

# Multiwave Distortion Technology

By

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## **Introduction**

While there are literally hundreds of audio distortion products on the market, most rely on a relatively few well established approaches to create signal distortion. Whether emanating from tubes or transistors, these classic analog circuits have defined the world of distortion. By and large, these circuits have only seen incremental change and refinement since the 1960s and 1970s. In the mid 1990s the advent of audio digital signal processing allowed somewhat accurate modeling of the classic distortion sounds, and a new wave of products were brought to market that offered many of the classic sounds in one box.

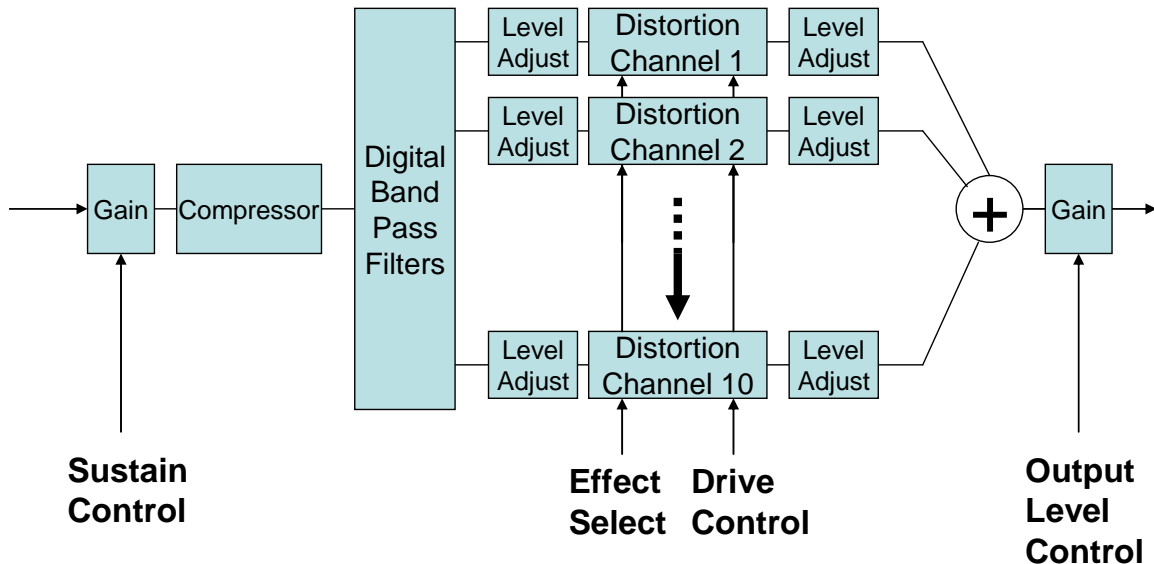
All distortion approaches suffer from varying degrees of inter-modulation artifacts when playing more than one note, some more sensitive than others. Although they have become part of what we expect when we hear distortion, they do limit the use of heavy distortion with complex chords.

As we sought to create a distortion product we took a new approach. The Soundblox™ Multiwave Distortion provides some truly unique distortion sounds. In creating this effects pedal, we didn't intend to duplicate, model, or emulate any existing types of distortion. The types of algorithms we use to create the distortion are quite different from the standard set, although with certain settings the result can sound similar. Finally, the use of a multi-band approach represents the first significant reduction in inter-modulation distortion to be brought to the floor-based guitar effects market. The purpose of this paper is to describe the two key principles enabling the unique capabilities of this new product.

## **Inter-modulation distortion and the Multiwave Approach**

When more than one note is played through a distortion stage, one also gets a generated note at the frequency sum, as well as additional linear combinations of the original frequencies. These additional notes may or may not be harmonically linked to the original notes. As more notes are played, there is an increased likelihood that the resulting sound will be an unrecognizable mess. It is well known that complex chords do not sound good when heavily distorted, and inter-modulation is the source of this problem.

## Multiwave Distortion Block Diagram



In the Multiwave Distortion we have developed a technique to divide up the input guitar signal into multiple frequency bands. Each band is separately distorted, and then all are recombined. If chords are played, there can be a lot of clarity between the various notes. It's possible to leave several notes droning, while a melody is played on top. A normal distortion tends to reduce such playing to mush. Because of the multiple bands, it's also possible to get several notes feeding back at the same time. The first 14 settings (labeled MULTI BAND) on the EFFECT knob use band splitting while the last 7 (labeled SINGLE BAND) do not.

### Foldback Distortion – A new approach

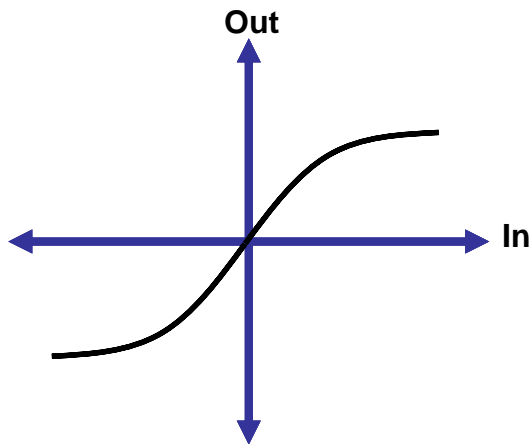
The shape of the distortion mapping curve is also different from standard distortions. Normally, as the input signal voltage rises, the output voltage also rises, but begins to level off and finally pins (or clips) at a maximum value. With a foldback curve, for large enough values of the input, the output will begin to decrease. With more extreme amounts of foldback, after decreasing for a while, the output can begin to increase again. Maximum foldback has many regions where the output alternates between increasing and decreasing. These kinds of curves add a lot of high frequency content to the output. It also can provide a lot of control over the sound, based on the level of the input signal. With foldback, chords containing only octaves and fifths tend to sound best. Other intervals can cause some strange, although not necessarily undesirable sounds.

Using a special shape of the distortion curve, strong second harmonics can be created, sounding like a note an octave higher. Rolling off the guitar tone control or switching to the neck pickup will help maximize the octave impression by attenuating the higher-order harmonics. Complex chords don't typically work well for octave settings. The result is

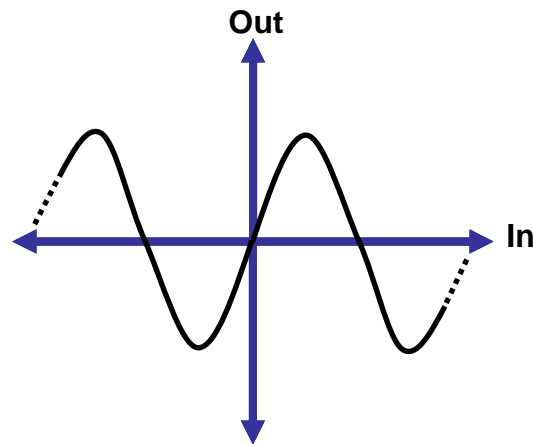
very sensitive to the input signal level (as long as the SUSTAIN and DRIVE controls are not set too high) and can give a sort of auto-wah effect.

A conventional distortion effect tends to turn the guitar signal into square waves. Playing harder only makes the transition from negative clipping to positive clipping a little bit steeper. With our foldback and octave algorithms, a slightly higher input can have a radical effect on the shape of the output signal.

## Input/Output Characteristics



**Traditional Distortion Curve**



**Foldback Curve**

## Description of Effects in the Multiwave Distortion Product

### **MULTI BAND – NORMAL 1-3**

- Description: These three settings are best for maximum clarity of the individual notes in a chord. These distortion curves are similar to standard distortions.

### **MULTI BAND - FOLDBACK 4-9**

- Description: The foldback of the distortion curve greatly increases the distortion components for these settings. The higher numbered effects have more foldback creating even more distortion. Big chords may not work well.

### **MULTI BAND – OCTAVE 10-14**

- Description: Settings 10 and 11 give the purest octave effect. Settings 12 through 14 also have foldback and can get pretty strange. Unlike classic octave effects, chords can produce some useful results.

### **SINGLE BAND – NORMAL 15-16**

- Description: These two settings are fairly conventional distortion sounds.

### **SINGLE BAND – FOLDBACK 17-19**

- Description: With the entire guitar signal processed through a single foldback distortion curve, there will be much more intermodulation-type distortion produced.

### **SINGLE BAND – OCTAVE 20, 21**

- Description: 20 is the purest single band octave effect, and 21 includes some foldback.

**Use with Hot Hand:**

While the primary function of the Multiwave Distortion is as a standalone effects pedal you also have the option of exploring some additional functions by plugging in a Hot Hand sensor. When a sensor is plugged in the amount of DRIVE is controlled by the Hot Hand sensor. The maximum amount of drive you can get by moving the sensor is determined by the position of the DRIVE knob.