PARTICLE

Owner's Manual

Red Panda®

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Please register your product at redpandalab.com/register

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

For technical support, email support@redpandalab.com

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Introduction

Thank you for purchasing the Particle 2. I designed the original Particle in 2010 and released the first batch in 2011. I drilled, painted, labeled, soldered, and assembled those first pedals in my garage and a spare bedroom. Thanks to the support of experimentally-minded musicians throughout the world, Red Panda has been able to grow to a small team and continue to work on hard, interesting projects.

My goal with the original Particle was to take granular synthesis and map it to a real-time effect that was easy to understand and control. Some of it's limitations - and character - came from finding clever ways to do things like reverse delay and granular playback on the Spin FV-1 DSP chip.

New in Version 2
The Particle 2 uses a much more powerful processor, and is a full-fledged granular processor capable of generating dozens of simultaneous grains. It keeps the immediacy and control of the original Particle, with improved fidelity, usability, and tweaks some of the knob responses. A primary goal was to make it more pedalboard-friendly and easier to use on tour.

Some of the improvements include:
* Smaller enclosure, with all jacks on top
* Stereo (TRS) input/output
* Presets (4 on front panel, 127 via MIDI)
* Soft touch switches
* Momentary freeze footswitch
* Tap tempo with note divisions
* Higher sampling rate
* Higher headroom
* Better signal-to-noise ratio
* Improved pitch shifting
* Longer delay time
* Longer maximum grain size
* More simultaneous grains
* Additional parameters
* Ability to combine parameters from different modes
* USB MIDI
* Multi-purpose control port for expression pedal, CV, remote switches
* Expression pedal can be assigned to any combination of parameters
* USB firmware updates

Getting Started

The Particle™ is a granular delay pedal. It chops your signal into small slices (grains), which are shifted, randomized, and mangled using the techniques of granular synthesis. Results include radical pitch and delay modulation, shimmering repeats, time stretching, stutter, and glitch sounds.

The Particle has five delay-based modes and three pitch-based modes. You can combine all of the modes and access additional parameters via MIDI, saving the results in a preset for live use. Tap tempo can be used for the delay time, grain size, density, and LFO rate, with different note divisions for each.

In the delay modes, the **BLEND**, **DELAY**, and **FDBK** knobs work just like a standard 3-knob delay. Start by selecting **REV** (reverse delay), setting the **CHOP** to 9:00 and **PARAM** knob to 5:00.
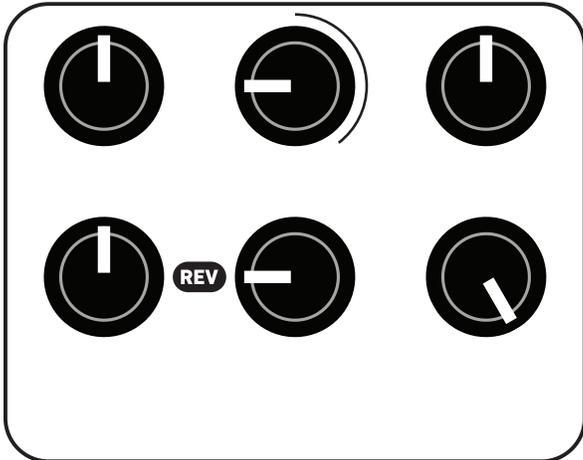
In **REV** (reverse) mode, the **PARAM** knob sets the probability of each grain playing forward or reverse. The signal will always be played in reverse at 7:00, always forward at 5:00, and at 12:00 it will randomly play each grain forward or reverse. The **CHOP** knob sets the size of each grain (below 12:00).

Next, change to **RND** (random delay) mode. The **CHOP** knob still sets the size of each audio slice, but now the **PARAM** knob sets the randomization range. At 7:00 there is no randomization, and at 5:00 it randomly jumps within the set delay time.

To explore each mode, set the **BLEND** knob to 5:00, **CHOP** around 9:00, and **FDBK** to 7:00. Step through each of the eight modes, adjusting the **DELAY/PITCH** and **PARAM** knobs to see how they affect the sound. Using a looper pedal to repeat a phrase or playing a recording through the Particle will make it easier to discern the effect.

The **FREEZE** footswitch holds the signal in the delay line indefinitely while the button is held down, so you can sample and manipulate a phrase. When the **CHOP** knob is above 12:00, it sets the threshold for audio-controlled freeze. The input signal plays through when its level exceeds the threshold. When the input level drops below the threshold, it starts reading from the delay buffer instead. This allows you to catch the beginning of each note and repeat it. When the chop knob is fully clockwise (5:00), it continuously loops. Lower thresholds can create drones in between notes or tape splice effects.

We provide a web-based editor to configure your Particle, access hidden parameters, and fine-tune presets. See "Web Editor" on page 21 for more information..   It requires the Google Chrome browser, and can be accessed at
https://www.redpandalab.com/content/apps/particle-editor/index.html

For live performance manipulation, we recommend using the Touch OSC template available on our web site, or programming your MIDI controller using the information in "Using MIDI" on page 25.

Controls

Overview
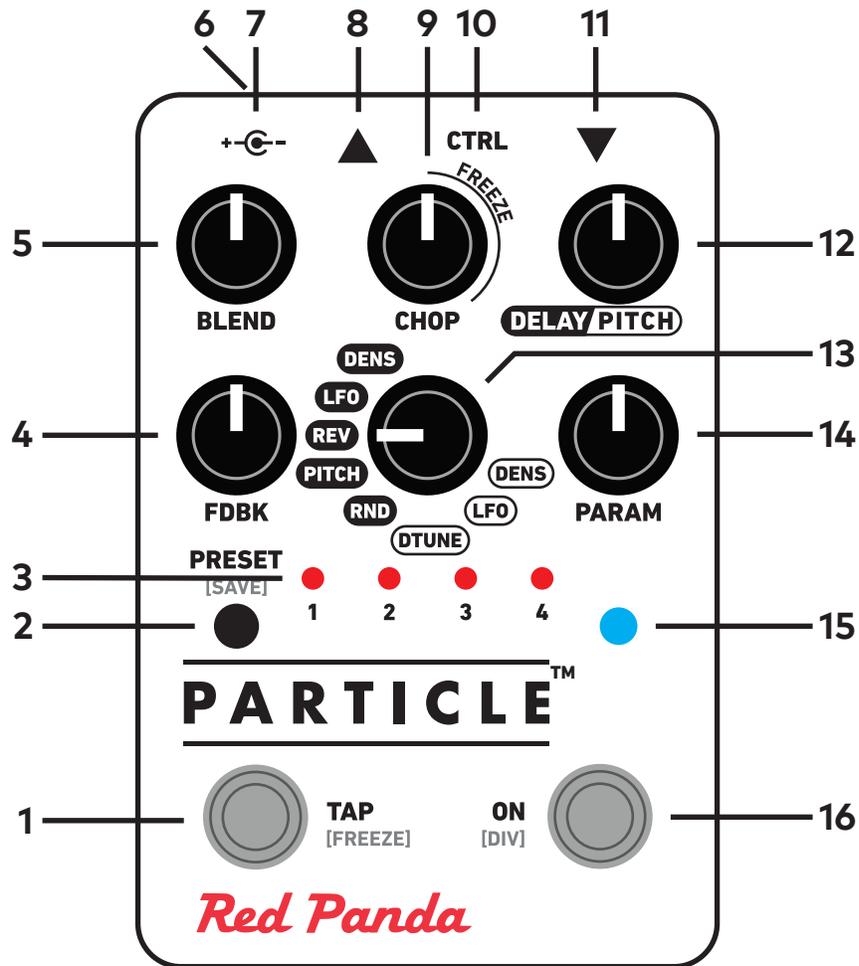
1 Tap tempo/freeze	**9** Chop/freeze threshold	
2 Preset switch	**10** Expression pedal	
3 Preset indicator	**11** Input	
4 Feedback	**12** Delay time/pitch shift	
5 Wet/dry blend	**13** Mode	
6 USB MIDI	**14** Parameter	
7 9V DC 250 mA	**15** Bypass indicator	
8 Output	**16** Bypass/tap division	

Alternate Controls [DIV]

Press and hold the **ON/[DIV]** footswitch to adjust tap divisions and alternate parameters. Alternate functions are labled **[DIV]** in the following sections.

To access **[DIV]** settings:
1. Start with the Particle enabled (blue light on)
2. Hold the **ON/[DIV]** footswitch until the LED changes to yellow (the pedal will briefly go into bypass)
3. While holding the **ON/[DIV]** footswitch, adjust the knobs and mode switch as desired
4. Release the **ON [div]** footswitch to store the settings

BLEND

Adjusts the wet/dry mix, from 100% dry to 100% wet. The dry signal stays at unity gain until 12:00, so there will be a slight volume boost when the wet and dry signal are combined.

FDBK

Adjusts audio feedback (repeats).

[DIV] Feedback tone (see "Feedback Lowpass Filter (Tone)" on page 10).

CHOP

Adjusts grain size from 7:00 to 12:00. Above 12:00, sets the freeze threshold (see "Freeze" on page 9).

[DIV] sets grain size to a note division.

MODE

Selects one of the delay or pitch modes and which of the parameters are controlled by the DELAY/PITCH and PARAM knobs.

[DIV] sets delay time to a note division.

DELAY/PITCH

Sets the delay time or pitch shift amount, depending on mode. The pitch shift range is ±1 octave, with no shift at 12:00.

[DIV] sets delay time to a note division.

PARAM

Adjusts a mode-specific parameter.

[DIV] sets grain density (interonset time) or LFO to a note division, depending on mode.

Bypass

The right footswitch turns the effect on and off. Tap to toggle between bypass and effect. From bypass, pressing and holding the footswitch will engage the effect momentarily and return to bypass when you release.

The Particle remembers its bypass state when power is removed.

Hold down the right footswitch while plugging an expression pedal, CV cable, or remote switch into the **CTRL** port to configure the port. See "Control Input" on page 15 for details.

You can also hold down the right footswitch to adjust tap tempo note divisions (**[DIV]**) and hidden parameters. See "" on page 18, and the following sections.

Trails

Turning on trails will cause the effect to decay naturally after the effect is switched to bypass. You can turn trails mode on or off using our web-based editor or MIDI CC #111. The trails mode is saved when the Particle is turned off, and is saved in presets.

Freeze

When the **CHOP** knob is above 12:00, it sets the amplitude threshold for freezing the current delay buffer. Holding the **TAP**/**FREEZE** (left) footswitch will momentarily turn on freeze mode. The bypass LED changes from blue to cyan while freeze is active.

The Particle has two different freeze modes:
- **grain freeze (default)**: the delay buffer is frozen
- **delay freeze (v1):** the delay output is recycled

You can change the freeze mode via MIDI or our web editor. It is stored in presets, and will be remembered when power is off.

Grain freeze

The delay buffer is frozen, allowing you to scrub through the frozen audio without degrading the sound. The results vary depending on which mode is active:
- **DELAY+DENS**: repeats a slice of audio with length set by **CHOP**, **DELAY** scrubs through buffer.
- **DELAY+LFO**: scrubs through buffer at length set by **PARAM**.
- **DELAY+REV**: repeats a slice of audio with length set by **CHOP**, **DELAY** scrubs through buffer.
- **DELAY+PITCH**: repeats a slice of audio with length set by **CHOP**, **DELAY** scrubs through buffer.
- **DELAY+RND**: randomly jumps around buffer.
- **PITCH+DTUNE**: repeats a slice of audio with length set by **CHOP**.
- **PITCH+LFO**: repeats a slice of audio with length set by **CHOP**.
- **PITCH+DENS**: repeats a slice of audio with length set by **CHOP**.

Delay freeze

Delay freeze recycles the delay output to its input, like the Particle v1 worked. When the delay time is changed, the frozen loop is pitch shifted and mangled.

REPEATING LAST-PLAYED AUDIO
The Particle is always listening to your signal, even in analog bypass mode. This allows you to repeat a phrase that you just played. With the Particle in bypass, set CHOP to 100% the DELAY knob to the desired repeat time, or use tap tempo When you click the ON footswitch, the Particle will enter freeze mode the the last segment of audio played.

TAP - FREEZE
Since the left footswitch is used for both setting delay time (tap) and freeze (hold), you can use it to set the freeze time on the fly, in all modes. Tap once, wait, and then press and hold the footswitch. The length of the frozen segment will depend on the tap division.

Feedback Lowpass Filter (Tone)

You can adjust the cutoff frequency of the feedback lowpass filter to control the brightness of the repeats. The setting is stored in presets, and remembered when power is removed.

To adjust the feedback lowpass filter:
1. Start with the Particle enabled (blue light on)
2. Hold the **ON [div]** footswitch until the light blinks (the pedal will briefly go into bypass)
3. While holding the **ON [div]** footswitch, adjust the **FDBK** knob for the desired tone
4. Release the **ON [div]** footswitch to store the setting

Realtime adjustment is available via MIDI continuous controller messages.

Modes

Mode		Delay/Pitch	Param	Description
DELAY	DENS	Delay time	Grain density (interonset time)	Delay with grain density
DELAY	LFO	Delay range	Stretch/compress ratio (LFO speed)	Time stretch/compress
DELAY	REV	Delay time	Direction probability	Reverse delay
DELAY	PITCH	Delay time	Pitch shift amount	Delay with random pitch jump
DELAY	RND	Max. delay time	Time randomization range	Random delay
PITCH	DTUNE	Pitch shift	Detune amount	Detune/pitch clouds
PITCH	LFO	Pitch shift range	LFO speed	Pitch modulation
PITCH	DENS	Pitch shift	Grain density (interonset time)	Pitch with grain density

DELAY + DENS

The delay knob sets the delay time. The param knob controls the density of grains, breaking the incoming audio down into blips at lower settings. The chop and param knobs interact in this mode. Get VO-SIM-like effects by setting the chop and delay knobs equal with feedback cranked up.

When the **CHOP** and **PARAM** knobs are both at higher settings, the audio will perfectly overlap.

DELAY + LFO

Steps through the delay buffer at a rate set by the parameter knob. The **DELAY** knob sets the length of the audio buffer (maximum delay time). Audio plays at normal speed with the param knob at 12:00, is stretched at lower settings, and compressed at higher settings. The chop knob adjusts the length of each playback slice. Results can be similar to subtle phasing with short delay times. Longer delays create time stretching, skip/repeat, and glitchy robot sounds.

For time stretching, adjust the **CHOP** knob to minimize or maximize audio artifacts.

DELAY + REV

Reverse delay with delay time set by **DELAY** knob. The **PARAM** knob controls the probability of each grain playing forward or reverse. Fully counterclockwise gives a reverse delay. At 12:00, grains are equally likely to play forward and reverse. The **CHOP** knob sets the grain size, but also imposes a minimum delay. Longer grains reduce artifacts, especially for sustained sounds. Very short grains produce glitchy tremolo sounds.

For live reverse delay, use tap tempo with **DELAY** and **CHOP** set to the same note division. You can also set **CHOP** to a smaller note division, so that the phrase is rewound in smaller chunks.

DELAY + PITCH

The delayed signal is randomly pitch shifted up or down by the amount set by the **PARAM** knob. The **DE-LAY** knob sets the delay time. The **CHOP** knob controls how often the pitch changes.

DELAY + RND

The **DELAY** knob sets the maximum delay time. The **PARAM** knob sets the randomization range. The **CHOP** knob controls how often the delay time is changed (size of the audio slices). Short delays create a chorusing sound. Use longer delays for random beat slicing effects.

With tap tempo, try setting **DELAY** to a whole note and **CHOP** to 1/8th or 1/16th note.

PITCH + DTUNE

The **PITCH** knob sets +/- 1 octave pitch shift. The **PARAM** knob controls the amount of random detuning around the set pitch. Each grain is detuned by a random amount, so the **CHOP** knob controls how smooth or stepped the effect is.

Lower settings of the **PARAM** knob will introduce slight detuning, similar to a dual-oscillator synth. As the **PARAM** knob is increased, the amount of detuning and number of simultaneous grains will increase. Higher settings will create pitch clouds.

For organ-like sounds, use little or no detuning (**PARAM**), +1 octave pitch shift, and high **FDBK**. The **CHOP** knob can be used to fine-tune the pitch shifting, and at higher settings it will introduce a slight delay between repeats. That is useful for creating "power up" video game sound effects from percussive sounds.

For chorus or reverb-like sounds, set the **PITCH** knob for no shift (12:00), use the **PARAM** knob to add a bit of detuning, and increase **FDBK** to create a reverberant sound. The **CHOP** knob will adjust the smoothness of the effect.

PITCH + LFO

The **PITCH** knob controls the range of pitch shift, from one octave down to one octave up. Within that range, the pitch ramps at a frequency set by the **PARAM** knob. The pitch changes with each new grain, so the **CHOP** knob controls how smooth or stepped the effect is. **FDBK** can be used to smooth out the effect.

PITCH + DENS

The **PITCH** knob sets +/- 1 octave pitch shift. The **PARAM** knob controls the density of grains, breaking the incoming audio down into blips at lower settings. The **CHOP** and **PARAM** knobs interact in this mode, and at higher settings there will be multiple overlapping grains.

Combining Modes

In its default configuration, the **MODE** knob will assign the **DELAY/PITCH** and **PARAM** knobs to specific functions and reset the previous mode's parameters. For example, switching from **DELAY+DENS** to **DELAY+LFO** will set the grain density so that they perfectly overlap.

You can combine modes in several different ways:
*   In the pitch modes, use tap tempo to set a delay time.
*   Use MIDI to set parameter values. All of the Particle's parameters are available via MIDI.
*   Assign the expression pedal to the **DELAY/PITCH** or **PARAM** knob in a different mode (see "Control Input" on page 15).
*   Use the "modeless" configuration setting to change the behavior of the **MODE** knob (see next section).

Modeless Configuration Setting

The mode switch reassigns the **DELAY/PITCH** and **PARAM** controls without clearing the audio buffer. When switching modes, the **PARAM** assignment from the previous mode is reset by default. Using MIDI controller 119 (or our web editor), you can change the behavior of the Mode switch so that the previous changes are retained. The setting is saved in presets, and also remembered when power is turned off.

When CC 119 is turned on, the **MODE** switch simply assigns the knobs to different parameters. This is very flexible, but can also be confusing because the hidden parameter settings make it hard to find your way back after making changes. You can always press the **PRESET** button to load the next preset, and when the preset LEDs are off it will reset everything to the current knob settings.

We recommend leaving CC 119 off in normal use, and setting up one or more presets that allow you to combine modes. The preset gives you a predictable starting point for manipulating the sound live.

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 (see "Web Editor" on page 21).

The configuration is remembered when power is turned off. Expression pedal assignments 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, 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. Those devices contain an optocoupler to prevent current loops.

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.

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.

The selected mode is remembered when power is turned off, and does not change when loading a preset.

Remote Modes

Mode	Switch	Function	LED Indication

1	A	Preset 1
		  Tap: load preset
		  Double tap: knob settings
		  Hold: save preset
			Blinks green when saved

	B	Preset 2
		  Tap: load preset
		  Double tap: knob settings
		  Hold: save preset
			Blinks green when saved

	C	Preset 3
		  Tap: load preset
		  Double tap: knob settings
		  Hold: save preset
			Blinks green when saved

	D	Preset 4
		  Tap: load preset
		  Double tap: knob settings
		  Hold: save preset
			Blinks green when saved

2	A	Left footswitch (tap/freeze)	
	B	Right footswitch (on)	
	C	Preset down	
	D	Preset up	

Presets

The Particle stores 127 presets. Presets 1-4 are accessible from the front panel, and all are accessible via MIDI program change messages. MIDI program 128 resets the parameters to the current knob settings. (Note that some controllers label MIDI programs 0-127 and some use 1-128.)

If preset 1-4 is selected, the Particle will remember the current preset when power is turned off and restore it. That allows it to be gig-ready, without worrying if the knobs have been moved.

Changing the Current Preset

- Press the preset button to cycle through presets 1-4 and the live knob settings.
- Send a MIDI program change message.

Saving a Preset

To save preset 1-4, press the preset button to select the desired preset, then hold the preset button for 2 seconds to store the current settings in that preset location. Note that when you select the preset location, the sound will change to that preset. After holding the button 2 seconds, the current knob settings will be saved.

To save any preset (1-127) via MIDI, send a MIDI program change message while holding down the **PRESET** button (do this without preset 1-4 selected, to avoid accidentally overwriting). You can also save a preset using a MIDI System Exclusive message (See "System Exclusive (SysEx)" on page 32).

Tap Tempo

Tap the left footswitch at quarter note intervals to activate tap tempo. The LED will blink yellow to indicate the current tempo. To cancel tap tempo, quickly double tap the left (TAP) footswitch. Turning a knob will cancel tap tempo for that parameter, but other parameters with note divisions set are not affected.

You can set independent note divisions for chop (grain length), delay time, density, and LFO rate. The tap divisions are stored in presets, and remembered when power is removed. More note divisions are available via MIDI. To disable tap tempo and MIDI clock sync for a preset, set all note divisions to off.

Out of the box, the delay time is set for quarter notes and tap divisions are off for other parameters.

To view or change tap divisions:
1. Start with the Particle enabled (blue light on)
2. Hold the **ON [div]** footswitch until the LED changes to yellow (approximately 2 seconds)
3. While holding the **ON [div]** footswitch, adjust the controls as described below
4. Release the **ON [div]** footswitch to store the settings

While in tap division mode, the **PRESET** LEDs blink based on the current tap division (off for none). The Bypass LED blinks red at quarter notes.

Tap tempo LED assignments

Preset	1	2	3	4
Assignment	Grain size	Density	LFO rate	Delay

Tap tempo control assignments

Control	Tap Division Assignment
CHOP	Chop (grain size)
DELAY/PITCH	Delay time
MODE	Delay time
PARAM	DENS: density
	LFO: LFO rate

Delay note divisions (MODE knob)

Mode Position	Note Division
DENS	Whole note
LFO	Half note
DTUNE	Dotted quarter note
RND	Quarter note
PITCH	Quarter note triplet
REV	Dotted eighth note
LFO	Eighth note
DENS	Eighth note triplet

Delay, chop, and density note divisions (CHOP, DELAY, PARAM knobs)

	Off (tap tempo disabled)		
	Whole note		Eighth note triplet
	Half note		16th note
	Dotted quarter note		16th note triplet
	Quarter note		32nd note
	Quarter note triplet		32nd note triplet
	Dotted eighth note		64th note
	Eighth note		64th note triplet

LFO note divisions (PARAM knob)

	Off (tap tempo disabled)		
	8 measures		Eighth note
	4 measures		Eighth note triplet
	2 measures		16th note
	Whole note		16th note triplet
	Half note		32nd note
	Quarter note		32nd note triplet

Web Editor

The web-based Particle 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 mini cable and go to the web editor URL using Chrome:

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

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

The editor is currently beta software. It is fully functional, but does not look great.

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 Particle's realtime parameters. The on-screen controls are updated to match the current state of the pedal, but there is a slight lag that may make it unsuitable for live performance. The web editor's controls allow higher resolution changes than MIDI continuous controller messages (up to 24 bits).

Modeless allows you to access parameters from all modes using the pedal's **MODE** switch. See "" on page 13 for information.

Freeze Mode changes the freeze behavior as described in "Freeze" on page 9.

Mod

The Mod 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.

Preset

The Preset tab allows you to send MIDI program change messages and save presets to the pedal's on-board memory. Presets 1-4 are also available via the pedal's **PRESET** button.

Config

The Config tab allows you to configure the pedal for your setup. Configuration settings are described in "Advanced Configuration" on page 23.

If the pedal detects an error condition, a diagnostic code will be displayed on this tab.

This tab also displays the installed firmware version and the input power supply (PSU) voltage. Turn on the **PSU Voltage** toggle to display the realtime voltage reading. A low PSU voltage may indicate that the power supply is not able to provide enough current to properly power the pedal.

JavaScript Console

The JavaScript console prints MIDI System Exclusive data that is sent to the pedal, which can be helpful when programming MIDI controllers. For realtime parameter manipulation, we recommend using MIDI continuous controller messages, since they are broadly supported.

Advanced Configuration

The Particle uses MIDI System Exclusive messages to access configuration settings.   See "System Exclusive (SysEx) Messages" on page 32 for a complete list of properties. We provide a web-based editor (requires Chrome) and a Touch OSC template (for iOS and Android) to make it easier to access these settings.

Setting maximum input level

The Particle can handle signals up to +5.2 dBu (4 Vpp) in its default setting. The maximum input level is adjustable using MIDI System Exclusive (SysEx) messages, or via the TouchOSC template we provide. The Particle adjusts the input and output levels to maintain a consistent signal level.

If you are using a synthesizer or mixing console and the Particle is clipping, you can increase the maximum input level.

If you are using a quiet instrument, such as single coil guitar pickups or a consumer cassette deck, you can set the Particle to a +0.5 dBu maximum input level, which may give a slight improvement in signal-to-noise ratio.

Setting MIDI channel

The Particle transmits and receives on MIDI channel 1 by default. The MIDI channel can be changed using MIDI System Exclusive (SysEx) messages, or via the TouchOSC template we provide. It is remembered when power is off.

Setting bypass mode

The Particle has three different bypass modes:
- **Analog** - analog bypass path. There may be a slight click when switching between bypass and effect, due to discontinuities in the waveform.
- **DSP** - signal always passes through DSP. Smoother switching between bypass and effect.
- **Kill Dry** - dry signal is muted - even in bypass - for use on an aux send.

Kill Dry is useful when using multiple effects processors in parallel and mixing their outputs together, including:
- Using an aux send to route a signal to the Particle, bringing the output back to an aux return or mixer channel.
- Splitting the signal into multiple bands, processing each with a different effect, and combining the outputs with a mixer.

Kill Dry is not intended for typical serial effects routing or amp effects loops. The dry signal will be muted at all times. The **BLEND** knobs acts as an output level control.

The bypass mode can be changed using MIDI System Exclusive (SysEx) messages or our web-based editor.

Reset to Factory Defaults

Use the following procedure to reset the Particle's configuration data to factory default settings. This will erase any advanced configuration and control port settings, but presets will not be affected.

1. With the pedal unplugged, set the mode switch to the **PITCH**+**DENS** position.
2. Hold the ON footswitch while plugging in power. The right LED will be solid white.
3. Rotate the mode switch to the **DELAY**+**DENS** position.
4. When the factory reset is complete, the Particle will cycle through its LEDs.
5. Power cycle the pedal to continue.

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 pro-grams.
*   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 connec-tors 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) Messages" on page 32 for more information.

TRS MIDI Input

See "Using MIDI" on page 25 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.
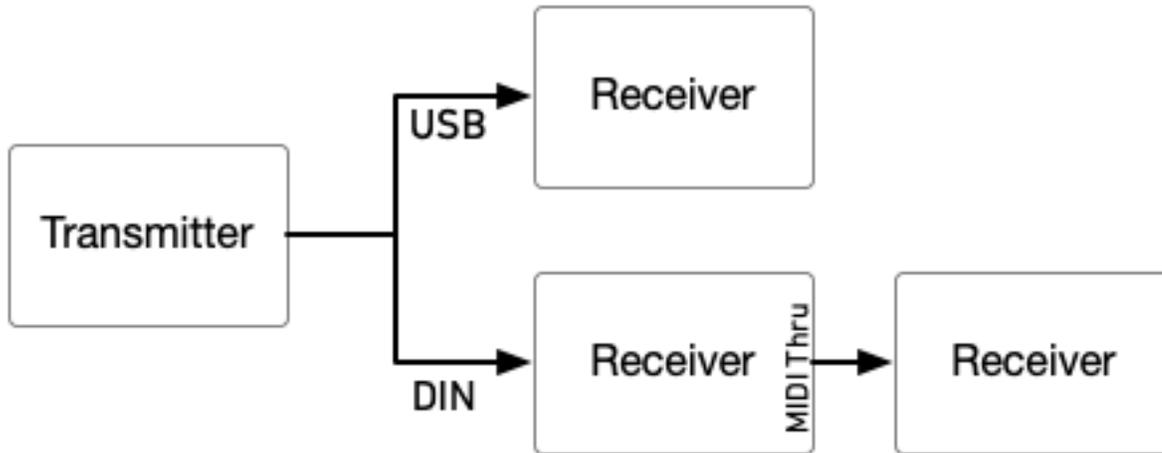
MIDI Timing Clock

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

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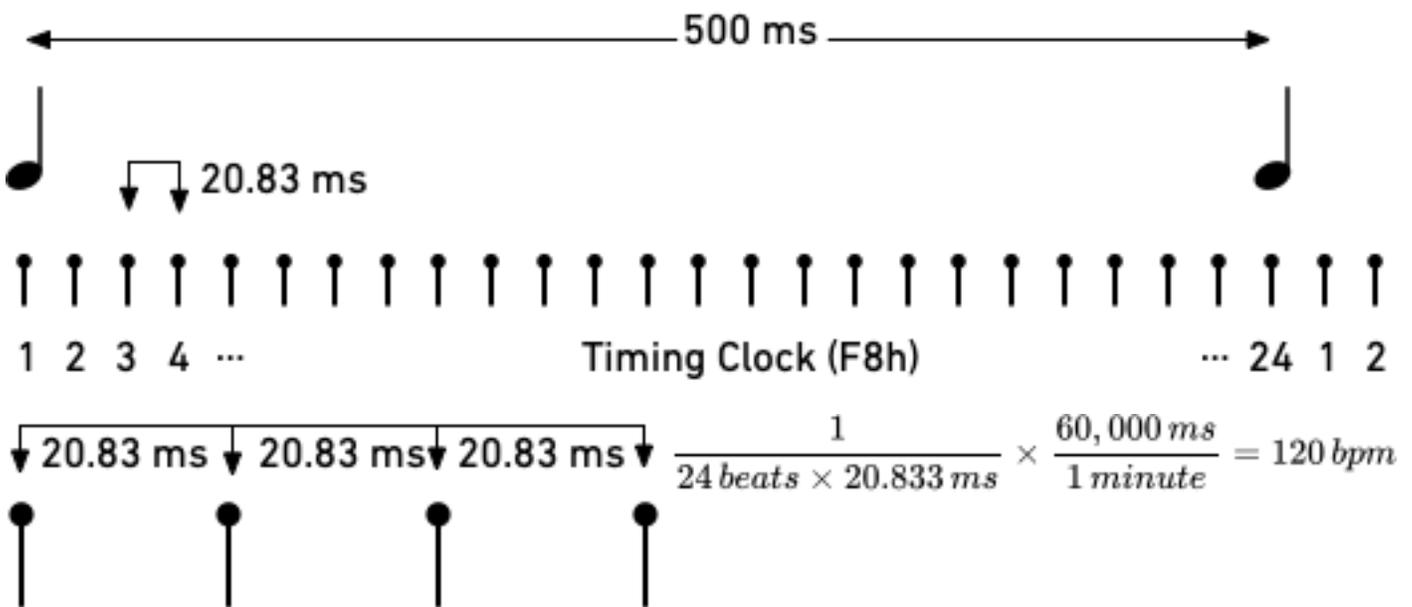
continues sending timing clocks when it is stopped so that receivers can be ready when playback starts or continues. A start message will reset playback to the first beat, and a continue message will pick up where playback left off.

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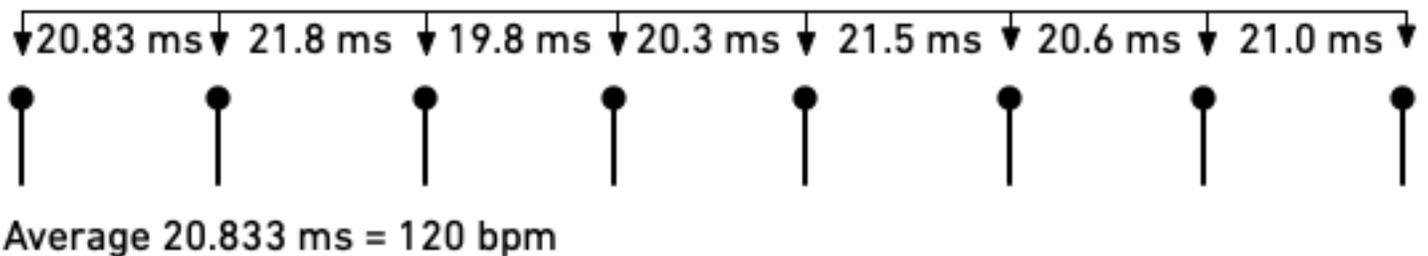
Some devices do not transmit start, stop, and continue messages, so the pedal will begin synchronizing if it receives a MIDI timing clock message without a start or stop message first.

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" on page 19for information about note divisions for each parameter.

MIDI Continuous Controller Messages

CC Num	Destination	Notes		
4	Expression pedal	CTRL input		
12	Blend			
13	Chop	Grain size		
14	Freeze threshold	0	Off	
		1–126	Threshold	
		127	On	
15	Feedback			
16	Delay	Sets the delay time in seconds, with same scaling as DELAY/ PITCH knob.		
17	Delay random			
18	Pitch			
19	Pitch detune			
20	Pitch random			
21	Density			
22	Direction	0	Reverse	
		1–126	Probability	
		127	Forward	
25	LFO rate			
27	Feedback Lowpass Filter			
80	Freeze	0–63	Off	
		64–127	On	
81	Effect on	0–63	Bypass	
		64–127	Effect	
88	Effect on (receive only)	0–63	Bypass	
		64–127	Effect	
89	Tap (receive only)	64–127	Remote tap	

CC Num	Destination	Notes	
102	Mode	0	Pitch/density
		1	Pitch/LFO
		2	Pitch/detune
		3	Delay/random
		4	Delay/pitch
		5	Delay/reverse
		6	Delay/LFO
		7	Delay/density
103	Chop/freeze	0–63	Chop
		64–127	Freeze threshold
104	Delay/pitch	Depends on current mode	
105	Param	Depends on current mode	
106	Delay note division	See "Note Divisions" table	
107	Density note division	See "Note Divisions" table	
108	Chop note division	See "Note Divisions" table	
109	LFO rate note division	See "Note Divisions" table	
110	Receive MIDI clock (global)	0–63	Off
		64–127	On (default)
111	Trails mode	0–63	Off (default)
		64–127	On
118	Freeze mode	0	Grain freeze
		1	Delay freeze (V1)
119	Mode switch reassigns knobs	0–63	Off (default)
		64–127	On (combine modes)

Pitch Semitone (CC 18) Mapping

MIDI CC Value	Transposition	MIDI CC Value	Transposition
0-4	-1 octave	64	Unison
9	-M7	69	m2
14	-m7	74	M2
19	-M6	79	m3
24	-m6	84	M3
29	-P5	89	P4
34	-d5	94	d5
39	-P4	99	P5
44	-M3	104	m6
49	-m3	109	M6
54	-M2	114	m7
59	-m2	119	M7
64	Unison	124-127	octave

Note Division Continuous Controller Values

Allowable values for each parameter are limited by the minimum and maximum parameter values. Note that values are grouped by dotted/basic/triplet notes for each division and are not in strictly decreasing order.

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
27	Dotted 64th note
28	64th note
29	64th note triplet
30	Dotted 128th note
31	128th note

System Exclusive (SysEx) Messages

The Particle uses MIDI System Exclusive Messages to get and set configuration properties and state. The protocol is very similar to MIDI Capability Inquiry (MIDI-CI) Property Exchange, but the defined properties and semantics for MIDI-CI Property Exchange are not part of the MIDI-CI specification and have not been published as of March 2019.

The following System Exclusive messages can be used to configure the particle, 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 Particle. Our web editor prints the System Exclusive messages that it sends to the JavaScript console, so you can perform an action using the web editor and then copy the SysEx to your controller.

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	Particle family ID
01	Particle 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	Particle family ID
01	Particle product ID
00	Message version
36	Set property
7F	Save preset to memory byte 1
13	Save preset to memory byte 2
00	Bank (always 0)

Byte (hex)	Description
03	Preset location (0-based hexadecimal 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.

Error Code

Get	Set	ID 1	ID 2	Data Bytes	Data
X		7F	0A	10	2 32-bit integers, each encoded in 7-bit bytes

Returns a diagnostic error code that can assist Red Panda in troubleshooting problems.

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.

Maximum input level (headroom)

Get	Set	ID 1	ID 2	Data Bytes	Data
X	X	7F	10	1	01: +7.2 dBu max (5.0 Vpp) 02: +5.2 dBu max (4.0 Vpp) (default) 03: +0.5 dBu max (2.3 Vpp)

Adjusts the input/output gain to accommodate different signal levels.

Bypass mode

Get	Set	ID 1	ID 2	Data Bytes	Data
X	X	7F	11	1	01: analog bypass 02: DSP bypass 03: kill dry

Bypass mode.

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 current settings as 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. 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.

Support, Repairs, and Warranty

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 resources 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

This product is warranted against defects in materials and workmanship for one (1) year from date of original purchase. It does not cover damages or wear resulting from accident, misuse, abuse, or unauthorized adjustment and/or repair. Should this product require service (or replacement at our option) while under warranty, please contact support@redpandalab.com.

Firmware Updates

The Particle'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 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 PARTICLE (Mac OS) or "USB Drive" (Windows) 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/#particle
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 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 PARTICLE (Mac OS) or "USB Drive" (Windows) drive on your computer.
7. Drag and drop the firmware binary (.bin) file to the drive.
8. The red preset LEDs will light in sequence 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 drive from your computer and it should resume. If not, retry the procedure.
10. If an error occurred, the red LED will blink instead.
11. Eject the PARTICLE (Mac OS) or "USB Drive" (Windows) drive from your computer:
    Mac: click the eject button or drag the PARTICLE icon to the trash
    Windows: right-click on the PARTICLE icon in My Computer and select "Eject"
12. Disconnect the USB cable.
13. Turn the pedal's power off.

Troubleshooting
If the left LED blinks red, turn the Particle off, then on, and try again.

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

Specifications

Maximum input level:	+0.5 dBu (high gain)
	+5.2 dBu (default)
	+7.2 dBu (max)
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
	Eric Iverson
	Morgan Marentic
Testing	Sylvie Demers
	Randy Molina
	Andy Pitcher