Contact FEA Labs at:

www.fealabs.com

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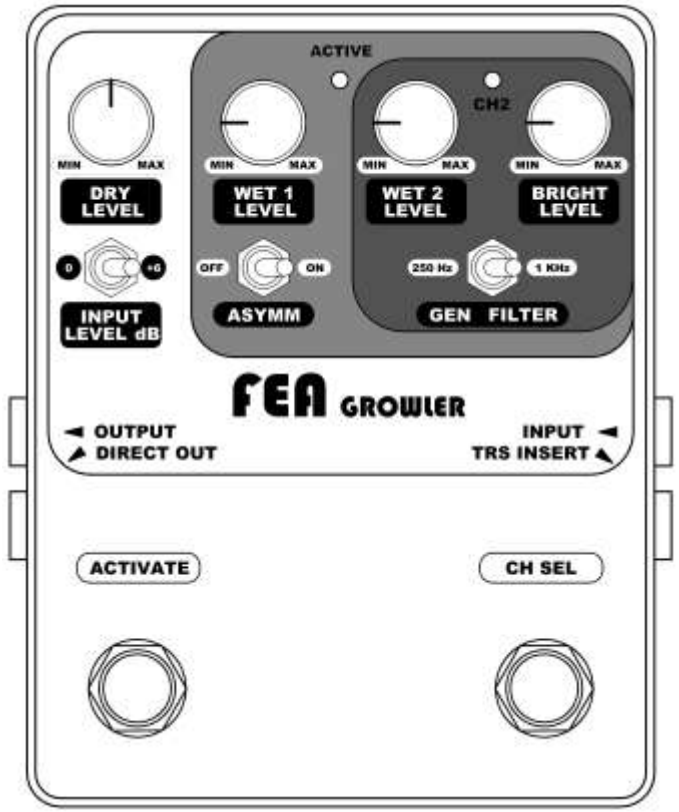
REV 3.0

FEA
GROWLER



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About the design:

The FEA Growler was designed as an enhancement pedal to provide a true analog even order harmonic tone to the notes of a bass guitar. This tone is mostly comprised of a generated second harmonic of the input signal.

These even order harmonic tones are blended with the original signal to create a rich full tone. This even order harmonic tone also makes the sub audible or low amplitude notes from a down tuned bass guitar more audible. Most bass rigs do not efficiently reproduce the fundamental frequencies of the lowest bass notes. By adding more of the even order harmonics, the amplifier and speakers appear to be louder and more efficient.

The FEA Growler generates this harmonic signal by using an analog four quadrant multiplier, also known as a Double Balanced Modulator. Since this harmonic generator is based on a true multiplication function, the Growler has no tracking issues. Due to the exponential function of the modulator, the lower amplitudes of the harmonic partials in the note decrease in amplitude exponentially as their frequency increases. The generated signal by itself has a hollow sound (lacking the fundamental and the higher partials), but when added with the original dry signal a pleasing textured tone is created. The FEA Growler will not make your bass guitar sound like a regular guitar, because some of the harmonic structure of the bass note exists in the generated signal.

The FEA Growler has a toggle switch that allows the user to add asymmetrical soft clipping to the generator amplifier. This asymmetrical clipping adds more harmonic content to the generated signal. It can be heard as a very soft distortion or fuzz sound.

The same Silonex AOI's (Analog Optical Isolators) that are in the FEA Optical Compressors are used in the Growler compander circuitry.
The compander (compressor/expander) circuitry compresses the amplitude of the signal to a workable level for the harmonic generator. Then the compander takes the output of the generator and restores the amplitude back to the original signal

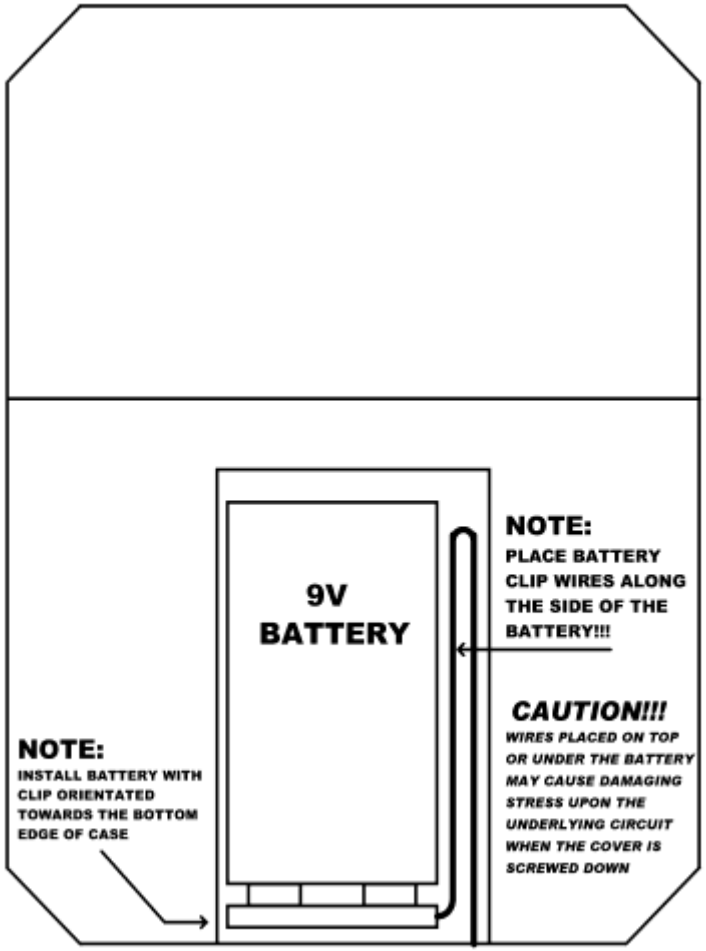
Warranty:

The FEA Growler is fully covered for a period of 5 (five) years and the foot switches are covered for 1 (one) year against defects in material and workmanship. Abuse and neglect are not covered under the warranty. The customer will be responsible for shipping cost to and from FEA Labs for repairs. Contact me before attempting to ship a unit for repair at: info@fealabs.com.

All repairs made outside of the warranty period will be very reasonable (usually only the cost of the parts)… your satisfaction is priority one.

Battery replacement:

Remove the four screws on the bottom cover to access the battery compartment. If storing the unit for long periods of time the battery should be removed to prevent corrosion of the battery snap. Be sure to place the battery wires along the side of the battery in the battery pocket and use care while replacing the bottom cover.



level. This compander is an essential part of the Growler due to the exponential amplitude function of the generator. Otherwise, the output of the generator would not be musically useful in this application. The Growler compander circuitry has been carefully designed to allow an exaggerated attack to each note played. This gives the Growler an aggressive punch to the tone giving the bass guitar a livelier sound.

The FEA Growler has a toggle switch that engages an additional 6dB of gain for the input amplifier. This is useful to allow low output instruments to drive the compander circuitry harder for better effect of punch and growl.

The FEA Growler uses 1% metal film resistors, multi-layer metallized polyester film capacitors (where possible) and hi-fi quality JFET operational amplifiers in the signal path. These are the same op-amps that are used in some very high-end studio mixing consoles.

The dual rail power supply in the Growler is built on an isolated circuit board. The power supply can be powered with 9 to 25V DC and is over filtered two times to assure exceptionally clean power for the signal circuitry. This power supply provides 18Volts (+9V and -9V) to the circuit board to provide plenty of headroom for the signal. The power supply was designed to provide separate power for the compander circuitry. This assures that any natural electrical noise that the compander circuitry generates will not bleed into the signal circuitry. I have not seen this approach to power distribution in any of the other manufacturer's guitar effects. Is it overkill? Maybe…but I feel that it is absolutely crucial to eliminate every bit of noise where possible.

The case is a standard Hammond aluminum enclosure. After the Hammond case is machined and sanded it is then color powder coated, the aluminum faceplate is applied and then the entire case is clear epoxy powder coated for protection.

Frank E. Appleton (FEA)

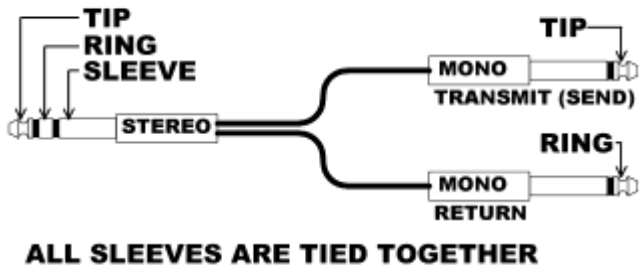
Features:

- **WET 1, WET 2 and DRY LEVEL controls for mixing the original signal (DRY) with either of the analog harmonic signals (WET).**
- **The CH SEL footswitch selects between the WET1 or WET2 harmonic channels when the pedal is active.**
- **GEN FILTER switch applies a 12 dB/octave low pass filter before the generator circuit. Two cutoff frequencies of 250Hz or 1KHz can be selected by this switch. This switch only affects wet channel two. Wet channel one has its filter is set to 250Hz all of the time.**
- **ASYMM switch adds asymmetrical soft clipping to the harmonic generator amplifier. The ASYMM function will add more harmonic content to the WET1 and WET2 channels.**
- **BRIGHT LEVEL is a treble tone control for the generated wet signal on channel two. Wet channel one is not affected by this control.**
- **ACTIVATE foot switch places the Growler unit in the signal chain or in Direct Bypass mode. In Direct Bypass mode the signal at the input is directly connected to the output and does not pass through any electronics.**
- **The Growler has minimal components in the signal paths to maintain the utmost signal quality. All resistors in the circuit are low noise 1% metal film type. The capacitors used in the dry signal path are tight tolerance, quiet, multi-layer and metallized polyester film type. The operational amplifiers used in the signal path are JFET input, low-noise, low-distortion "hi-fi quality" devices.**
- **The compander (compressor/expander) circuit in the Growler utilizes AOI's (Analog Optical Isolators), also known as light dependent resistors. This allows the circuit to have only passive components control signal gain to keep noise and distortion to minimum levels.**
- **DIRECT OUT output jack for optional use to send the**

Technical Specifications:

❑ **DRY Signal level:**	**Adjustable to +3.5dB**
❑ **WET Signal level:**	**Adjustable to +6.0dB**
❑ **INPUT gain level switch:**	**Selectable 0dB or +6dB**
❑ **Maximum Input:**	**13dBu @ 0dB Gain switch setting**
❑ **Maximum Output:**	**15dBu**
❑ **Harmonic GEN LP filter:**	**220Hz or 1KHz of DRY signal**
❑ **Residual Output Noise:**	**-65dBu from 15Hz-15kHz (un-weighted) output gains set to maximum. **This is the absolute worst case noise scenario.****
❑ **Frequency Response:**	**15Hz – 15KHz @-3dB (100Kohm output load)**
❑ **Input Impedance:**	**1M ohm**
❑ **Output Impedance:**	**1K ohm**
❑ **Power adapter noise rejection:**	**40dBu @ 60Hz >90dBu @ 2KHz**
❑ **Current Consumption:**	**Approx. 35mA**
❑ **Battery Life:**	**Approx. 14 hours (Due to the higher current needed for the generator circuit the use of a power adapter is advised.)**
❑ **Power adapter (optional):**	**9VDC 2.1mm Barrel Connector with negative center pin**

TRS Insert cable diagram:



The TRS insert cable is used to patch in external effects into the WET2 signal path. The TRS end transmits the wet signal from the Growler via the TIP and the signal is returned via the RING of the plug.

NOTE: Any effect or volume pedal used in the insert jack should be actively buffered with high input and low output impedances for proper circuit operation.

input to another signal processor or amplifier. This is a passive direct connection from the input jack to the dry output jack.

- **TRS INSERT jack for external processing of the generated signal on the WET2 channel. This is a standard TRS insert where the signal is sent out via the Tip and it is returned via the Ring of a TRS plug. (See Page 7)**

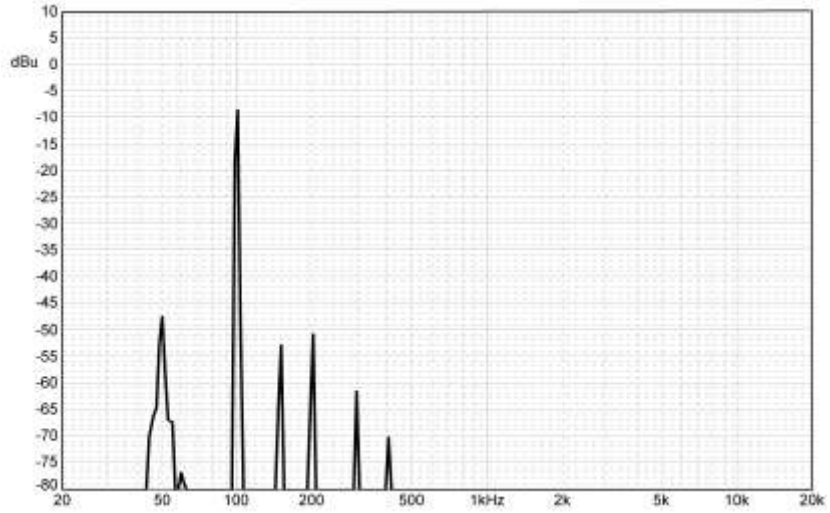
- **The power supplies onboard voltage charge pump allows the circuitry to operate at 18volts (+9 and –9 volt rails) from a single 9-volt battery or AC power adapter of 9 volts or greater. This allows the signal plenty of headroom from active electronic guitars and aggressive playing techniques (i.e. pop and slap).**

- **The onboard power supply can accommodate power adapter voltages up to 25 volts DC with protection from reversed polarity. The "switch on" power supply current is less than 1µA (micro amp) on the signal ground at the INPUT jack. This is approximately 45,000 times (-93dB) less than the commonly used method of connecting the battery's negative terminal to ground via the sleeve of the plug inserted into the INPUT jack. The "switch on" sensing method used in the FEA Growler keeps nearly all of the circuit's generated white noise and transient currents out of the INPUT stage signal ground. Extreme measures have been taken to keep the power and signal paths as clean as possible. *NOTE: Unplug the cord from the INPUT jack when not in use to prolong battery life.***

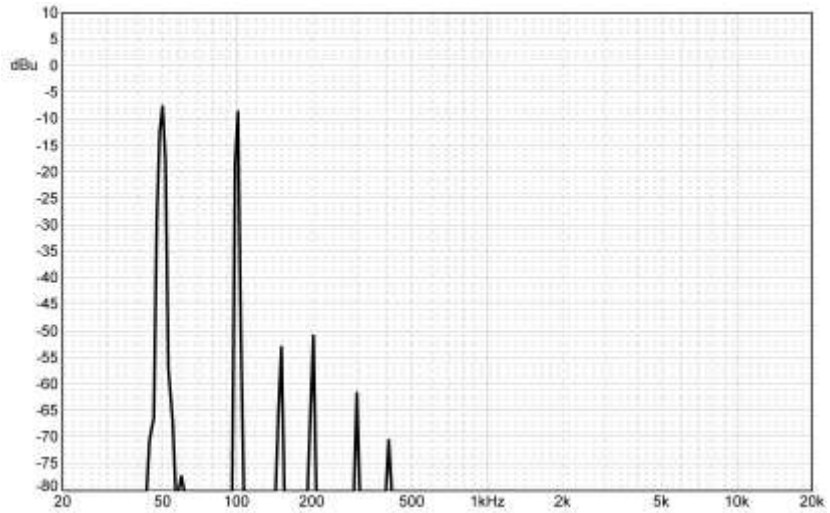
- **The power and grounds for the signal path circuitry are separated from the compander side-chain power and grounds to protect the audio signal from spurious noise. The power for the signal amplifiers is exceptionally clean, filtered twice for each rail and all filter stages are oversized.**

FFT Graphs:

Fundamental signal input -10dBu @ 50Hz with second harmonic @ 100Hz. WET level set to unity and DRY signal set to minimum.



Fundamental signal input -10dBu @ 50Hz. WET and DRY levels set to unity.



Growler Block Diagram: