flight of harmony

the Sound Of Shadows

Digital Delay Effect v3.0
Eurorack Module
Kit

Specifications

Supply Voltage	±12VDC[1]		
Supply Current (max draw @ ±12V & +5V)	I_{+12V}= 19mA	I_{-12V}= -15mA	I_{+5V}= 21mA
Supply Current (max draw @ ±12V)	I_{+12V}= 41mA	I_{-12V}= -15mA	
Max. Input Voltage (@ ±12V)	$10V_{p\text{-}p}$		
Max. Output Voltage (@ ±12V)	$6V_{p\text{-}p}$		
Input & Ouput (I/O) coupling	Direct[2]		
Output Impedance	1kΩ		
Control Voltage (CV) inputs	$\pm V_{supply}$		
CV input coupling	Direct		
CV input impedance	100kΩ		
Number of pieces (nuts & washers of pots & jacks not counted)	132		
Kit Difficulty	Medium-advanced		

1) Has been tested and performs well with supply voltages from ±9VDC to ±15VDC.
2) I/O jacks are direct-coupled. The Delay circuit itself is not. A DC signal at the input will be available at the Clean, and Mix outputs, but not available at the delay output.

Contents

(1) Front Panel
(3) PCB- Main, Potentiometer, Jack
(3) Resistor Card
(1) Semiconductor Card
(1) Capacitor Card

(1) Hardware bag
- (1) 9″ ribbon cable
- (1) 2x8 box header
- (2) 2x8 IDC socket connector with strain relief
- (2) M3x0.5 eurorack mounting screw
- (2) M3 nylon washer
- (1) 1x3 Right Angle (RA) pin header
- (1) 2x3 0.235" post pin header
- (1) 1x4 0.235" post pin header
- (1) 1x6 0.235" post pin header
- (1) 1x6 0.318" post pin header
- (1) 1x7 0.318" post pin header
- (1) 1x4 socket header
- (2) 1x6 socket header
- (1) 1x7 socket header
- (2) Nylon PCB Standoff (long)
- (2) Nylon PCB Standoff (short)
- (2) 1x2 Shunt[1] (the +5V header shunts)

(1) Potentiometer bag
- (2) A100k Potentiometer (Input, Insert)
- (3) B100k Potentiometer
- (5) Washer
- (5) Nut
- (5) Knob

(1) Jack bag
- (7) 3.5mm TS jack
- (7) Washer
- (7) Nut

(1) Reference manual (this thing)

1) Shunt vs. jumper: A jumper is a means to route a signal across another signal when it cannot be done directly by trace on the PCB, whereas a shunt is a means of configuring/directing signal flow.

Overview (taken from SoS-E manual)

What is it?

The Sound of Shadows (SoS) is a voltage-controlled (VC) digital delay module based around the PT2399 echo IC[1] from Princeton Technology – which was, by the way, originally designed for Karaoke equipment.

As with all f(h) products, the SoS was engineered towards maximizing functionality while keeping cost as low as possible. If some aspects of the unit seem awkward, it is most likely due to this. The goal is to make unique, useful, enjoyable, and affordable instruments, not just hoover[2] out your bank account.

And remember: every instrument has its quirks and unexpected aspects, so RTFM[3] all the way through! Specific quirks are mentioned in the description of the particular feature they apply to, so please read this through before emailing!

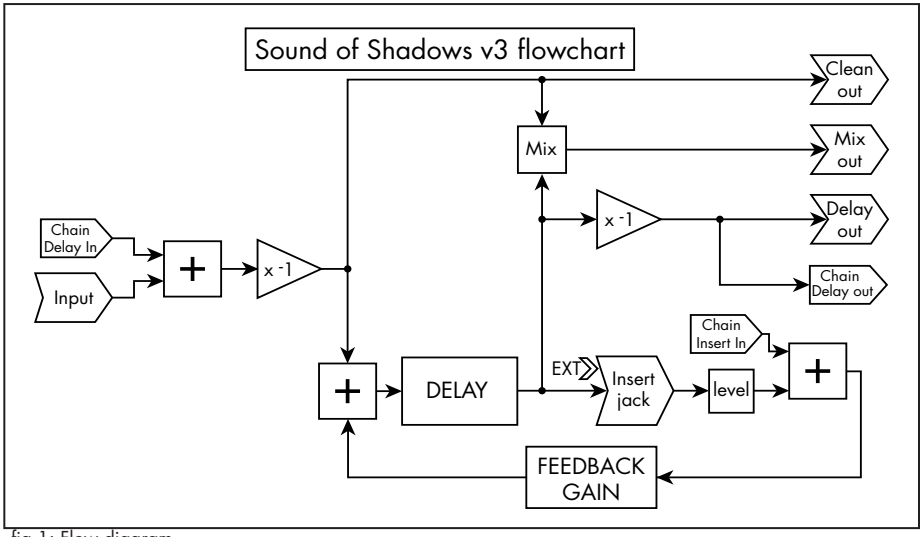


fig.1: Flow diagram.

Feature summary:

- VC delay rate.
- VC feedback level.
- Signal input.
- Clean, Delayed, and Mix outputs.
- Feedback loop insert jack.
- Multiple units can be chained together via rear header.
- Chaining cable available separately.

1) Integrated Circuit
2) Hoover is a company that manufactures vacuum cleaners.
3) RTFM = Read The F*cking Manual!

Overview (cont.)

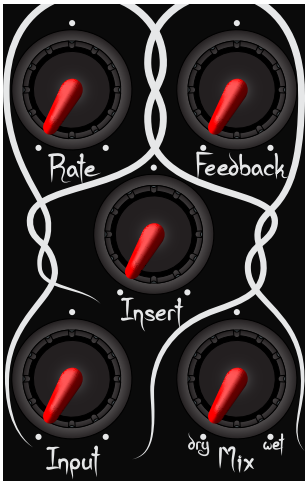


fig.2: Control knobs.

Controls

Rate: This controls the delay clock rate, which in turn controls how fast the delay steps through its memory array and thusly the amount of delay. Clockwise rotation increases the rate (which decreases the delay time), counter-clockwise decreases the rate (which increases the delay time).

Feedback: Controls how much of the delayed signal is fed back into the delay cell. Feedback is what creates a reverberation or echo sound – multiple repetitions of an acoustic event. Clockwise rotation increases the amount fed back, and thus the number of repeats, counter-clockwise decreases the amount. The nominal operating area is between 6:00 and 9:00 during normal usage. More than this will set up a self-propagating feedback cycle that will quickly get out of hand.

Insert: This is the attenuator for the feedback loop insert jack. The jack is situated between the delay cell output and the feedback cell input. The feedback cell input is calibrated for the output of the delay cell, which is around 1.5$V_{p\text{-}p}$ maximum, and most standard signals inserted here will overload the feedback cell unless attenuated, hence the Insert attenuator. Turn clockwise to increase the signal level, counter-clockwise to attenuate.

When not using the Insert jack, it is recommended to keep this control turned *fully clockwise*, to the maximum position. Otherwise, you are attenuating the output of the delay cell, which will affect everything else further down the signal path.

Input: This is the input level control. Just like a volume knob – clockwise increases level, counter-clockwise attenuates the signal level.

Mix: Um, yeah. Guess what this controls? The balance of the mixed signal at the Mix output! Seriously, this controls the mix between the Clean and Delay signals at the Mix jack, really!

Overview (cont.)

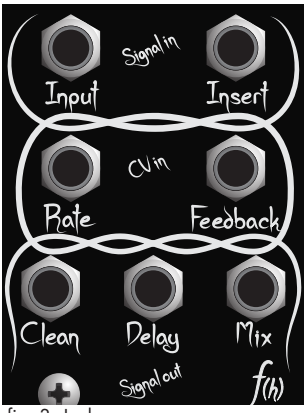


fig. 3: Jacks.

Jacks

The jacks are grouped by the type and direction (into or out of the module) of the relevant signal.

Signal in

Input: This is kind of important for a delay unit: you need a signal to delay, or else they're somewhat dull effects. This is the jack where that signal is input into the delay.

Insert: This is the feedback loop insert breakjack. Inserting a plug here will disconnect the output of the delay cell from the input of the feedback cell, with the inserted signal now going directly to the feedback gain cell.

One use for this is to insert an effect – or even another delay unit (yes, they can be daisy-chained quite effectively) – into the feedback loop. To do this, patch the Delay out into the desired effect, and the output of the effect into the Insert jack. You may need to adjust the Insert level control (see above) for best sound.

CV in

Rate: Quirk warning: Rate CV behavior is inverted. Negative increases rate, positive decreases. If that bugs you too much, just think of it as the delay CV input and the issue magically disappears! Positive increases the delay, and negative decreases the delay.

Feedback: This works normally, positive CV increases feedback, negative decreases same.

Output

Clean: A buffered and inverted copy of the input signal.

Delay: The buffered & scaled output of the delay cell

Mix: A linear mix of the Clean and Delay signals, the balance of which is set by the Mix control pot.

Overview (cont.)

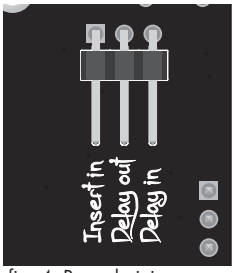


fig. 4: Rear chaining header

Chaining Header

The rear header is to chain two or more SoS together for longer delay times, and other effects, without using up the front jacks. There is one output and two possible inputs (See fig.1 for graphical locations of the connection points.):

Delay out: Buffered, inverted, delay signal output.

Delay In: Equivalent to the Input jack. Chained signal is summed with input signal and sent directly to delay cell with no attenuation (see following Chaining Delay Trimmer section).

Insert in: Equivalent to using the Insert jack, but without breaking signal path. Chained signal is summed with output of Delay and Insert, then sent through the feedback gain cell before entering the delay circuit, allowing signal attenuation.

Chaining Delay Trimmer

During development, it was noticed that overdriving the delay input of the second Sound of Shadows resulted in some delightfully horrific mangling, screeching, and generally cacophanous sounds. However, it could not be the default because it also drove the output up to ±10V, risking damage to connected modules. This trimmer is the compromise.

Want a dangerous, horrendous, mess? Turn it all the way down (counter-clockwise). Want a safe, factory-friendly setting? Turn it all the way up (clockwise). In between? Put it where you want it. To repeat, however, and in officially-legal-sounding words[4] :

WARNING: USE AT YOUR OWN RISK. USE OF THIS FEATURE WILL CAUSE OUTPUT LEVELS THAT ARE NOT COMPATIBLE WITH EURORACK STANDARDS AND WILL DAMAGE SOME MODULES, AND MAY DAMAGE THE REST. FLIGHT OF HARMONY CANNOT ACCEPT RESPONSIBILITY FOR ANY DAMAGE CAUSED BY USE OF THIS FEATURE.

The Chaining Delay Trimmer *only affects the chained signal connected to the Delay In pin* and has no effect on unchained devices.

4) >A.K.A.: Royal Capslock

Overview (cont.)

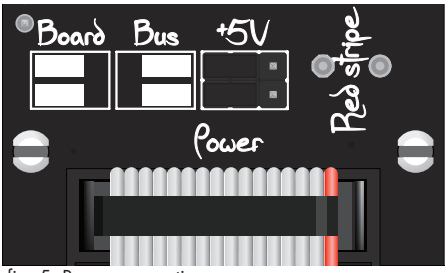


fig. 5: Power connections.

Power

The power connector header is a 2x8/16-pin shrouded box header which accepts the standard Doepfer power cable. This header style is polarized, meaning the connector can only be inserted one way, to prevent connecting the power backwards and damaging the unit.

This assumes that you are using either the supplied cable or one manufactured by Doepfer.

Looking at the rear of the module, the negative supply (red stripe) is on the left, positive supply is on the right (see fig.4).

+5V Source Selection

The Header marked "+5V" allows you to select whether the +5V is supplied by the main +5V power bus or derived internally from the +12V supply. Set the shunts in the position indicated by the PCB legend.

Stuff

A big thank you to those who have sent in suggestions and comments, keep them coming!

Comments, inquiries, samples, suggestions, complaints to:
flight@flightofharmony.com

http://www.flightofharmony.com

By the way, the cover art is a an exercise I did in art class decades ago. One of those where you make gestures with your hand and try to draw them on a pad of paper without looking at the paper, only at your hand. Then you work on it in charcoal afterward and pretend it's real art. I even had to give it a title: "The Guarding Dark".

But hey, it's got shadows so it works for this. Don't judge me.

We are tomorrow's shadows...

Kit Notes

Static Discharge Warning

Some pieces in this kit are static-sensitive and can easily be destroyed by Electrostatic discharge (ESD). Make sure to discharge yourself and your work surface while handling components from the semiconductor card.

How to safely discharge static: Use an ESD wrist strap and work mat. *Do not just connect everything directly to ground;* that just creates a low-resistance path for large currents to discharge through and will cause damage if the static-sensitive component is in the path. ESD wrist straps have a high resistance built in to safely limit the amount of current to below destructive levels. Keep in mind: current does the damage, voltage creates the path for current to flow through.

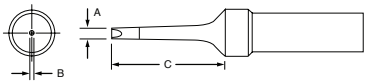
Skills

This kit assumes that you have a basic understanding of electronics, electronic components, and soldering and assembling electronics. Note that this kit is almost entirely Surface Mount Technology (SMT), so the assumption is that you understand how to work with Surface Mount Devices (SMD) and have some experience.

This doesn't mean that you're *completely* on your own, just that I'm not going to hold your hand[1]. Below are a few things to help get you started. Feel free to ignore them.

Assembly Tips

- Use the smallest soldering iron tip that you have. My favorite is the Weller ETR (fig. 6). (Not an endorsement, nor do I get anything from it, it's just a good reference point.)



Narrow Screwdriver

Cat.	A		B		C	
No.	in.	mm	in.	mm	in.	mm
ETR	0.062	1.60	0.044	1.12	0.625	15.90

fig.6: Weller ETR soldering tip

1) For many reasons, but two in particular: First, I'd have to leave my house, and I hate doing that. Second, it's really hard to solder with only one hand.

Kit Notes (cont.)

- Good, fine-tip tweezers are a must. The Wiha 4b and 7a tweezers are great[2].
- One helpful trick for soldering SMD with wire solder is to pre-solder one pad for each component location. Next, hold the component in place and touch your soldering iron tip to the pre-soldered pad to reflow the solder. Then you can solder the other side normally.
- *Flux is your friend.* Use flux. Water-soluble flux is best for a clean finish, but you have to make sure to get it all off when done, as it can corrode the joint and some fluxes may also be capacitive. You can also use no-clean flux.
- *Smallest first.* Solder the components in increasing order of size.
- *Minimize heat exposure.* Heat destroys components, and SMD are particularly sensitive because they have less mass to distribute the heat. Flux helps with this too.
- Use the face plate to line up the potentiometers and jacks before soldering; much easier than resoldering them to line them up correctly afterward.
- Headers: The easiest way to align headers is to plug the related pin and socket headers together, insert them into the circuit boards, then solder. A rubber band — or even some tape — around the boards works to hold them in place if you don't have some small clamps.

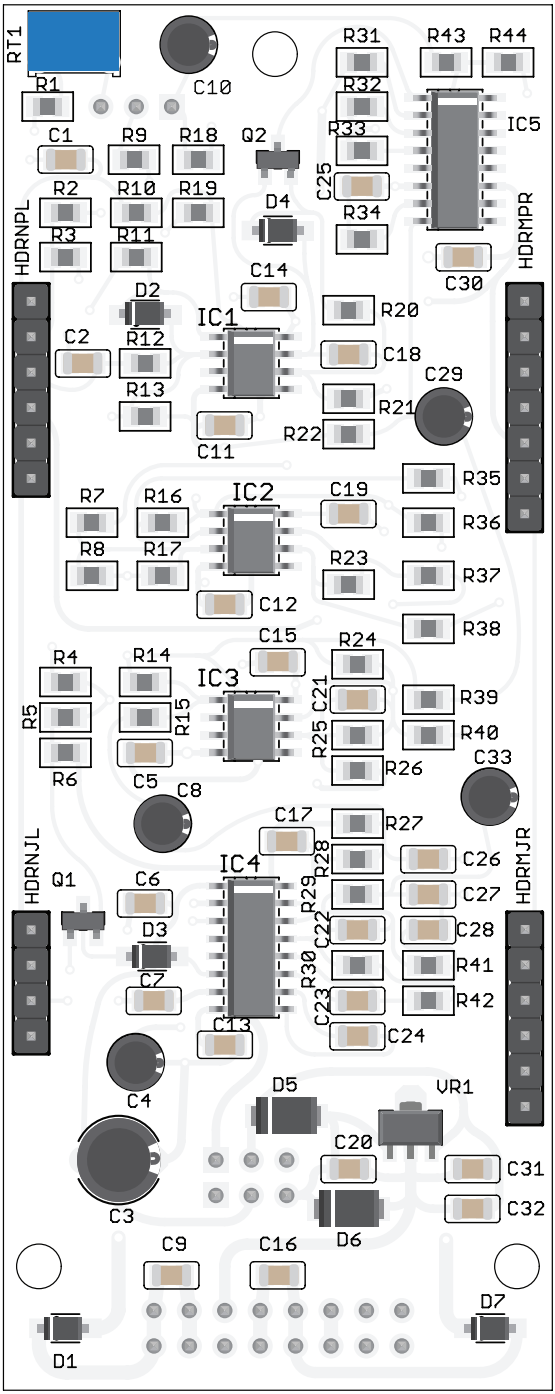
Help

If you're still having problems, email me! I am always happy to help. When emailing, please include high-resolution pictures of your circuit boards.

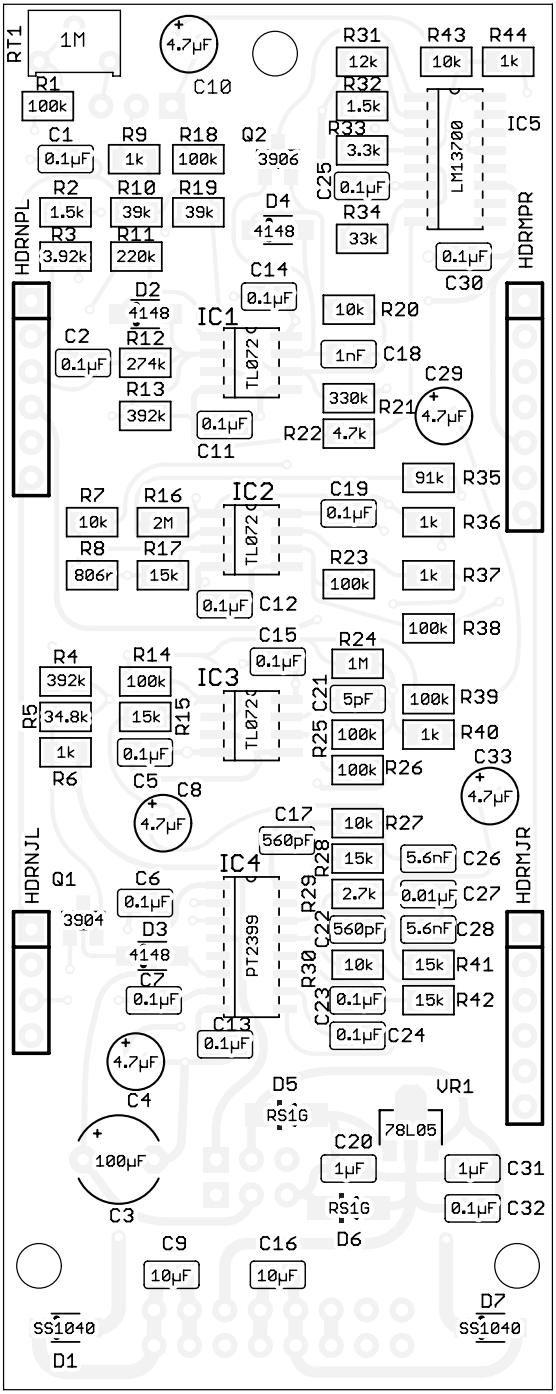
Most of the troubleshooting requests I have received were solved by zooming in and closely examining the pictures. Cold solder joints are sneaky and hard to spot if you haven't dealt with them before. A cold solder joint is where the solder doesn't adhere to both the pad and the component lead, and just flowed around one of them without making contact. They happen, and they suck, but they're easy fixes once you find them.

2) IMO, their 5abb were the best, but they discontinued them so FML. No, you can't have mine.

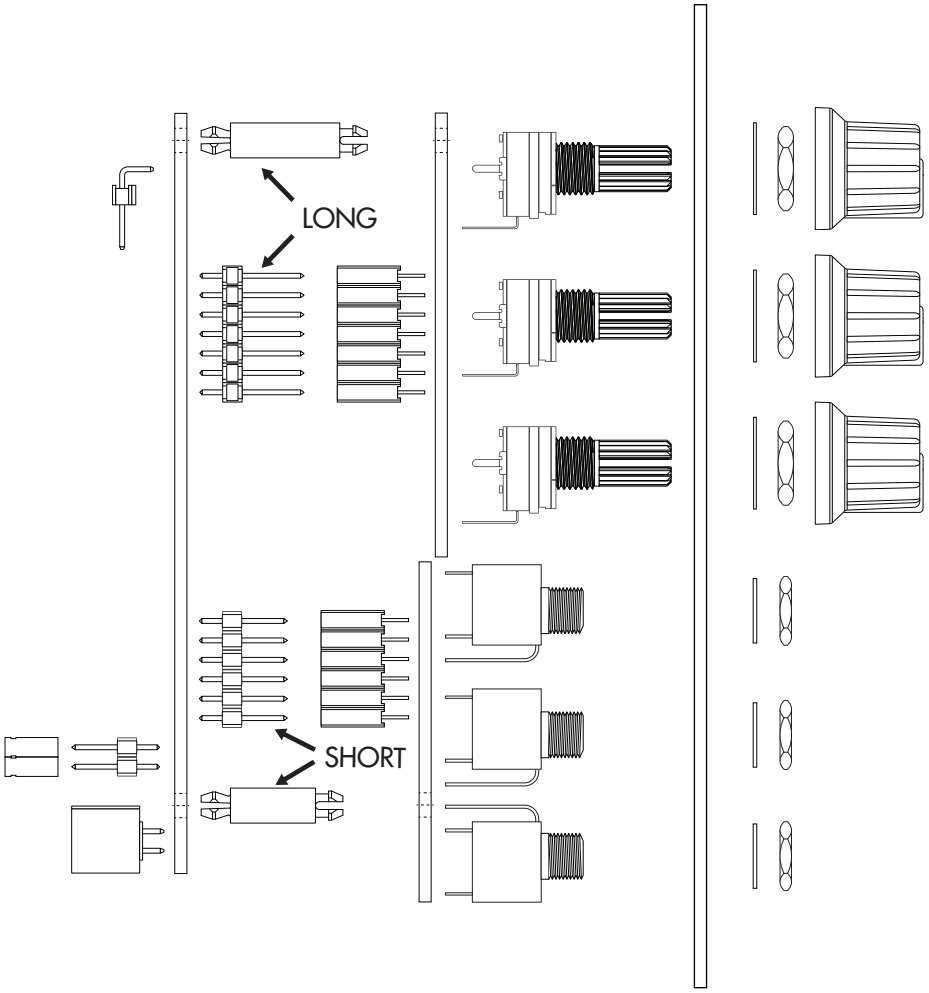
PCB Assembled View



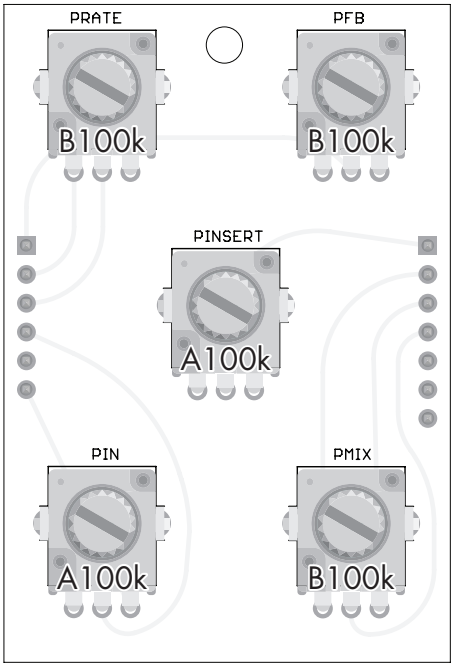
SMD Reference

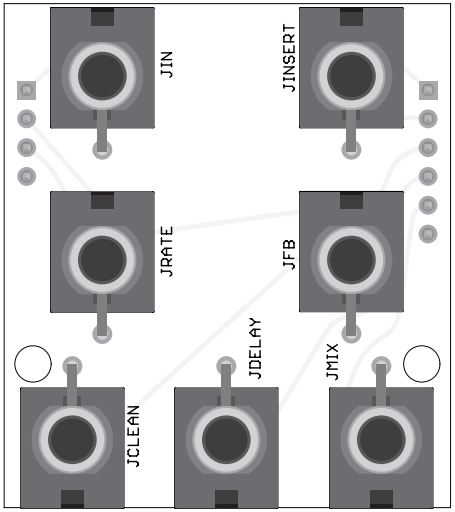


Exploded View

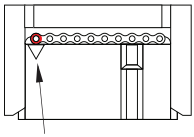


Control & Jack Reference

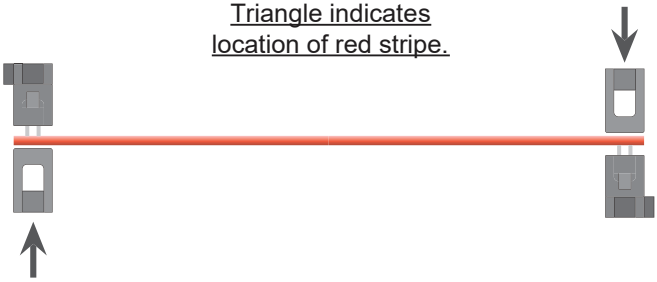




Power Cable Assembly

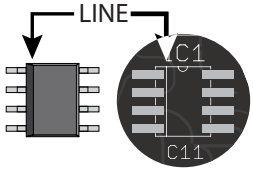


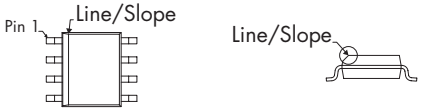
Triangle indicates
location of red stripe.



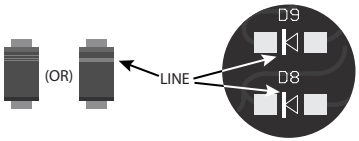
Miscellaneous

IC Orientation





Diode Orientation



Capacitor Orientation