BITMAP 2
Owner's Manual

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For firmware version 2.1+

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Please register your product at redpandalab.com/register

Product manuals and firmware updates are available at redpandalab.com/downloads

For technical support, email support@redpandalab.com

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Introduction

Thank you for purchasing the Bitmap 2.

The first Red Panda product was a bitcrusher module released in 2009 for the Line 6 ToneCore® dock. The Bitmap 1 was released in 2014 and featured an updated bitcrushing algorithm, but had fewer features than the 2009 bitcrusher due to hardware limitations. The Bitmap 2 combines the features of both bitcrushers, along with an unreleased foldover distortion pedal.

The Bitmap 2 is tuned to provide maximum sustain without sputtering on staccato notes. Less extreme settings add layers of nonlinearities that interact in subtle ways, giving you the warmth and grit of 8- and 12-bit samplers. Sample rate reduction turns your guitar into 8-bit video game sounds or twists scales into inharmonic melodies. Sample rate modulation adds subtle motion or morphs your guitar into entirely new textures.

Bitmap 2 Features:
• Fractional bit reduction (1-24 bits)
• Sampling rate reduction from 48 kHz to 110 Hz
• Sampling rate modulation
• Envelope modulation of sampling rate and blend
• Waveshaper, wave folder, and window comparator
• Drive control with saturation
• 4 pole lowpass filter
• Presets (4 on front panel, 127 via MIDI)
• MIDI via USB and TRS
• Assignable expression pedal
• Web-based editor
• Stereo input/output
• Line level capability

Why was a bitcrusher our first product? When I was in 5th grade, I heard "777-9311" and *1999*. The drums sounded different than anything I had heard before (Linn LM-1). The next year, "Sucker M.C.'s" had a hard, minimal beat from an Oberheim DMX. Then in 1985, "Marley Marl Scratch" hit with raw, aggressive sampled drum sounds (2x Korg SDD-2000 triggered by a Roland TR-808). *Yo! Bum Rush The Show* blew my mind when I was 14 and is still one of my favorite albums (maybe a Korg DDD-1 and E-mu SP1200), but "Rebel Without a Pause" was on another level (Ensoniq Mirage). My formative years were spent listening to bit-crushed samples. Early samplers added a certain type of distortion and *musical* noise, and their limitations forced creativity. Manufacturers were pushing the limits of technology and musicians were using the tools to invent new ways of expressing themselves.

New in version 2.1

Bitmap version 2.1 firmware expands its sonic range with more distortion and filter options, and adds the ability to transfer presets between your pedal and a computer . It was released in December, 2024.

We recommend doing a factory reset after updating your firmware. If you upgrade without performing a factory reset, the output gain will be set to 0 dBu. Hold the WAVE button until the LED changes to cyan and turn the MIX knob to its minimum setting to enable automatic gain control.

- Input drive has 60 dB of gain (was 40 dB in version 2.0.x).
- Three input drive saturation types. Hard clipping (default) is the same as version 2.0.x and is similar to overdriving a mixer channel. Distortion 1 is a full-frequency distortion. Distortion 2 is a mid-range-focused distortion that cuts through in a band setting or mix.
- Filter has 3 ranges: 330 Hz - 20 KHz (normal), 20 Hz - 20 kHz (extended), and ±2 octaves relative to the sampling rate (relative).
- The filter resonance can be adjusted by holding dow the **WAVE** button and turning the **FILTER** knob.
- Anti-aliasing filter with response similar to classic 12-bit samplers. The anti-aliasing filter can be set to on (default), off (matches v2.0.x), and adjustable (tracks filter frequency).
- Adjustable output level (-30 to +6 dB) by holding down the **WAVE** button and turning the **MIX** knob. At the minimum setting, it uses an automatic gain control to match the output volume to the input.
- The envelope follower is now pre-drive, to allow more dynamics with saturation. The envelope follower has a wider range.
- The envelope destination can be set to the filter or mix (inverted) by holding down the **WAVE** button and setting the **ENV:DEST** toggle switch to the left or middle position, respectively.
- The right LED is green if the envelope follower is active and an input signal is present.
- If the AUX switch is set to Modulation On/Off, the left LED will be green if modulation is on and red if it is off (previously it blinked when the setting changed).
- Filter resonance, modulation, and envelope destinations are remembered when power is off.
- Added mono in/mono out and stereo in/stereo out configurations.
- Hold tap tempo switch to cancel tap tempo.
- Improved out-of-band noise rejection.
- USB and 1/4" MIDI improvements.
- Web editor allows you to upload, download, copy, and paste presets.
- Web editor has been updated for the new features listed above. It is also supported on Linux.
- TouchOSC template for performance control and configuration (optimized for iPad).

Signal Flow
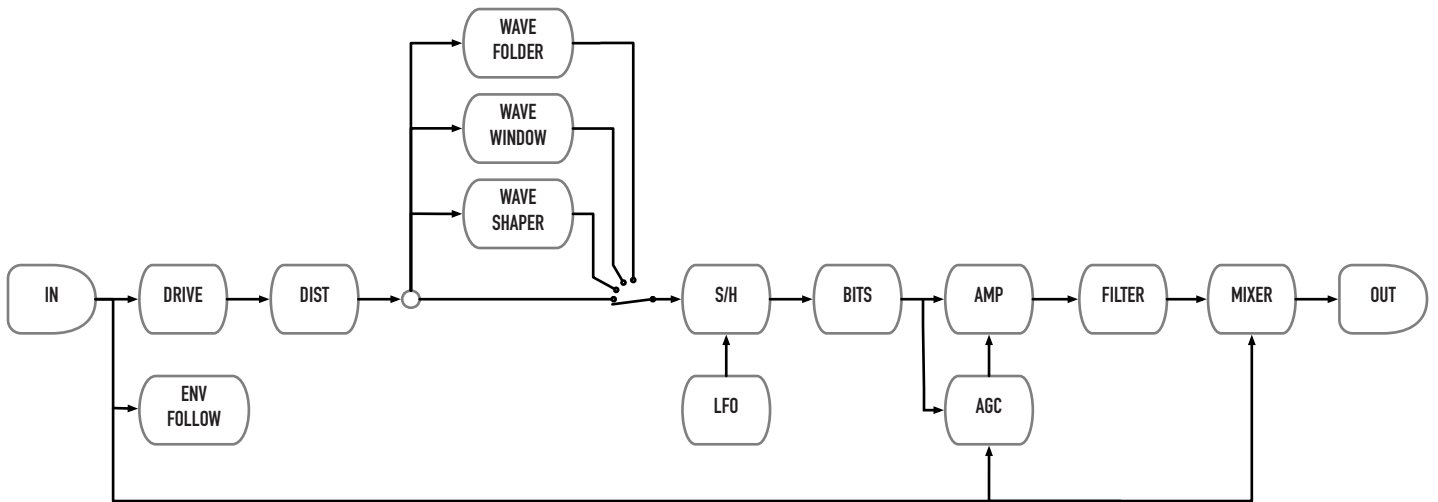
Bit crushing and waveshaping are amplitude-dependent effects, so it is helpful to be familiar with gain staging. Gain staging is adjusting the signal level at each point in the signal path - usually to maximize signal-to-noise ratio without distortion. In this case, we adjust the signal level to layer nonlinearities.

The **DRIVE** control amplifies the input signal with hard clipping. Use it to adjust the input gain based on signal level, or overdrive the input stage for distortion. The preset and wave LEDs display the signal level for a few seconds after the knob is moved (the ⚠ LED indicates saturation/clipping - which is ok!). Lowering the drive will cause the signal to sputter and cut out. Increasing drive will give a more saturated sound. The web editor allows you to select three different distortion algorithms.

The wavefolder, wave window, or waveshaper can be used instead of sample rate modulation to create additional nonlinear distortion. The **DEPTH** knob adjusts the transfer function that is applied to the input signal, adding more harmonics as you increase the depth. The effect is amplitude-dependent, so the combination of **DRIVE** and **DEPTH** settings give a wide range of possibilities. Using **DRIVE** to clip the input signal will flatten the output at a level controlled by the **DEPTH** (not necessarily the waveform peak).

After drive and waveshaping, the signal is sampled and bit-depth reduced. Samping rate reduction (**FREQ**) causes higher partials to fold back down to lower frequencies, where they intermix with the lower partials, creating inharmonic distortion based on the relationship between the instrument's pitch and the sampling rate. Bit reduction (**CRUSH**) makes the waveform less accurate and adds noise that is correlated with the signal - quiet when you are not playing, white noise during louder passages, and static-y artifacts as notes decay. The Bitmap uses digital models of A/D and D/A converters similar to early samplers, which adds additional nonlinearities.

After the sampling rate and bit-depth reduction, a 4-pole lowpass **FILTER** can be used to smooth out the rough edges. You can adjust the resonance and modulate the filter cutoff by the LFO or envelope for dynamic filtering.

An optional automatic gain control (AGC) block analyzes the input signal and the effected signal and tries to match their loudness so that you can smoothly blend from dry to wet. Hold the **[WAVE]** button and adjust **MIX** to set the output level directly.

Getting Started
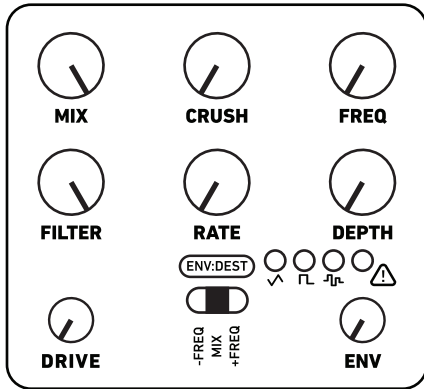
Place the knobs as shown for a neutral setting with 100% wet and the filter wide open. Next, adjust the drive control so that 8-segment level meter peaks around 7/8 (random LFO LED) with the last LED occasionally blinking. That amplifies your signal so that it is using all of the bits (full-scale signal).

Slowly turn the **CRUSH** knob clockwise. At first you will hear some noise, and then gradually the signal gets distorted until it resembles a gated square wave fuzz. Turn the **CRUSH** knob back to its minimum and slowly increase the **FREQ** knob. Around 8:45, hi hats will get crunchy. As you turn the knob clockwise, the sampling rate decreases and aliasing artifacts start to appear. Set it somewhere in the middle (10:00-2:00) that sounds nice.

The **FILTER** knob controls the cutoff of the output lowpass filter. To the left, the signal will get darker.

Next, set the LFO **RATE** control to about 1:00 and increase the **DEPTH** control until you hear the sampling rate sweeping up and down. Press the **WAVE** button once for square wave trills, and again for random sample and hold effects. Turn the **RATE** and **DEPTH** knobs back to minimum.

Set the **ENV:DEST** control to **FREQ+** and turn the **ENV** knob clockwise until you hear the sampling rate swing up when you play a note and fall back down as it decays. Notice that the LED is green when **ENV** is active and a signal is present. Then set **ENV** back to minimum.

Next, set **FREQ** to minimum and **FILTER** to maximum. The knobs should resemble the setting above, with **DRIVE** set based on your instrument level.

Press the **WAVE** button again so that two LEDs are on (●○○●). This is a wavefolder, which flips the top and bottom of the waveform down to create new harmonics. Adjust the **DEPTH** knob to vary the effect. Then press the WAVE button to try the wave window (○●○●) and waveshaper (○○●●), adjusting the **DRIVE** and **DEPTH** knobs for different effects.

Web Editor

We provide a web-based editor to configure your Bitmap, access hidden parameters, and manage presets. See "Web Editor" on page 24 for more information..   It requires a browser that supports Web MIDI (Google Chrome, for example). The editor can be accessed at
https://www.redpandalab.com/content/apps/bitmap-editor/index.html

Note the "http**s**" URL protocol. "http" will not allow Chrome to access MIDI devices.

Power

Use a 9V center negative (Boss-style) regulated power supply that can provide 250 mA or more of current. The plug should have 2.1mm inside diameter and 5.5mm outside diameter. This is the type of power supply used by almost all guitar pedals, and we recommend using one designed specifically for effects. If you have a few pedals, we recommend a multi-pedal power supply with independent regulated outputs (not daisy chained).

If our pedals detect a problem with the power supply, the bypass LED with change to magenta (or pink), the pedal will switch to bypass and enter a low power mode. After a few seconds, the pedal will restart. The most common reasons are that the power supply is not providing enough current, or it is an unregulated voltage converter. Note that some multi-pedal supplies are rated at 100 mA except for a couple of high-current outputs. Some multi-pedal power supplies also share current across multiple outputs. You need to make sure the total current required for all connected pedals is within the power supply's limits.

For additional information, please see our knowledge base.

Inputs and Outputs

DC POWER	Connect a 9V DC center negative power supply rated at 250 mA or higher.
USB	USB mini B connector for MIDI, web editor, and firmware updates.
IN	1/4" TRS mono or stereo input.
CTRL	1/4" TRS jack for expression pedal, remote, tap tempo, or MIDI.
OUT	1/4" TRS mono or stereo output.

The CTRL port can be configured using our web editor.

Input/Output Configuration (version 2.1+)

Mono in / mono out	Input and output use 1/4" TS (mono) plugs.
Mono in / stereo out	Input uses 1/4" TS plug. Output uses 1/4" TRS plug with left signal on tip, right on ring.
Stereo in / stereo out (default)	Input uses 1/4" TRS plug with left signal on tip, right on ring. Output uses 1/4" TRS plug with left signal on tip, right on ring. You can use 1/4" TS plugs in this mode for mono signals.

The input/output configuration can be set using our web editor or TouchOSC. In most cases, you can leave it as stereo in/out.

Controls

Press and hold the **WAVE** button until the LED changes to cyan to access alternate parameters.

MIX

Adjusts the wet/dry mix, from 100% dry to 100% wet.

[WAVE]-MIX (v2.1+) adjusts the output level from -30 dB to +6 dB. Automatic gain control is enabled at the minimum setting. The output level does not change until the knob position matches its current setting (knob catch).

CRUSH

Adjusts the bit depth from 24 bits down to 1 bit, including fractional bit depths.

FREQ

Adjusts the sampling rate, from 48,000 Hz down to 110 Hz. The sampling rate can be modulated by the LFO or envelope follower.

FILTER

Adjusts the cutoff frequency of the 4-pole lowpass filter. The cutoff can be modulated by the LFO or envelope follower. See "Filter" on page 17 for more information.

[WAVE]-FILTER (v2.1+) adjusts the filter resonance. At high resonance, the filter will self-oscillate with no input.The filter resonance does not change until the knob position matches its current setting (knob catch).

WAVE (LFO)

LFO waveform and wave modulation selection. The waveform LEDs indicate the current selection:
●○○○ Triangle wave LFO
○●○○ Square wave LFO
○○●○ Random LFO
●○○● Wavefolder
○●○● Wave window
○○●● Waveshaper

RATE (LFO)

LFO modulation rate. The waveform LED will blink at the modulation rate. The LFO can be synced to tap tempo or MIDI clock. It syncs to quarter notes by default, but a variety of note divisions can be set using the web editor or MIDI. The modulation note division is stored in presets and remembered when power is off.

The **AUX** footswitch can be configured to freeze the modulation (LFO hold) or turn it on/off.

The LFO rate can be set to audio frequencies. It is often useful to lower the modulation **DEPTH** when using higher modulation rates.

DEPTH (LFO)

LFO modulation depth and waveshaping intensity. Turn fully counter-clockwise to turn off modulation.

Depending on the **WAVE** setting, the **DEPTH** control modifies:
- LFO modulation amount (±)
- wavefolding threshold and number of folds
- wave window position and width
- waveshaping function

The LFO modulates the sampling rate (**FREQ**) by default, but can be assigned to the filter cutoff (**FILTER**) or wet/dry blend (**MIX**) using our web editor or MIDI. The destination is stored in presets.

DRIVE

Adjusts the input gain from 0 dB to +60 dB. When the knob is moved, the **PRESET** and **WAVE** LEDs will temporarily display the signal level.

Adjust the **DRIVE** knob so that the ⚠ LED blinks only occasionally to maximize the input range. Reduce it to make the signal sputter and cut out. Increase it for hard sustain and a more saturated sound.

ENV:DEST

The envelope follower can modulate the sampling rate (up or down) or wet/dry blend. You can also assign it to the filter cutoff for autofilter effects, using the web editor or MIDI. See "Envelope Follower (ENV)" on page 18 for more information.

[WAVE]-ENV:DEST allows you to assign the envelope to filter cutoff (left position) or inverted mix (middle position).

ENV

Envelope modulation amount. See "Envelope Follower (ENV)" on page 18.

PRESET

Press to cycle between presets or live knob settings (all LEDs off). Hold to save the current settings to the selected preset slot. The right LED will blink green when the preset is saved.

You can select presets 0-126 using MIDI program change messages. MIDI program 127 selects the current knob settings. You can save to any preset using our web editor or MIDI SysEx messages. To save a preset using a simple MIDI controller, first press the **PRESET** button until all of the LEDs are off and then hold down the **PRESET** button and send a program change message.

What the LEDs Mean

| Left LED		Right LED	
Red	LFO off or hold (AUX switch set to LFO hold or mod on/off)	Off	Bypass
Green	LFO on (AUX switch set to mod on/off)	Blue	On
		Cyan	Editing alt params (v2.1+)
		Green	Env follower active (v2.1+)
		Green (blink)	Preset or global setting saved
		Yellow (blink)	Tap tempo or MIDI clock
		Red (blink)	Error saving preset or global data Check Config tab of web editor for details

Bitcrushing

A bitcrusher uses two methods to produce distortion: sample rate reduction and bit depth reduction. On the Bitmap, they are controlled by the **FREQ** and **CRUSH** parameters, respectively.

Typical distortion techniques - overdrive, fuzz, tape saturation - add new harmonics to the signal. Bitcrushing adds inharmonic frequencies and noise, but it is signal-dependent, *organized* noise that can sound musical.

Sample Rate Reduction

Sample rate reduction reduces the number of snapshots used to represent the sound each second. It is analogous to the number of frames per second for video. Low frame rates make video appear jumpy and unnatural, but above a certain frame rate motion is smooth and individual images can no longer be perceived. For audio, the sampling rate determines the frequency response of the digital signal. The signal needs to be sampled often enough to capture the highest frequency present, but higher sampling rates increas the amount of data that needs to be stored or transmitted. Early samplers and cheap electronics are limited by the cost of memory, so they used lower sampling rates to increase the recording time.

Human hearing range is 20 Hz - 20,000 Hz. To accurately reconstruct a sampled signal, the sampling rate needs to be at least twice as high as the highest frequency (the Nyquist–Shannon sampling theorem). When the sampling rate is too low, the system does not capture enough samples per cycle and the waveform looks the same as a lower-frequency waveform - that is *aliasing*. The plot below shows a sine wave that is properly sampled (left) and undersampled (right). When the sampling rate is too low, the signal looks identical to a sine wave that is equal to the real signal at each sample instant, but whose frequency is below the sampling rate.

6.0 kHz sine, Fs=48.0 kHz   6.0 kHz sine, Fs=4.5 kHz
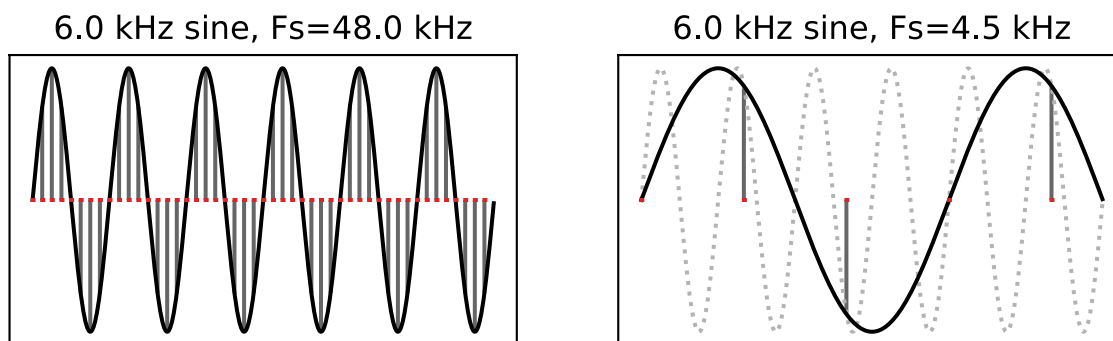
Once sampled, we cannot tell the difference between the two sine waves because they are identical at the instants that we sampled them. In fact, there are an infinite number of sine waves at higher frequencies that will pass through the same points at the same time. Once sampled, we lost any information about what happened in between the sample points. If you look out your window every day at 5:00 PM and your neighbor's cat is in your yard, you don't know if the cat comes by once, twice, or ten times a day. So when *properly* sampling a signal, we need to make sure we remove all of those higher frequencies by using an anti-aliasing filter in front of the analog-to-digital converter. Classic early samplers, like the Fairlight CMI and Ensoniq Mirage, used low sampling rates and simple filters that resulted in some aliasing at high frequencies. For plucked or struck instruments such as guitars, pianos, and drums, all of

the energy is imparted by the initial pluck or hit and high frequencies decay faster than low frequencies. Aliasing of the high frequencies during the initial attack adds energy and punch.

As sampler specifications improved, higher sampling rates and better filters allowed more accurate reproduction of instruments. That was a good thing for musicians using samplers to reproduce album sounds on tour or hear orchestral scores as they composed, but lost the grit, warmth, and character that made early samplers unique instruments alongside analog and FM synthesizers.

Getting a little more technical, the picture of the sine wave above shows what aliasing looks like in the time domain. If we look at it in the frequency domain, when a signal is sampled we get copies (called "images") of the signal at multiples of the sampling rate. Here is a 5 kHz signal with three harmonics that is sampled at 48 kHz.


5.0 kHz + harmonics, Fs=48.0 kHz
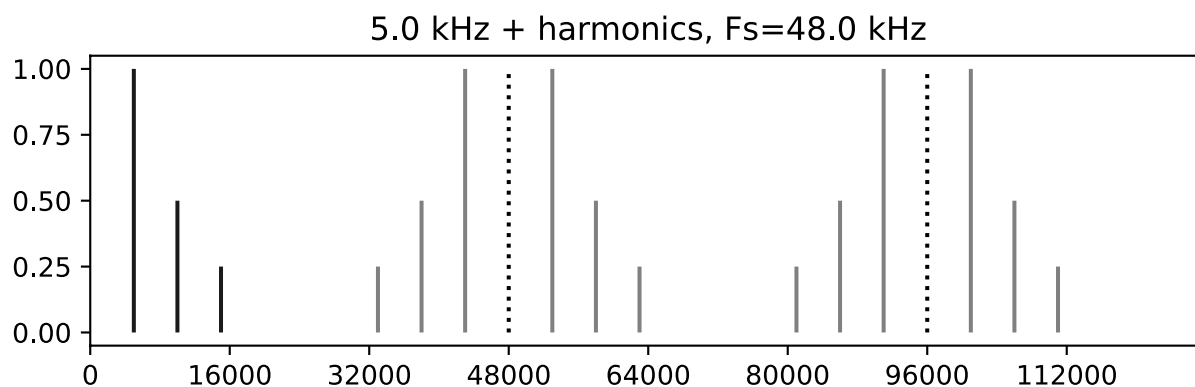
The highest harmonic is 15 kHz, which is less than half the sampling rate so no aliasing occurs. There are copies of the signal at 48 kHz, 96 kHz, etc., but since they do not overlap we can reconstruct the signal by filtering out everything above 24 kHz.

When a sampled signal is played back or resampled, a filter removes the images and we get the original signal back. We need some space (bandwidth) in between the images so that we can remove the images without affecting the original signal too much. That is why CDs use a 44.1 kHz sampling rate. (44.1 kHz does not leave a lot of bandwidth for the filter, one reason why early CD players sounded harsh until DAC filters got better.)
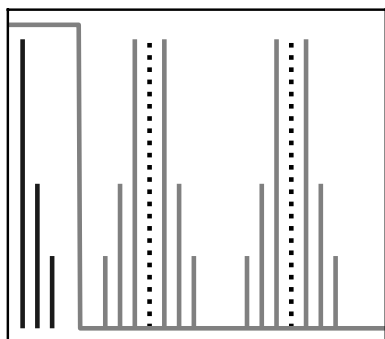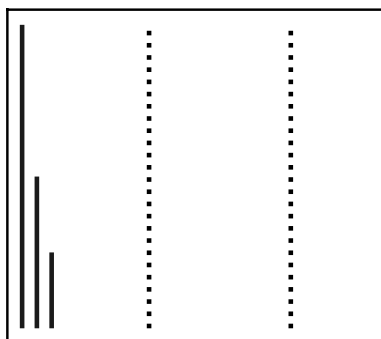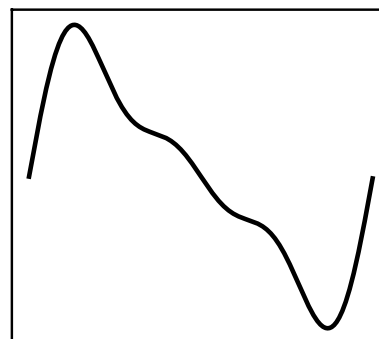

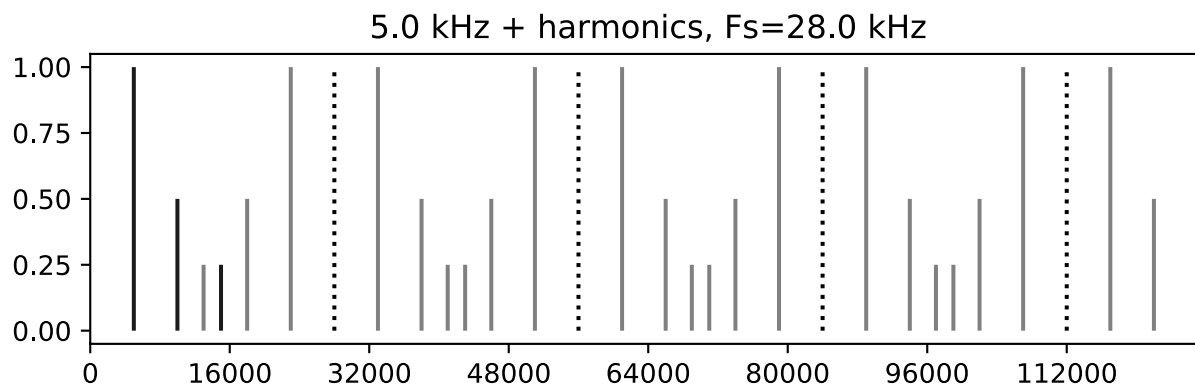
### Digital signal and LPF   Reconstructed signal   Waveform

If we lower the sampling rate to 28 kHz, the aliased (gray) copy of the third harmonic is at a lower frequency than the true (black) third harmonic.

5.0 kHz + harmonics, Fs=28.0 kHz

The aliased image cannot be untangled from the real signal. We have a new, inharmonic partial at 13 kHz. When we try to reconstruct the original signal, there is no way to filter out that 13 kHz partial while keeping the original harmonics. If we use a perfect anti-aliasing filter at half the sampling rate (14 kHz), we get the 13 kHz partial instead of our original 15 kHz harmonics.
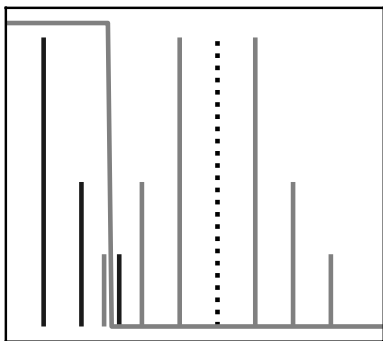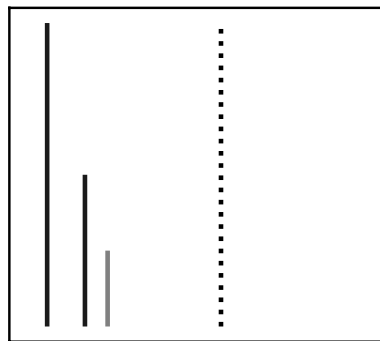
Digital signal and LPF   Reconstructed signal   Waveform
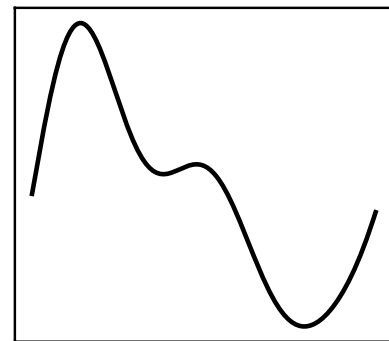
The lowpass filter cuts kills off our real third harmonic at 15 kHz and keeps the aliased harmonic that folded down to 13 kHz. (This example shows an ideal lowpass filter, in reality it would have a slope.) The output waveform is visibly - and audibly - different than the previous example.

Even if the signal was sampled correctly (without aliasing), simple pitch-shifting algorithms like the drop-sample interplation used by the Ensoniq Mirage and E-mu SP-1200 will cause aliasing. They are essentially resampling the signal with no filtering.

When playing back the sample, we can lower the filter cutoff to get rid of the aliasing but that will also cut out the true harmonics, since we can't separate them. That adds to the dark, warm, lo-fi sound.
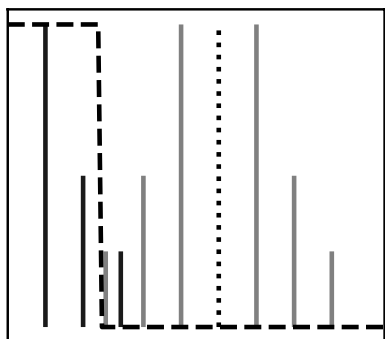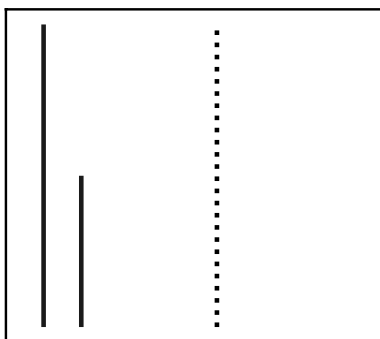
Digital signal and LPF	Reconstructed signal	Waveform

Bit Depth Reduction

Bit depth reduction reduces the number of discrete levels used to represent each snapshot of sound. When an analog signal is sampled by an au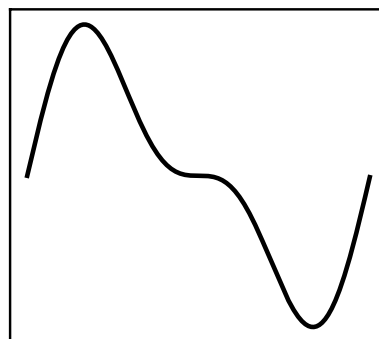dio interface or sampler, an analog to digital converter (ADC) measures the voltage and *quantizes* it to a fixed number of levels. The precision is limited by the ADC and the resolution of the digital system. When the first affordable samplers were introduced, A/D converters and memory were both extremely expensive.   The Fairlight CMI, E-mu Emulator, and Ensoniq Mirage were 8 bit samplers that could measure 256 discrete levels. Newer ADCs are 24- or 32-bit, which can differentiate between billions of different levels.

A physical analogy is that a U.S. tape measure usually has markings every 1/16", but a machinist's steel rule has 1/32" or 1/64" graduations for more precise measurements. Once you write down a measurement as 3-1/4", you lose the precision of whether it was really 3-5/16" or 3-13/64" and cutting a new board based on the 3-1/4" measurement will not give you an exact match.

Quantization adds noise, but the noise is nonlinear and signal-dependent. Louder signals use more of the available bits, so unlike overdrive and fuzz, quiet signals are more distorted than loud. In addition, when the signal drops below the lowest bit it becomes zero.
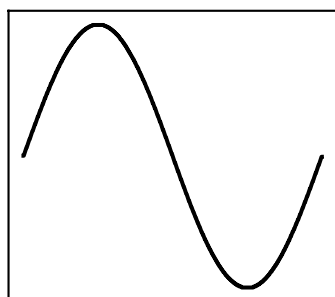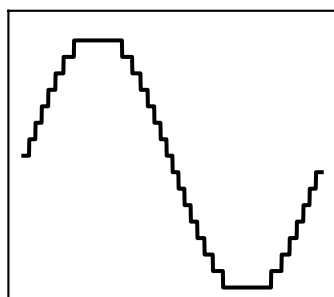
8 bits	4 bits	3 bits
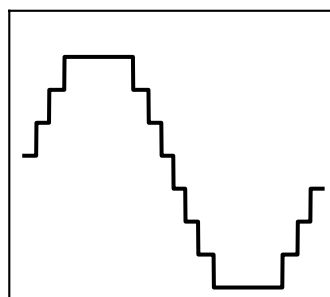
At lower bit depths, the Bitmap also emulates early analog to digital converters with imperfect components. The resulting layers of non-linearities capture the character of early digital hardware.

Anti-Aliasing (v2.1+)
Use the web editor, TouchOSC, or MIDI to turn anti-aliasing on or off. Anti-aliasing generally gives a tighter sound - more gritty sampler and less 8-bit video game.

Anti-aliasing is on by default in versions 2.1 and higher). The anti-aliasing setting is stored in presets and reme

Waveshaping

The ⚠ modulation settings add additional waveshaping distortion that get more extreme as the DEPTH is increased. They are level-dependent, so you can adjust the DRIVE and DEPTH knobs to get different effects. The signal flow is DRIVE --> WAVESHAPE --> CRUSH, so the DRIVE control can saturate the input signal before waveshaping and the CRUSH control sets resolution of the waveshaping. They generally work best on simpler waveforms, and rolling back the FILTER cutoff can tame some of the harshness when desired. Playing a triangle wave and viewing the output on an oscilloscope will show what the effect is doing.

Wavefolding folds the peaks of the waveform down, creating new harmonics. It is similar to an octave fuz, but instead of folding the bottom half of the waveform up it folds both the top and bottom towards the center. At extreme settings, it will fold the signal multiple times.

A Window comparator lets the signal pass when it is within a certain range of amplitudes and sets it to zero outside. Similar to a noise gate, but working sample by sample and it zeros out both high and low amplitude samples, leaving samples in the middle alone. The DEPTH control adjusts the height of the window (which amplitudes are passed through). Windowing works best on drums and simple sounds like synth or clean guitar, but is generally less useful than wavefolding or waveshaping.

Waveshaping uses a polynomial to introduce new harmonics. At lower settings it gives a nice saturation, and at higher settings the input signal is folded over itself to create complex timbres from simple signals. At extreme settings, it works best with clean signals.

Filter

The Bitmap's filter is a 4-pole 24 dB/octave filter similar to those used in the E-mu SP-1200 and Ensoniq Mirage. Reducing the filter cutoff will tame harsh distortion and help create a dark, lo-fi sound. Increasing resonance will create a peak at the filter's cutoff frequency and reduce the amplitude at low frequencies.

To adjust resonance, press and hold the WAVE button until the LED changes from blue to cyan, then turn the FILTER knob.

Assign the envelope follower to the filter cutoff for auto-filter/auto-wah effects. With percussive sounds, it is also similar to the dynamic filter on outputs 1&2 of the E-mu SP-1200.

Assign an expression pedal to the filter cutoff and add some resonance for a wah effect. You can assign the expression pedal to both parameters so that the cutoff and resonance both vary as you sweep the expression pedal.

Filter range (version 2.1+)

The filter can be set to three ranges using the web editor, TouchOSC or MIDI continuous controller messages. The setting is stored in presets, and remembered when power is off.

Normal	330 - 20,000 Hz
Full	20 - 20,000 Hz
Relative	±2 octaves relative to the sampling rate set by the **FREQ** knob and modulation.

Relative mode allows you to adjust the amount of aliasing. At 12:00, the filter cutoff tracks the sampling rate. To reduce aliasing, the filter cutoff must be less than half the sampling rate (-1 octave or more). Above 12:00, increasing amounts of aliasing will be heard.

Setting the **Anti-Aliasing** mode to **Adjustable Filter** will make the input anti-aliasing filter track the low-pass filter. Settings around 8:00-10:00 will be similar to classic samplers.

Low Frequency Oscillator (LFO)

This section is coming soon.

Triangle with slow sweeps and dry signal mixed in can give slowly shifting sounds.

Square with the LFO rate set to an odd time signature will be cause the melody to shift polyrhythmically.

Random gives "thinking computer" sounds. With the FREQ control at minimum, you can use the random LFO to add occasional glitches as the sampling rate drops.

Tap tempo and MIDI sync, lots of ratios availablein the eidtor

Envelope Follower (ENV)

The envelope follower tracks the dynamics of the input signal to control the sampling rate, filter cutoff, or wet/dry mix. The envelope follower tracks the input signal - before the drive control - so you can get saturated output with dynamics. The right LED will change from blue to green when the envelope follower is active and an input signal is detected.

Turn the ENV knob fully counterclockwise to turn off envelope modulation.

An envelope follower tracks the countour of the signal, generating a control signal that matches the dynamics. Envelope followers can be used to vary the intensity of the effect on loud vs soft notes and change the effect as the note decays.
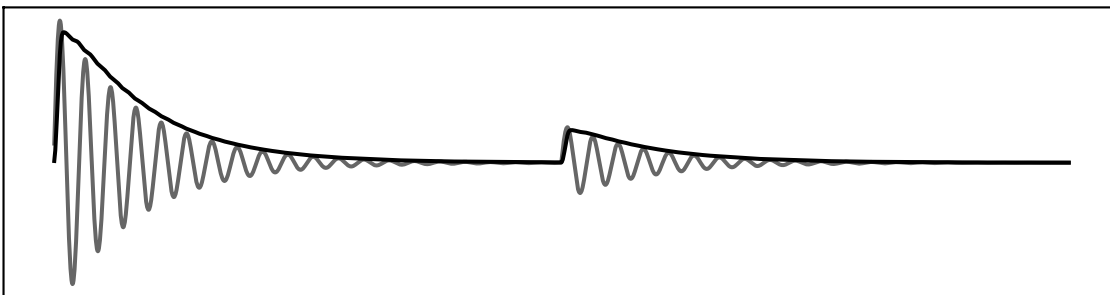
The envelope follower output is added to the destination parameter. You can think of it as an invisible hand that turns the knob at the start of each note and returns it to the set position as the note decays.

The **ENV:DEST** toggle switch sets the envelope follower designation to the **MIX** or **FREQ** controls, with additional destinations available via secondary controls, the web editor, TouchOSC, and MIDI:
- **FREQ-** reduces the sampling rate as the signal level increases, giving more aliasing on loud notes and note attacks.

- **FREQ+** increases the sampling rate as the signal level increases, giving a cleaner sound on loud notes and more aliasing as notes decay.
- **MIX**: increases the wet blend as the signal level increases, creating a more dynamic effect.
- **MIX-**: decreases the wet blend as the signal level increases, so that loud notes are clearer and quieter notes are crushed. (**[WAVE]-MIX**)
- **Filter**: the filter cutoff tracks the input signal level for auto-filter effects. (**[WAVE]-FREQ-**)
- **Off** disables envelope modulation.

Setting **ENV:DEST** to **MIX** with a small amount of modulation will make the bitcrushing more dynamic and responsive. Turn the **MIX** control down to the cleanest sound that you want, then increase the **ENV** control for the desired responsiveness.

The **FREQ** knob decreases the sampling rate, so the envelope follower modulates it in the opposite direction.

Drive

The **DRIVE** control adds up to 60 dB of gain with saturation, before the waveshaping and bit reduction. Bit depth reduction and waveshaping are both amplitude dependent, so the **DRIVE** control can be used to boost your signal level to use the full range of each effect. The preset and wave LEDs display the input signal level for a few seconds after the **DRIVE** control is moved.

The Bitmap's drive control incorporates saturation and clipping, so it also can add analog-style distortion before the digital distortion of the waveshaping and bitcrusher. Three distortion algorithms can be selected using the web editor, TouchOSC, or MIDI:

Hard Clipping (default)	Hard clipping similar to an overdriven mixer channel
Distortion 1	Full-frequency distortion with pre- and post-EQ
Distortion 2	Midrange-focused distortion that sits well in a mix or band setting

ON Switch

The **ON** footswitch engages or bypasses the effect. A short press will switch between on and bypass (latching). When the pedal is in bypass, pressing and holding the **ON** switch will momentarily engage the effect, returning to bypass when the switch is released.

The on/off state is remembered when power is off.

AUX Switch

The **AUX** footswitch can be assigned to different functions using our web editor or MIDI system exclusive messages. It is a global setting, so that it has the same behavior with all presets.

Tap (default)

Pressing the **AUX** switch sets the tap tempo. Tap in quarter notes to set the tempo. The LFO note division can be set using our web editor or MIDI. It is saved in presets and remembered when power is off.

Adjust the **RATE** knob or hold the **AUX** switch for 2 seconds to disable tap tempo.

Preset

Pressing the **AUX** switch cycles between front-panel presets and the manual knob and switch settings.

Preset Shift

Holding the **AUX** switch momentarily jumps to the next preset. Releasing the switch goes back to the previous preset or manual settings. It can be used to add emphasis. Works with these settings:
Manual --> Preset 1
Preset 1 --> Preset 2
Preset 2 --> Preset 3
Preset 3 --> Preset 4

Modulation On/Off

Pressing the **AUX** switch alternates between turning the modulation on and off. The left LED isgreen when modulation is on and red when it is off. This affect the LFO and waveshaping, so it can be used to add modulation or more extreme digital distortion.

LFO Hold

Holding the **AUX** momentarily freezes the LFO at its current value. Releasing the switch will cause the LFO to run again. The left LED is red while the LFO is held.

LFO Hold On/Off

Pressing the **AUX** switch alternates between LFO hold (left LED red) and running (left LED off).

Control Input

The **CTRL** (control) input supports different methods of remotely controlling the pedal:
- Expression pedal
- Control voltage (CV) with 0-3.3V range
- Tap Tempo
- TRS MIDI in (tip active)
- Remote switch

To configure a expression pedal or remote switch, hold down the right footswitch while plugging it in. The pedal will detect which device is connected using the steps below. You can also use our web editor to configure the port.

The configuration is remembered when power is turned off. Expression pedal assignments and remote switch settings are stored in presets and remembered when power is turned off.

Expression Pedal

An expression pedal can be assigned to any combination of knob settings at the heel and toe position (up to 6 parameters). Moving the expression pedal will morph between the settings.

You can also calibrate the range of the expression pedal, to ensure that its full travel is used.

Calibrating Expression Pedal Range (no knob assignments):
1. Start with the pedal powered on and nothing plugged into the **CTRL** port.
2. Hold the right footswitch while plugging in the expression pedal. The right LED will blink yellow three times to indicate it is in **CTRL** configuration mode. You can release the right footswitch and begin configuration immediately.
3. Move the expression pedal to the heel down position.
4. Move the expression pedal to the toe down position.
5. Hold the right footswitch for 3 seconds to save the configuration. The right LED will blink green to indicate that the configuration has been saved.

Configuring Expression Pedal Knob Assignments
1. Start with the pedal powered on and nothing plugged into the **CTRL** port.
2. Hold the right footswitch while plugging in the expression pedal. The right LED will blink yellow 3 times to indicate it is in **CTRL** configuration mode. You can release the right footswitch and begin configuration immediately.
3. Move the expression pedal to the heel down position.
4. Adjust the knobs for the desired sound.
5. Move the expression pedal to the toe down position.
6. Adjust the knobs for the desired sound.
7. Hold the right footswitch for 3 seconds to save the configuration. The right LED will blink green to indicate that the configuration has been saved.

Knobs that are not adjusted during configuration will not be affected by the expression pedal. Expression pedal assignments are stored in presets and when the expression pedal is unplugged or power is turned off. Expression pedals with 5-25 kΩ linear potentiometers work best.

Control Voltage

Control voltage input is configured the same way as an expression pedal.

CV Range: 0-3.3V (with over/under-voltage protection)
Tip: 0-3.3V input
Ring: 3.3V output (with current limiting)
Sleeve: ground

The expression input has current limiting in case you use a TS cable, but it is preferable to use a 1/4" TRS cable with the ring unconnected. We sell a suitable cable at our web site, and the Expert Sleepers 'floating ring' cable is another option. Instructions for building your own cable are available on our [Knowledge Base](#).

Tap Tempo

Uses a normally open momentary switch. Configure it using the web editor.

TRS MIDI

Select **MIDI (TRS)** in the web editor to use the control port as a MIDI input. This is a non-standard MIDI interface, because there is no optocoupler on the input to prevent current loops, but it is used by many guitar pedals. You will need a converter or a MIDI controller with 1/4" TRS outputs, which are available from Empress Effects, Disaster Area Designs, and others.

Remote Switch

A remote switch has up to 4 modes of 4 switches that can access presets and pedal functions. It works with our remote switches, some third-party switches, and is DIY friendly for different control interfaces. See our [Knowledge Base](#) for infomation on building a compatible switch. Note that the switch uses parallel resistors, and switches with shorting contacts will not work without an adapter (most tap-tempo switches and the Roland FS-6, for example).

1, 2, 3, and 4-button switches are supported. The modes and functions accessible will depend on the number of buttons. A single-button switch can load or save your favorite sound.

To save a preset, hold the corresponding button for two seconds. The right LED will blink green to indicate that the preset has been stored. Presets are also accessible via the **PRESET** button and MIDI program change messages.

Configuring a Remote Switch:
1. Start with the pedal powered on and nothing plugged into the **CTRL** port.
2. Hold the right footswitch while plugging in the remote switch. The right LED will blink yellow 3 times to indicate it is in **CTRL** configuration mode. You can release the right footswitch and begin configuration immediately.
3. Press one of the buttons on the remote switch to select a mode.
4. Hold the right footswitch for 2 seconds to save the configuration. The right LED will blink green to indicate that the configuration has been saved.

Remote Modes

Mode	Switch	Function	LED Indication
1	A	Preset 1 Double tap: manual settings Hold (4 sec): save	Blinks green when saved
	B	Preset 2 Double tap: manual settings Hold (4 sec): save	Blinks green when saved
	C	Preset 3 Double tap: manual settings Hold (4 sec): save	Blinks green when saved
	D	Preset 4 Double tap: manual settings Hold (4 sec): save	Blinks green when saved
2	A	Next preset	
	B	Bypass / on Hold: momentary on	
	C	LFO hold	
	D	Tap Hold (4 sec): disable tap	Blinks yellow at tempo

In mode 2, **LFO hold** (C) will freeze the LFO while the button is held down.

Web Editor

The web editor can be used to configure your pedal, access hidden parameters, and fine-tune presets. It is intended for "offline" configuration and editing. For live performance editing, we recommend using dedicated MIDI hardware or software and MIDI control change messages.

Connect your pedal to a computer using a USB cable and go to the web editor URL using Chrome:

https://www.redpandalab.com/content/apps/bitmap-editor/index.html

Note the **https** in the URL. **http** will not allow the browser to acess your MIDI devices.

The editor uses Web MIDI, which is not supported by all browsers. We officially support Chrome.

Pedal Status

The web editor indicates whether the pedal is connected. If the status is "not found", ensure that the pedal is turned on and connected to your computer. Click the refresh button to refresh the status.

Status: connected ⟳

Edit

The Edit tab shows all of the pedal's realtime parameters. The on-screen controls are updated to match the current state of the pedal, but hidden parameters are not updated. Press the **Refresh** button to update all of the parameters. The web editor's controls allow higher resolution changes than MIDI continuous controller messages.

Ctrl Port
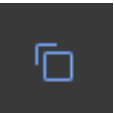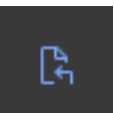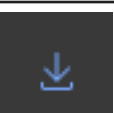
The Ctrl Port tab allows you to configure the pedal's **CTRL** port for an expression pedal or remote switch. The control port mode (expression or remote) is stored globally, but expression pedal assignment and remote switch configuration are stored in each preset.

The expression pedal can be assigned to up to 6 parameters, with a minimum/maximum range for each. If no assignments are made, it will control the **FREQ** parameter from its minimum value to the knob position.

Presets (version 2.2+)

The Preset tab shows allows you to manage preset. Empty preset locations are grayed out.   You can use this back to back up your presets, share presets, and upload presets created by us or other musicians.

These actions are available for managing presets:

Column	Heading	Description
1	# (Load)	Click this button to load a preset. Grayed out if no preset is stored in that location.
	Write	Writes the current pedal settings to the pedal's flash memory in the selected preset location. The LED will blink green to confirm it is stored.
	Copy	Copies a preset so that it can be duplicated or moved to a different preset location.
	Paste	Pastes a preset into a new preset memory location, overwriting any existing preset in that location. The LED will blink green to confirm it is stored in the pedal's flash.
	From Pedal	Downloads the selected preset from the pedal to a local file. Your browser settings will determine the location (typically your "Downloads" folder).
	To Pedal	Opens a file browser to select a preset (.syx or .bin) file. If the file contains a valid preset, it will be written to the pedal's flash memory and the LED will blink green.

The preset load (#) buttons use standard MIDI program change messages.

Most of the functions require firmware version 2.1 or later. With earlier firmware versions, you can load and write presets.

Config

The Config tab allows you to configure the pedal for your setup.

This tab also displays the installed firmware version. If the pedal detects an error condition, a diagnostic code will be displayed.

Help

The **Show MIDI Devices** button on the Help tab will display all of the MIDI devices accessible by your browser.

TouchOSC

Download the TouchOSC (Next Gen) layout from our web site to control your Bitmap using the TouchOSC app on iOS, Android, macOS, Windows, and Linux. The TouchOSC layout gives you performance-friendly access to all parameters, including hidden parameters, loading and saving presets, and configuration settings. You can modify the TouchOSC layout to fit your needs.

Compared to the web editor, TouchOSC is better suited to live performance. The web editor has a tighter integration with the pedal and does some things that TouchOSC cannot, including expression pedal assignment and advanced preset management.

Using MIDI

Your pedal supports USB MIDI (in/out) and 1/4" TRS MIDI (input only).

USB MIDI

Your pedal is a class-compliant USB device, which allows you to:
* Control all parameters
* Access additional hidden parameters

The pedal can work with any USB MIDI host, including:
* Macintosh and Windows computers. The pedal shows up as a MIDI device and is available to all programs.
* Apple iPad, iPod touch, and iPhone using the Lightning to USB 3 Camera Adapter.
* Standalone USB MIDI hosts allow you to connect the Tensor to hardware with 5-pin DIN MIDI connectors without the use of a computer. Examples include:
  iConnectivity iConnectMIDI4+
  iConnectivity mio4
  Disaster Area Designs Gen3 MIDI controllers with their gHOST option
  Kenton MIDI USB Host MkII
  MidiPlus USB MIDI Host
  See our [Knowledge Base](#) for up-to-date information

The pedal sends and receives on MIDI channel 1 by default. You can change the MIDI channel using MIDI System Exclusive messages or our web-based editor. The MIDI channel is remembered when power is off. See "System Exclusive (SysEx)" on page 33 for more information.

TRS MIDI Input

See "Control Input" on page 21 for information about configuring TRS MIDI. Only MIDI input is supported, so you can use the web editor to change parameters and configuration settings, but it will not show the current state of the pedal.

MIDI Timing Clock

MIDI timing clock messages are used to synchronize multiple MIDI devices to a single clock transmitter. The clock is typically provided by a DAW in computer-based setups and a sequencer or drum machine in hardware-only setups. Dedicated MIDI clock generators are available for more complicated setups that need tight synchronization, and some devices can convert between MIDI clock, DIN sync, and taps.

How MIDI clock works

MIDI clocks are sent out at regular intervals by a clock *transmitter* to one or more *receivers*. The transmitter controls playback and sets the tempo.

The transmitter never tells the receivers the actual tempo. Instead it sends 24 timing clock messages
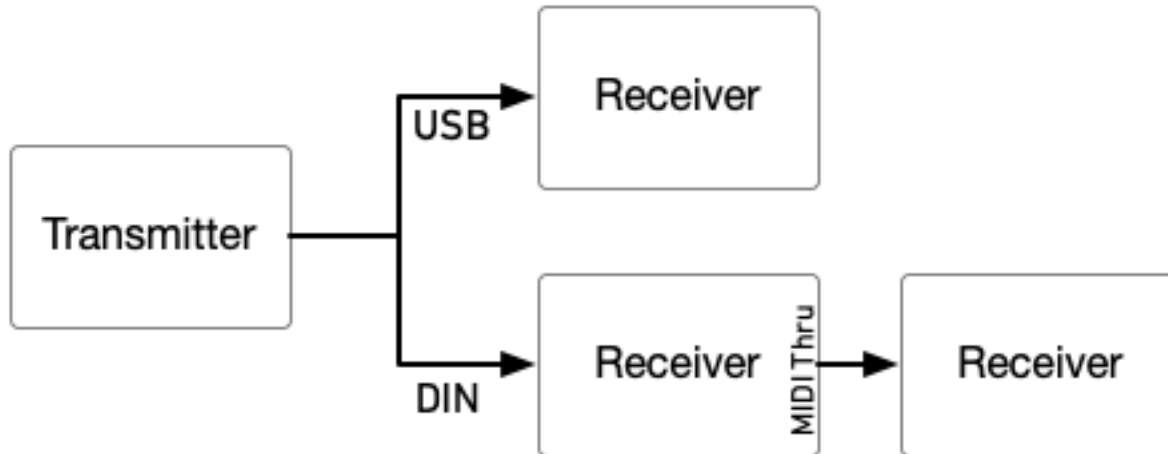
every quarter note (24 PPQ) and the receivers each calculate the tempo independently.

Start, stop, and continue messages are used to synchronize playback between devices. The transmitter

MIDI Clock at 120 BPM

$$\frac{1}{24\,beats \times 20.833\,ms} \times \frac{60,000\,ms}{1\,minute} = 120\,bpm$$
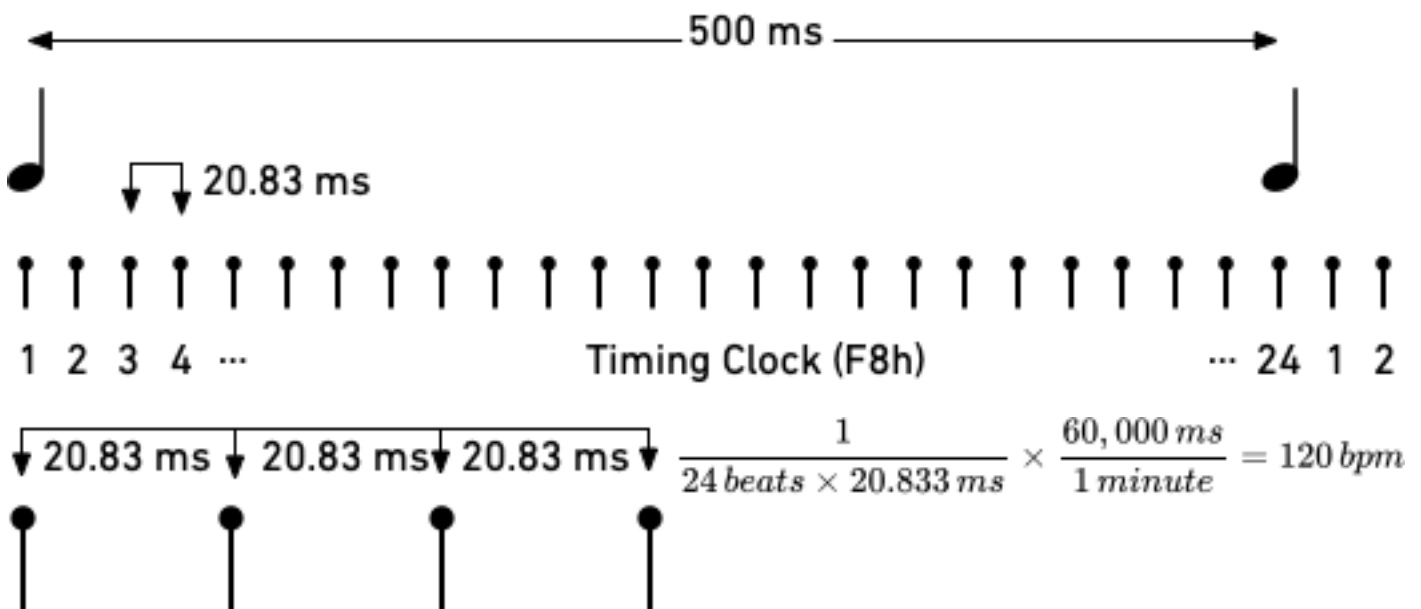
continues sending timing clocks when it is stopped so that receivers can be ready when playback starts or continues. A start message will reset playback to the first beat, and a continue message will pick up where playback left off.

MIDI real time messages are high-priority messages that can interrupt other MIDI messages to ensure the best possible syncronization timing. However, the accuracy of the clock depends on the transmitter and any devices it passes through. It is common to have +/-1 milliseconds of *jitter*, with is irregular timing due to individual clock ticks arriving too early or too late. All equipment that receives MIDI clock needs to smooth out the timing to maintain a stable tempo. The smoothing algorithm needs to handle jitter, but also track sudden or gradual tempo changes accurately and naturally. Different manufacturers use different synchronization algorithms, which can lead to sloppy timing. This was more of a problem with older MIDI equipment that had slower processors and complex setups with long MIDI chains and routers. It can also be a useful technique, synchronizing multiple hardware sequencers to give each musical part a slightly different timing and feel.

120 BPM with ±1 ms jitter

20.83 ms   21.8 ms   19.8 ms   20.3 ms   21.5 ms   20.6 ms   21.0 ms

Average 20.833 ms = 120 bpm

Some devices do not transmit start, stop, and continue messages, so the pedal will begin synchronizing if it receives a MIDI timing clock message without a start or stop message first.
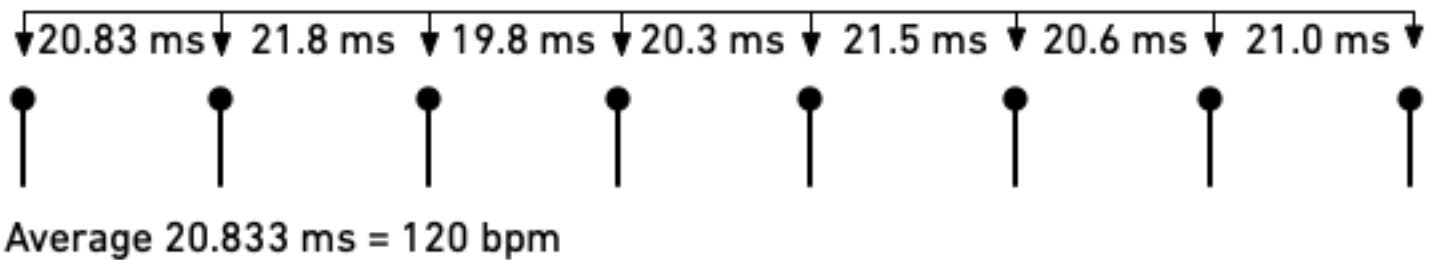
Comparison to tap tempo

Tap tempo is set by tapping quarter notes on a footswitch. It is simpler to set up, but is not synchronized to other equipment unless you are using a multi-pedal tap tempo controllers. Tap tempo controllers have an electronic switch on each output that simulates a footswitch press.

Neither tap tempo nor MIDI timing clock sends tempo information. The pedal calculates the tempo from the input and adjusts to tempo changes. Because MIDI timing clock sends 24 clock ticks per quarter note instead of 1 tap per quarter note, it enables tighter synchronization between equipment.

Note divisions for the pedal's parameters are configured the same way for tap tempo and MIDI clock, so you can switch between methods for recording and live use.

Configuring your pedal for MIDI clock

In the web editor's **Config** tab, set **Receive MIDI Clock** to On. You can also send MIDI continuous controller #110 to the pedal with a value of 64-127. The MIDI clock setting is remembered when power is turned off.

Setting note divisions

Configure note divisions using the pedal's "shift" mode, or using the web editor. See "Tap Tempo" for information about note divisions for each parameter.

MIDI Continuous Controller Messages

CC Num	Destination	Notes	
4	Expression pedal	CTRL input	
12	Mix		
13	Crush		
14	Freq		
15	Modulation depth		
16	Modulation rate		
20	Envelope mod amount		
21	Filter cutoff		
22	Filter resonance *		
23	Drive		
24	Output level (v2.1+)	–30 to +6 dB output gain on wet signal. At minimum setting, Automatic Gain Control (AGC) is enabled.	
		126	+6 dB
		108	0 dB
		90	-6 dB
		72	-12 dB
		54	-18 dB
		36	-24 dB
		18	-30 dB
		0	AGC (default)
80	AUX footswitch	Use gated mode to send 127 on press and 0 on release. Matches footswitch behavior.	
		0-63	Off (release)
		64-127	On (press)
81	ON footswitch	Use gated mode to send 127 on press and 0 on release. Matches footswitch behavior.	
		0-63	Off (release)
		64-127	On (press)

CC Num	Destination	Notes	
88	Bypass (Receive only)	0-63	Bypass
		64-127	Effect On
89	Tap (Receive only)	64-127	Remote tap
102	Modulation Waveform	0	Triangle
		1	Square
		2	Random
		3	Wave folder
		4	Wave window
		5	Waveshaper
103	Modulation destination (Receive only)	0	Freq (default)
		1	Filter cutoff
		2	Mix
104	Envelope destination	0	Off
		1	Filter cutoff
		2	Mix
		3	Mix – (inverted)
		4	Freq up
		5	Freq down
105	LFO hold	0-63	Off
		64-127	On
108	Modulation note division	See "Note Divisions" table	
110	Receive MIDI clock (global)	0-63	Off
		64-127	On (default)
111	Drive type (v2.1+)	0	Hard clipping (default)
		1	Distortion 1
		2	Distortion 2 (mid focus)
112	Anti-aliasing (v2.1+)	0	Off (matches v2.0.x)
		1	On (default)
		2	Track filter
113	Filter range (v2.1+)	0	Normal (default)
		1	Full
		2	Relative

Note Division Continuous Controller Values

CC Value	Note Division
0	Off (tap tempo disabled)
1	8 measure
2	7 measures
3	6 measures
4	5 measures
5	4 measures
6	3 measures
7	2 measures
8	2 measure triplet
9	Dotted whole note
10	Whole note
11	Whole note triplet
12	Dotted half note
13	Half note
14	Half note triplet
15	Dotted quarter note
16	Quarter note
17	Quarter note triplet
18	Dotted eighth note
19	Eighth note
20	Eighth note triplet
21	Dotted 16th note
22	16th note
23	16th note triplet
24	Dotted 32nd note
25	32nd note
26	32nd note triplet

MIDI System Exclusive Messages

The Bitmap uses MIDI System Exclusive Messages to get and set configuration properties and state. The following System Exclusive messages can be used to configure the Bitmap, read current configuration, and access other functionality that is not available through standard MIDI messages (for example, saving presets to internal memory). You can use these messages to write a custom editor or configure a MIDI controller to control the Bitmap.

The basic format is the same for all messages:

Byte (hex)	Description
F0	System Exclusive (SysEx)
00	Red Panda ID byte 1
02	Red Panda ID byte 2
23	Red Panda ID byte 3
01	Bitmap family ID
03	Bitmap product ID
00	Message version
1 byte	Message type: 0x34: get property 0x35: reply to get property 0x36: set property
2 bytes	Property ID
nn bytes	Property data (length depends on ID)
F7	End of Exclusive (EOX)

Example: Save Preset to Internal Memory 3

Byte (hex)	Description
F0	System Exclusive (SysEx)
00	Red Panda ID byte 1
02	Red Panda ID byte 2
23	Red Panda ID byte 3
01	Bitmap family ID
03	Bitmap product ID
00	Message version
36	Set property
7F	Save preset to memory byte 1
13	Save preset to memory byte 2
03	Preset location (0-based program change number)
F7	End of Exclusive (EOX)

Properties

Firmware Version

Get	Set	ID 1	ID 2	Data Bytes	Data
X		7F	01	8	Firmware version: 0: Major 1: Minor 2: Patch 3: Release type (ascii) 4-7: Build number

Returns the firmware version.

Input voltage

Get	Set	ID 1	ID 2	Data Bytes	Data
X		7F	0B	2	100 * PSU voltage in Volts

Returns the approximate input voltage. Can be useful for diagnosing power issues.

MIDI Channel

Get	Set	ID 1	ID 2	Data Bytes	Data
X	X	7F	12	1	00: channel 1 (default) 01: channel 2 ... 0F: channel 16

Get or set MIDI channel.

Save preset

Get	Set	ID 1	ID 2	Data Bytes	Data
	X	7F	13	1	Preset location (MIDI program number)

Save a preset to internal memory.

Get / Set Parameter Value (high resolution)

Get	Set	ID 1	ID 2	Data Bytes	Data
X	X	*yy*	*yy*	1	U1.23 fixed point value encoded as 4 7-bit digits

Uses internal parameter IDs to get and set parameters with high resolution. The property IDs (*yyyy*) are not currently documented, but can be found using our web editor and a MIDI monitor. We reserve the right to change the IDs and data format, so please email us if you plan to use them (or have any questions). Values are unsigned 1.23 fixed point numbers from 0 to 1, inclusive.

Reset to Factory Defaults

Use the following procedure to reset the Bitmap's configuration data to factory default settings. This will erase any advanced configuration and control port settings, but presets will not be affected. Note that this is rarely useful for troubleshooting problems with your pedal.

1. Start with the pedal unplugged.
2. Hold the PRESET, WAVE, and ON switches while plugging in power. The right LED will be solid blueish white.
3. Release the PRESET and WAVE switches first.
4. Release the ON footswitch.
5. When the factory reset is complete, the LEDs will cycle through different colors.
6. Power cycle the pedal to continue.

Firmware Updates

The Bitmap's firmware can be updated via drag and drop using any Mac or PC. No driver or special software is required.

To tell which version of firmware your pedal is running:
1. Hold down the AUX (left) footswitch and connect power.
2. The right LED will blink blue.
3. Continue holding the PRESET footswitch for 2 seconds.
4. The LED will turn solid blue. The pedal is now in USB Mass Storage mode.
5. Connect the pedal to the computer using a mini USB cable.
6. Open the BITMAP drive on your computer.
7. Open the VERSION.TXT file in a text editor.

Downloading the new firmware
1. Go to http://www.redpandalab.com/downloads/#bitmap
2. Download the firmware (.zip) file to your computer.
3. Unzip the downloaded file to extract the binary firmware file (.bin).

Caution
- Do not rename the extracted file.
- Never turn off the pedal's power while an update is in progress. Otherwise the system software or the pedal itself may be destroyed.

Update procedure:
1. Hold down the AUX (left) footswitch and connect power.
2. The right LED will blink blue.
3. Continue holding the footswitch for 2 seconds.
4. The LED will turn solid blue. The pedal is now in USB Mass Storage mode.
5. Connect the pedal to the computer using a mini USB cable.
6. Open the BITMAP drive on your computer.
7. Drag and drop the firmware binary (.bin) file to the BITMAP drive.
8. The left LED will blink to show progress.
9. After the firmware update is complete, the LED will turn solid green.
   If the firmware update seems to stall, eject the BITMAP drive from your computer and it should resume. If not, retry the procedure.
10. If an error occurred, the red LED will blink instead.
Eject the BITMAP drive from your computer:
    Mac: click the eject button or drag the BITMAP icon to the trash
    Windows: right-click on the BITMAP icon in My Computer and select "Eject"
11. Disconnect the USB cable.
12. Turn the pedal's power off.

Troubleshooting
If the left LED blinks red or the process stalls, turn the Bitmap off, then on, and try again.

If you continue to have problems, please email support@redpandalab.com. Please tell us what type of computer and which operating system version you are using.

Support and Repairs

Technical Support
Please register your product at redpandalab.com/register within 30 days of purchase.

For technical support, send your question via email to support@redpandalab.com or use the contact form on our web site. Be sure to include your serial number. We are a small company with limited re-sources for technical support, so it might take us a few days to reply.

Product manuals and firmware updates are available at redpandalab.com/support

Repairs
If you think your product needs repair, first send an email with your serial number and a description of the problem to support@redpandalab.com. We may be able to get you up and running again without sending in the pedal, but if it does need repair we will arrange for it to come back to us or an authorized service center close to you. Warranty repairs are done for free, and non-warranty repairs will be done at the lowest possible cost to you.

Warranty

ONE YEAR LIMITED MANUFACTURER'S WARRANTY

1.   Limited Warranty. For one (1) year following the date of purchase, Red Panda, LLC will repair or replace, in its sole discretion, the Product, in order to correct defects in material or workmanship that existed when the Product was purchased (collectively, "Manufacturing Defects". For purposes of this Limited Warranty, "Manufacturing Defects" includes only defects in the Product at the time of purchase and does not include normal wear and tear, modification post-sale, misuse, accidental damage or destruction, or other abuse occurring after purchase.

2.   SOLE AND EXCLUSIVE REMEDY. THE REPAIR AND/OR REPLACEMENT OF THE PRODUCT SHALL BE THE SOLE AND EXCLUSIVE REMEDY FOR MANUFACTURING DEFECTS. PROOF OF ORIGINAL PURCHASE DATE IS REQUIRED TO RECEIVE REPAIR OR REPLACEMENT OF THE PRODUCT.

3.   DISCLAIMER OF IMPLIED WARRANTIES. IMPLIED WARRANTIES, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED TO ONE YEAR OR THE SHORTEST PERIOD ALLOWED BY LAW. RED PANDA MAKES NO REPRESENTATIONS REGARDING THE PERFORMANCE OF, THE QUALITY OR THE DURABILITY OF THE PRODUCT OTHER THAN THOSE EXPRESSLY SET FORTH HEREIN.

4.   LIMITATION OF REMEDIES, EXCLUSION OF INCIDENTAL AND CONSEQUENTIAL DAMAGES. THE SOLE AND EXCLUSIVE REMEDY UNDER THIS LIMITED WARRANTY SHALL BE PRODUCT REPAIR OR REPLACEMENT AS PROVIDED HEREIN. RED PANDA SHALL NOT BE LIABLE FOR ANY INCIDENTIAL OR CONSEQUENTIAL DAMAGES. Some states and countries do not allow this exclusion or limitation, so these limitations and exclusions may not apply to you.

5.   Return and/or Replacement of Product due to a Manufacturing Defect. In the event of believed manufacturing defect, you should contact Red Panda at support@redpandalab.com, with the date of original purchase, a copy of the receipt and a description of the asserted Manufacturing Defect. Red Panda will, at its sole discretion, notify you to return the Product at the specified location or, alternatively ship a replacement Product within thirty (30) days of receipt. You are solely responsible for the payment of shipping costs and expenses to ship the Product to Red Panda. Red Panda will pay the cost of shipping the repaired or replacement Product to you. If the Product is returned for service and/or repairs, Red Panda will complete the repairs within sixty (60) days of receipt and ship the Product back to you. The Product will be warranted for the remaining term of the original Product's warranty period.

Specifications

Maximum input level:	+8 dBu
Frequency response:	20-20 kHz, +0/-0.5 dB
Input impedance:	1 MΩ
Output impedance:	< 1 kΩ
Bypass:	analog buffered
Power supply:	9V DC, center negative
Power connector:	2.1mm I.D. x 5.5mm O.D. barrel connector
Power consumption:	250 mA
Dimensions:	78 (W) x 124 (D) x 59 (H) mm
	3.1 (W) x 4.9 x 2.3 (H) inches
Weight:	0.4 kg / 14 oz

Credits

Design and engineering	Curt Malouin
Documentation	Curt Malouin
Graphics	Sylvie Demers
	Morgan Marentic
Sound consulting	Eric Iverson
and testing	Randy Molina