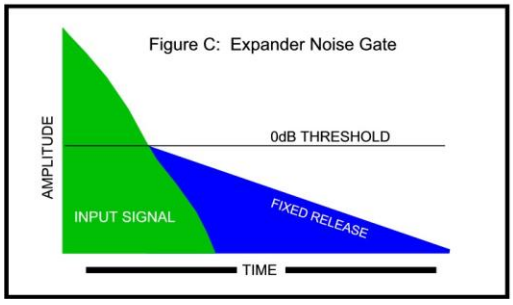


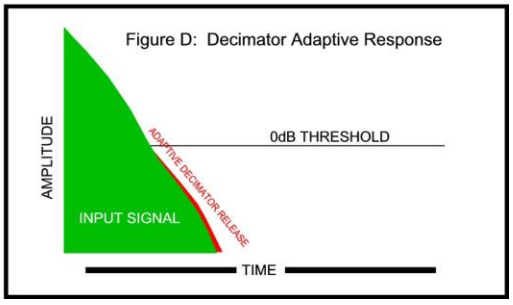
The next process is the Time Vector circuit, which sets up an extremely fast release response and a very long release and compares the short term fast response of the input signal with the adaptive slow release response and will dynamically vary the actual release response of the downward expander to optimize the release response to match the envelope of the input signal being played. The actual response will vary over a 1000 to 1 ratio with incredible tracking accuracy. As you can see in the block diagram below, a fast short burst or staccato note played at the input will produce a fast time constant output with a large amount of ripple. This signal, if used to control the Voltage Controlled Amplifier in the signal path of the Decimator, would cause audible modulation of the input signal and undesirable distortion. The problem is even more pronounced with a long sustained note shown at the bottom of the diagram. This ripple is smoothed with the adaptive slow time constant circuit by applying a correction signal based on the difference between the fast time constant and the adaptive slow time constant to vary the release time to match the actual envelope of the input signal. Over a short period of time, the output signal will adjust to match the actual envelope of the input signal being played.











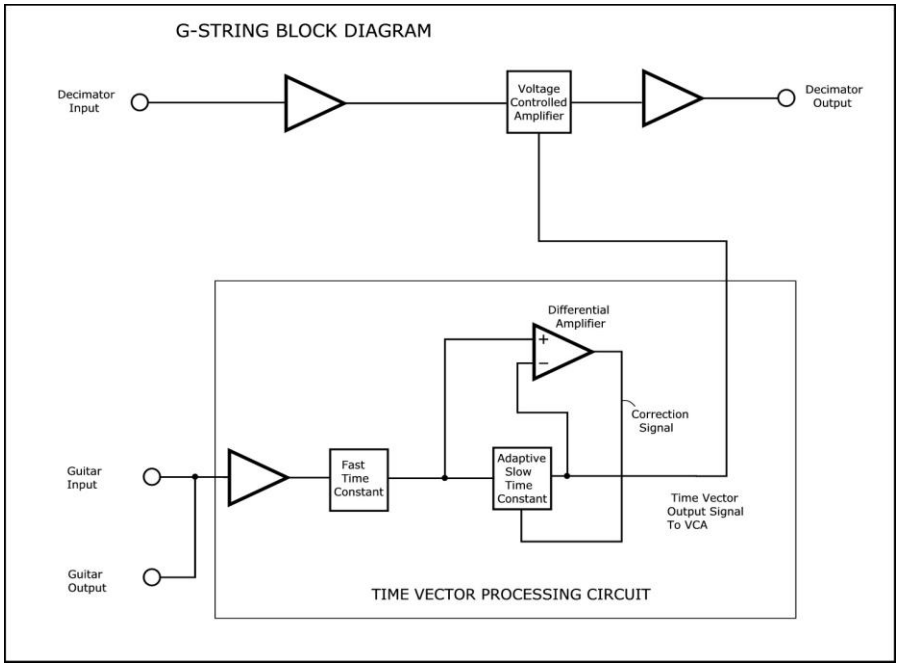
The figures to the left show the response difference that you get with a fixed release expander type noise gate vs. the Adaptive release response of the Decimator. Figure A and Figure B both have the same input signal with a threshold setting of 0db. When the signal drops below the 0db threshold point in Figure A you get a fixed release response vs. the

adaptive release response of the Decimator, shown in Figure B, due to the Time Vector Processing. Figure C and Figure D show how with a staccato note the problem of a fixed release response will become very noticeable with the expander gate but the Time Vector Processing circuit will adapt the release to track the envelope of the input signal.

Both the pedals and the ProRack units incorporate the Time Vector Processing circuit controlling a low level downward expander circuit. The original Decimator Pedal has a single downward expander and Time Vector Processing control circuit in a pedal with just one input and output. The Decimator pedal can be used to quiet noise from any signal that passes through the pedal. Many players use the original Decimator pedal to eliminate the 60 cycle hum and buzz at the output of the guitar. You can also insert the pedal in a series effects loop but you need to be aware that changes in the noise floor of the loop will require an adjustment in the threshold of the Decimator pedal for proper tracking. When using the Decimator pedal to eliminate the noise from a high gain distorted signal a high threshold setting will be required. Switching the guitar amp from high gain distortion to clean will require either switching the Decimator pedal off or adjusting the threshold to a lower setting since the noise floor of the input signal will have dropped.

The G-String Decimator Pedal

The G-string is similar to the original Decimator pedal but with a feed forward design. The G-String has a separate Guitar Input and Output and Decimator processor Input and Output. This allows the Decimator Time Vector processing circuit to track the direct output of the guitar signal and also provide a block of Decimator noise reduction that can be inserted at the end of a chain of pedals or in the loop of a series effects loop. In this configuration you can switch between an extremely high gain signal and clean signal and everything in between and never need to adjust the threshold of the Decimator G-String. You can see in the simplified block diagram of the G-String pedal below the Guitar Input and Guitar Output are connected together and allow the circuit to generate a Time Vector Processed control signal to control the Decimator signal path. There is no actual active circuitry between the Guitar Input and the Guitar Output to avoid any noise contribution from the G-String pedal. You connect the Decimator signal path at the end of your pedals or insert the Decimator In and Decimator Out in a series effects loop. This allows the Decimator to eliminate the noise of the signal path and never require any threshold adjustment since



the Time Vector Processing circuit is tracking the wide dynamic range of the Guitar input.

The ProRack and ProRackG Dual Channel Noise Reduction Systems

The ProRack is a two channel Decimator system with two totally independent channels of noise reduction incorporating both Low Level Downward Expansion and the additional process of Dynamically controlled Low-pass Filtering. The ProRack was designed primarily for professional recording or live sound applications where you can insert two independent channels on two different audio signals. The applications include separate tracks in the recording studio or inserted on separate channels of a mixer for live sound.

The ProRackG is a two channel Decimator system designed specifically for guitar applications with a feed forward control for the channel 2 noise reduction. Both channel 1 and channel 2 Time Vector processing control circuits look at the input of channel 1. The proper use of the ProRackG requires connecting the guitar directly to the input of channel 1. This will put a channel of Decimator between the guitar and the input of the amplifier or effects pedals to eliminate the noise picked up from the guitar. Then you insert channel 2 in a series effects loop or at the end of your effects pedals. Since channel 2 Time Vector Processing circuits are looking at the actual guitar input of channel 1 the player can change from high gain to clean and never need to adjust the threshold of the Decimator.

Dynamic Filtering

As mentioned above, the ProRack units also incorporate a second noise reduction process on each channel of Dynamic Low Pass Filtering. This allows the selective removal of just high frequency hiss and upper frequency harmonic buzz. The Dynamic low pass filter is controlled by a second Time Vector Processing circuit with a Frequency weighted control. The Dynamic Filter will open from 1kHz up to 20kHz when the input signal contains high frequency information. By controlling the Dynamic Filter with a second Time Vector Processing circuit the release response of the Dynamic Filter will track the envelope of the input signal the same as the Downward expander. The two processes work together to provide the most adaptive and effective real-time noise reduction available.

ProRackG Stereo Mod

The ProRackG Stero Mod was developed for the players who need two totally independent channels of Decimator Noise Reduction for a true stereo rig or for use with two different preamps or guitar amplifiers. The ProRackG Stereo Mod also incorporates a feed forward control of the Time Vector Processors but with two channels that can be inserted where needed in the signal path. The rear of the unit has a separate guitar input and output to connect to the guitar and feed the input of your guitar rig. Then both channel 1 and channel 2 have independent inputs and outputs that can be inserted in different signal paths for use in true stereo applications or more elaborate guitar systems.