

EPSi

**EPSi Effect Processor**

**User's Manual**



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## **Document revisions**

Dec 1 2013: Original draft. EPSi firmware 1.00

Jan 10 2014: Added a few details

Jan 13 2014: Fixed error “128 samples”

Feb 19 2014: Added support for Version C.00

Jun 04 2014: Added support for Version 1.01 and C.01

## **Introduction**

Thank you very much for purchasing a Logidy EPSi Effect Processor. We hope you find our product an inspiring tool in your quest toward musical bliss. You will find in this document all the information you might need to get the best out of our product.

Lets' get started.

# 1. Presentation

## 1.1. What is the EPSi?

The Logidy EPSi Effect Processor (EPSi from now on) is a DSP powered effects processor packed in a small pedal format. The interface and the inner workings of the EPSi are not tied to a particular application. Actual parameter names only show on the 3 character LED display and can be changed. And because the firmware running on the pedal is easily replaced via an SD Card, the EPSi can be turned into many different things.

As of now there are two versions of firmware available for the EPSi:

- Version 1.xx: This version is optimized for reverb sounds.
- Version C.xx: This version is optimized for cabinet speaker and room sounds.

Both versions make use of convolution and the SD Card to load sounds.

## 1.2. What is Convolution?

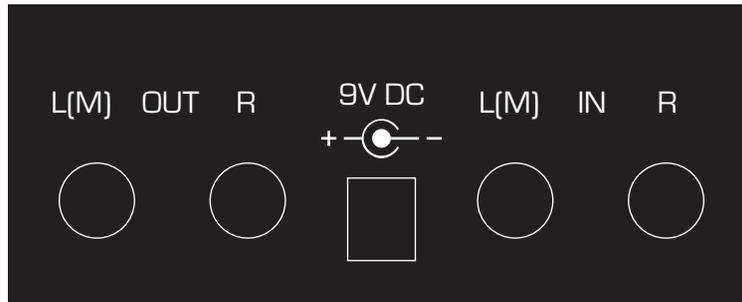
The behavior of a linear time invariant system (like an acoustic hall or a linear EQ) is fully described by its impulse response. An impulse response can be obtained by recording the sound coming out of such a system when an impulse – a kind of short pop – is applied to it. Once this impulse response is acquired, the behavior of that system can be recreated by convolving that impulse response with an input signal in a process that is equivalent to filtering. To simulate acoustic reverberation sounds the time window of that filter is as long as the decay of the effect. This leads to high computational requirements for long decay times. In the reverb version of the firmware we are able to reach windows of about 6 seconds in duration, which is long enough to simulate an acceptable variety of sounds found in nature or in devices trying to mimic it.

Version C of the firmware is optimized for zero latency convolution and dual channel processing. This leads to a reduce time window of 1.5 second.

# 2. Plugging In

If you have used effect pedals in the past, you will find that incorporating the EPSi works pretty much the same way as with any other pedal. The EPSi features 4 audio connectors on the back - 2 stereo pairs, one for importing

analog audio into the pedal and one producing analog audio out, as well as a power jack. The connectors are laid out as shown here:



## 2.1. Power Jack

Connect the included 9 Volt power supply to an AC outlet and to the power jack at the back of the unit. The EPSi uses the most common voltage polarity for effects pedals with the positive potential on the outside sleeve of the connector.

**Caution:** When using a different power supply, make sure it conforms to the specifications given at the end of this document. Insufficient or excessive current/voltage can easily result in damaging the electronic circuits inside the pedal and render it inoperable.

As soon as the EPSi is powered, it will start right away and go through its startup sequence. See the user interface section for more on this.

## 2.2. Audio Inputs

Facing the back of the unit, the input connectors are on the right. The EPSi can take in either a mono or a stereo signal. If a single jack is plugged in the L(M) input – which stands for “Left(Mono)” – the signal coming from that input will be copied onto the right side channel creating an internal split. If a single jack is plugged in the R input – which stands for “Right” – no direct signal will go to the left side channel. The impedance of the input stage is set so that an electric guitar can be plugged in directly without suffering much loss in brightness in the sound.

EPSi features an analog direct path so as not to add any latency to the dry signal. This dry path can be disabled through the user interface.

## 2.3. Audio Outputs

Facing the back of the unit, the output connectors are on the left. Plugging a single jack into the L(M) connector – which stands for “Left(Mono)” – has no effect on the dry path, but causes the left and the right channels of the processed audio to be summed.

## **2.4. SD Card Slot**

The EPSi uses impulse responses stored on an SD Card. The unit arrived to you with an SD Card pre-loaded with a collection of impulse responses. If, on power-up the EPSi does not detect the presence of a card, a test impulse response generated internally is used instead. Cards can be inserted and removed while the unit is running. Each time a card is inserted, the system will inspect its contents and adapt accordingly without interrupting the audio processing. SDHC Cards are currently not supported.

## **3. EPSi User Interface**

The EPSi features a simple user interface including an endless value rotary control, a button for stepping through parameters, a foot switch and a 3 digit LED character display.

**Note:** Because the front panel of the EPSi does not explicitly name parameters, it is possible for us to add/remove/change parameters in software. Make sure that the version of this document matches the version of the firmware that is running on your EPSi.

### **3.1. Firmware Version**

On power up the EPSi first displays the version number of the firmware being currently run. If an SD Card is present the system will quickly proceed with the file initialization and take over the display. If a card is not present, the firmware version number will show until the user interface is interacted with.

The Firmware on the EPSi can be replaced via the SDCard. Exact details on how to perform a firmware update are provided on our website along with the new program file.

### **3.2. Changing Parameter Values**

Parameters on the EPSi are changed one at a time by stepping through them with the “Param” button and using the “Value” knob.

A single push on the “Param” button causes the display to reveal the name of the current parameter. That name shows as long as the button is pushed and for about 2 seconds after the button is released. After that the display reverts to showing the value for that parameter. If the button is pushed again within the 2 seconds, the next parameter in the list becomes current and its value can be changed with the “Value” knob. When the last parameter is reached, the stepping loops back to the first parameter.

Scrolling through parameters can also be done while holding the “Param” button down and turning the knob. The parameter list can be scrolled through up or down that way.

### **Exception: Recalling an Impulse Response**

In the case of the first parameter the “param” button is also used to trigger the loading (“Recalling”) of a new impulse response. When the value shown for the first parameter does not match the index of the currently loaded impulse response, the display will alternate between the value and “rcL” as shown here:



“rcL” stands for “recall” and will flash 4 times for about 5 seconds. If the “param (Recall)” button is pushed during that time, the system will interrupt audio processing and load the new impulse response. If the button is not pushed during that time, the display reverts to showing the current impulse response index number and stepping through parameters can resume.

## **3.3. Foot Switch**

The foot switch on the top panel act as an effect enabling/disabling control. When the effect is bypassed the display shows the following symbol:



Disabling the effect is equivalent to disabling the input of the effect. This means that its trail will still be heard for some time after the foot switch is pressed.

While the effect is disabled access to parameters is still possible. When the user interface is accessed the display reacts accordingly, but the display eventually reverts to showing the symbol shown above.

## 4. Parameter List

### 4.1. Version 1.01 Parameter List

Display	Meaning	Values
	<b>1.Sd</b> The Index of the SD Card File used as an impulse response	The values available depend on the contents of the SD Card (see file naming section)
	<b>2.FL</b> FX Level. The level of the processed audio AKA “wet” level.	Unit: dB. Range: -40dB to +10dB Actual resolution: 0.25dB steps
	<b>3.rt</b> Reverb Time. The decay time in seconds for the impulse response. This is the measured RT60	Unit: seconds Range: from 50% to 150% of the nominal time of the impulse response*
	<b>4.dr</b> Dry Path Enable. The state of the internal analog direct path relay.	Unit: none Range: on - off
	<b>5.HP</b> High pass filter cutoff frequency. The wet path has an adjustable high pass filter.	Unit: Hz Range: Off, 18 - 992

\* Increasing or decreasing the perceived decay is done by applying a volume envelope to the impulse response. When increasing the decay time, the envelope adds gain to the end of the tail also increasing whatever noise might be in the file. This can sometimes make the tail sound unnatural.

### 4.2. Version 1.01 Algorithm

#### 4.2.1. Quality

Convolution is a straightforward process. Although there are several ways this process can be optimized for computational bandwidth, the end result can not differ from the simple theory. At the root and with a large enough bit depth (32-bit

floating point in our case) all convolvers sound the same. The quality of the sound generated largely depends on the quality of the impulse response used.

A peaky or fluttery impulse response from a low quality algorithmic reverb unit will sound the same on the EPSi. However an impulse response from a very diffused and uneven acoustic space will sound as smooth and transparent on the EPSi.

The collection loaded on the SD Card included with the EPSi has impulses from many different high quality sources (acoustic, electronic, electromechanical, and synthesized).

The maximum Impulse response duration is about 6 seconds (262144 samples at 44.1 KHz). Only the first 6 seconds of data get loaded for longer duration files. This can result in a very abrupt sounding cutoff if the wave does not include some sort of fade out within that time span.

The processing latency of the wet path is about 10.0 ms. As pre-delays in reverb sounds are often longer than this, the latency is not noticeable on reverb sounds. For zero latency processing, see firmware version C.

### **4.2.2. Stereo image generator**

In order to reach our 6 second time window the DSP can only process one channel. The EPSi only uses the first channel of a multichannel wave file. EPSi uses an original adaptive algorithm to synthesize a new stereo image. The result of this process sounds as if the impulse was re-captured with an M/S microphone pair and is convincing for most space simulation applications. However any hard panning built in the original impulse is lost through this process.

The stereo image generator is disabled when the right output jack is left unplugged (mono output mode). In this situation the processed signal is an exact rendering of the convolution.

### **4.2.3. Adding some life to linearity**

Basic convolution is a perfectly linear process. It can not simulate any sort of distortion or time varying effect. This can result in the output sounding somewhat stale. To remedy this, the stereo image generator also includes a little bit of detuning. The detuning amount is very slight (1.5 cent). The result is some subtle added sense of motion and chorusing, widening and warming up the sound with no audible pitch shifting.

### 4.3. Version C.01 Parameter List

	Meaning	Values
	<b>1.Sd</b> The Index of the SD Card File used as an impulse response	The values available depend on the contents of the SD Card (see file naming section)
	<b>2.Lo</b> Low frequency tone control level	Unit: none. Range: 0.0 to 10.0
	<b>3.Md</b> Mid frequency tone control level	Unit: none Range: 0.0 to 10.0
	<b>4.Hi</b> High frequency tone control level	Unit: none Range: 0.0 to 10.0
	<b>5.LF</b> Low frequency tone control cutoff	Unit: KHz Range: 0.01 to 9.90
	<b>6.HF</b> High frequency tone control cutoff	Unit: KHz Range: 0.01 to 9.90

### 4.4. Version C.01 Algorithm

#### 4.4.1. Quality

The algorithm in Version C is optimized for zero latency processing. The actual latency measured from analog input to analog output is 1.04 ms, 80% of this is due to the group delay of the anti aliasing filters of the A/D and D/A converters. A maximum convolution window in stereo of 1.5 sec (65536 samples) can be achieved.

## **4.4.2. Stereo operation**

Version C always processes audio on the left and the right channels independently. It can use either stereo or mono WAV files. If a mono file is used the same impulse is loaded on both channels. Unlike version 1, version C does not alter the stereo imaging in any way.

## **4.4.3. Tone Controls**

Version C features an extra filter emulating the general behavior of the tone stack of a guitar amp. The Low and High controls are used to increase the level in their respective frequency bands, while the Mid control is used to set the general level of the filter, the same way some classic tube amps handle EQ'ing.

The cutoff frequency for the High and Low bands can also be adjusted. This allows “voicing” of the EQ to various tone stack colors.

To flatten the EQ the following settings should be used:

- Low: 0.0
- Mid: Any value. In this setting the Mid becomes a general level control.
- High: 0.0

## **5. Managing Impulse Response Files**

### **5.1. SD Card and File Format**

The EPSi handles SD Cards formatted with either FAT16 or FAT32 file systems. Inserting a card with a different format will trigger an error message. SDHC Cards are currently not supported.

Impulse response files are 44.1 KHz Wave Files with either 16 or 24 bit depth. Trying to load files that do not match this specification will trigger an error message.

### **5.2. EPSi “EPDA” Folder**

The Epsi looks for files in a specific folder on the root directory of the SD Card called “EPDA”. If that folder does not exist, the EPSi reports an error. All files to

be used by the EPSi should be included in that folder. The EPSi ignores all subfolders in “EPDA”.

### 5.3. File Naming Convention

The EPSi differentiates impulse response files by looking for a 3 digit indexing prefix in the file name. When an SD Card is inserted, the EPSi searches for all files having that prefix and the .WAV extension and then creates a sorted list that can be scrolled through as the first parameter (1.Sd). The EPSi only looks for 3 digits at the beginning of the file name. The rest of the file name is ignored.

**Note:** If two Wave files have the same 3 digit prefix, the EPSi lists only one of them - picking the one somewhat randomly.

On a computer a file name might look like this:

`123 impulse response name.wav`



The EPSi shows the file as:

**Note:** The indexing prefixes in a list of files do not need to be contiguous. The EPSi only displays any combination of the 1000 available (000 to 999) that actually exists in the EPDA folder.

## Appendix A: Specifications

### Analog:

Nominal audio input/output level:	-10 dBm
Clipping audio input/output level:	+2 dBm
Dynamic range:	100 dB
Frequency response (+/- 1dB):	20Hz – 20KHz
Bypass type:	Buffered analog
Input Impedance:	500 KOhm

### Digital:

Sampling Rate:	44.1 KHz
Processing Bit Depth:	32 Bit Floating Point

### Inputs – Outputs:

Audio inputs:	2 * 6.35 mm (0.25 ") phone jacks
Audio outputs:	2 * 6.35 mm (0.25 ") phone jacks
Data connector:	1 SD Card socket
Power connector:	2.1 * 5.5 mm

### Mechanical:

Size:	10.1 * 11.3 * 5.9 cm 4.0 * 4.5 * 2.3"
Weight:	400g 15 oz

### Power:

Supply Voltage:	9V – 12V DC (center negative)
Supply Current:	250 mA

## Appendix B: Error Codes

Display	Meaning	Resolution
	<b>Error 0:</b> Hardware self test error	Contact customer support
	<b>Error 1:</b> SD Card initialization error	Try another SD Card
	<b>Error 2:</b> File System error	<ul style="list-style-type: none"><li>- Verify SD Card format</li><li>- Format SD Card as FAT16 or FAT32. No SDHC.</li></ul>
	<b>Error 3:</b> Wave file loading error	<ul style="list-style-type: none"><li>- Check wave attributes</li><li>- Resample to 44.1KHz</li><li>- Change bit depth to 16 or 24</li></ul>
	<b>Error 4:</b> Firmware loading error (boot loader generated)	Try replacing the application firmware via the SD Card.

## Appendix C: Reverb Impulse Responses List (IR V1.00)

### 1xx: Rooms

100 Busy Slap.wav	110 Bright Room.wav	120 Computer Room.wav
101 White Closet.wav	111 Circular Room.wav	121 Real Room.wav
102 Tiny Closet.wav	112 Room Algo.wav	122 Sun Room.wav
103 The Box.wav	113 Small Cave.wav	123 Mens Room.wav
104 Small Room.wav	114 Large Room.wav	124 Live Room.wav
105 Boiler Room.wav	115 Small Club.wav	125 Classroom.wav
106 Science Room.wav	116 Slap Cafe.wav	126 Large Dark Room.wav
107 Hotel Room.wav	117 Studio.wav	
108 Vintage Reflections.wav	118 Empty Room.wav	
109 Small Tiled Room.wav	119 Back Room.wav	

### 2xx: Halls

200 Tiny.wav	210 Warm Hall.wav	220 Large Hall.wav
201 Small Hall.wav	211 Vocal Hall.wav	221 Vintage Hall.wav
202 Drum Hall.wav	212 Sparkle Hall.wav	222 Long Wash.wav
203 Recital Hall.wav	213 Digital Concert.wav	223 Large Hall.wav
204 Small Dark Hall.wav	214 Medium Hall.wav	
205 Spike Hall.wav	215 Deep Hall.wav	
206 Studio Hall.wav	216 Leaky Hall.wav	
207 Dense Hall.wav	217 Concert Hall.wav	
208 Bright Hall.wav	218 Long Hall.wav	
209 Stage Hall.wav	219 Dark Hall.wav	

### 3xx: Spaces

300 Small Cave.wav	310 Gymnasium.wav	
301 Camp Site.wav	311 Arena.wav	
302 Forest.wav	312 Dark Church.wav	
303 Canyon.wav	313 Warehouse.wav	
304 Small Church.wav	314 Very Large Church.wav	
305 Speaker Hall.wav	315 Cathedral.wav	
306 Parking Garage.wav		
307 Factory.wav		
308 Large Church.wav		
309 Glass Church.wav		

### 4xx: Plates

400 Old Plate.wav	410 EMT Dark.wav	
401 Tiny Plate.wav		
402 Ambient Plate.wav		
403 Shiny Plate.wav		
404 Dense Plate.wav		
405 Rich Plate.wav		
406 Horn Plate.wav		
407 Deluxe Plate.wav		

408 EMT Bright.wav		
409 Factory Plate.wav		

5xx: Springs

500 Short Spring.wav	510 Combo Spring.wav	
501 Bright Spring.wav	511 Dub Spring.wav	
502 Tape Spring.wav		
503 Cheap Spring.wav		
504 Dark Spring.wav		
505 Multi Spring.wav		
506 Fake Spring.wav		
507 Medium Spring.wav		
508 Tube Spring.wav		
509 Deep Spring.wav		

6xx: FX

600 gated slap.wav	610 Chirp2.wav	620 Bloom.wav
601 Machine Echo.wav	611 Drum Fill.wav	621 Applause.wav
602 Squeeze.wav	612 Saw Mod.wav	622 Long Sweep.wav
603 Drum Roll.wav	613 Splash Cymbal.wav	623 In Session.wav
604 FX Snare.wav	614 Shaker Loop.wav	
605 Slurp.wav	615 Drum Loop.wav	
606 Alien.wav	616 Krypto Froth.wav	
607 Automatic.wav	617 Radio Jamming.wav	
608 Water.wav	618 Cymbal.wav	
609 Chirp1.wav	619 Encounter.wav	

## Appendix D: Cab Impulse Responses List (IR V1.00)

1xx: Single or dual speaker cabs

100 1X12 Celestion Blue.wav  
101 1X12 Jensen P12R.wav  
102 1X15 Jensen C15.wav  
103 2X12 Alnico Blue.wav  
104 2X12 Alnico Silver.wav  
105 2X12 Jensen C12N.wav  
106 2X12 JBL D120.wav  
107 2X12 Roland JC120.wav  
108 2X12 Celestion G12M25.wav  
109 2X12 Celestion G12H30.wav  
110 2X15 JBL D130.wav

2xx: Quad speaker cabs

200 4X12 Sheffiled 1200.wav  
201 4X12 Celestion G12L.wav  
202 4X12 Celestion G12H30.wav  
203 4X12 Celestion G12M20.wav  
204 4X12 Celestion G12M25.wav  
205 4X12 Celestion G12M.wav  
206 4X12 Celestion G12T75.wav  
207 4X12 Celestion G12T75.wav  
208 4X12 Celestion V30.wav  
209 4X12 Celestion V30.wav  
210 4X12 Celestion V30.wav  
211 4X12 Celestion V30.wav  
212 4X12 Celestion V30.wav  
213 4X12 Eminence S12X.wav  
214 4X12 Eminence Legend V12.wav  
215 4X12 Fane 122231.wav  
216 4X12 JBL K120.wav  
217 4X10 Jensen P10Q.wav

3xx: Single or dual speaker cabs with added studio ambiance – Same list as 1xx

4xx: Quad speaker cabs with added studio ambiance – Same list as 2xx