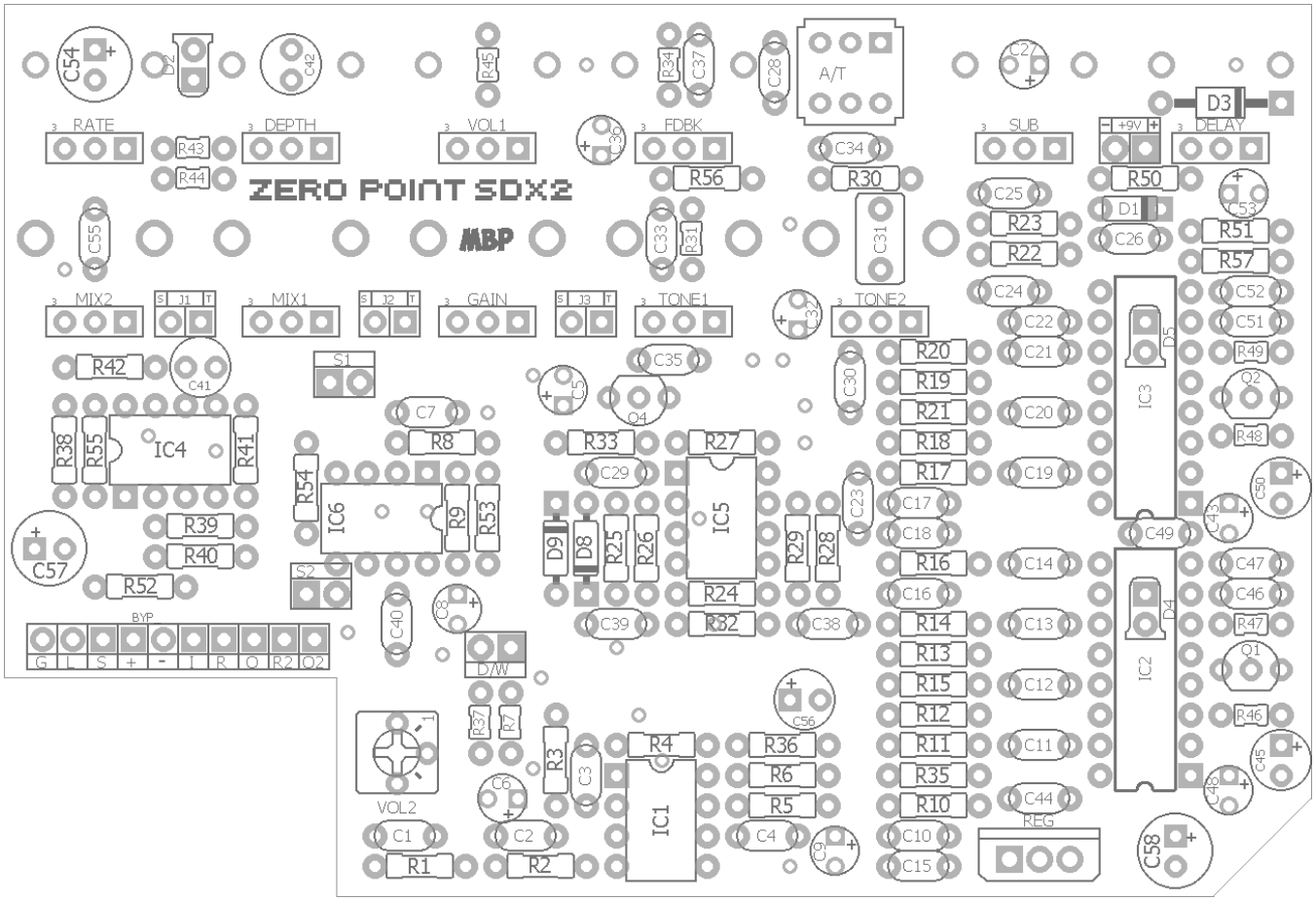
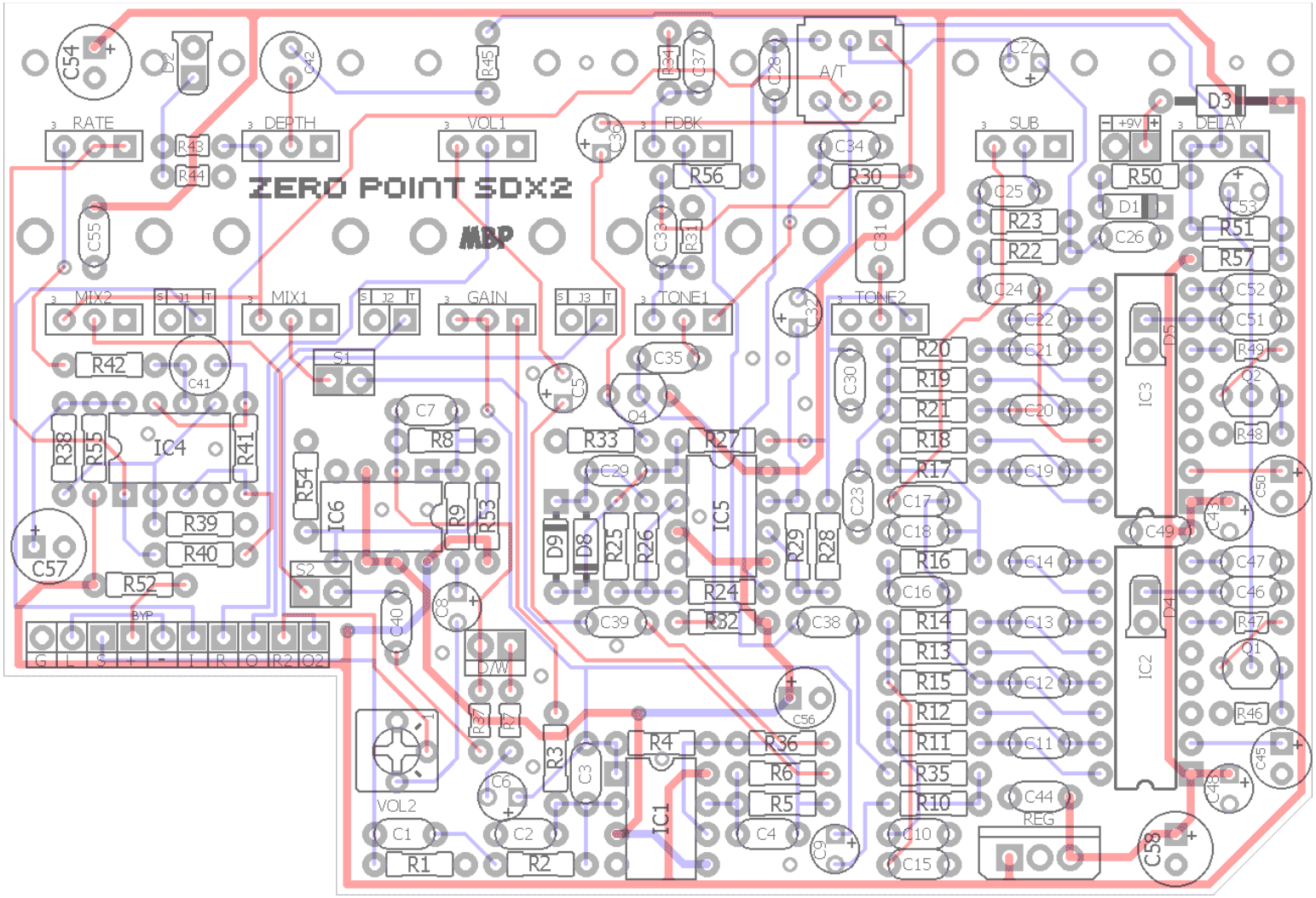
ZERO POINT SDX2

FX Type: Delay

4.325” W x 2.95” H



09/12: Correction to the wiring diagrams. The input signal needs to be re-wired due to a ticking issue with the LFO.


ZERO POINT SDX2
MBP
RATE
DEPTH
VOL1
FDBK
A/T
SUB
+9V
DELAY
MIX2
MIX1
GAIN
TONE1
TONE2
BYP
VOL2
REG
IC1
IC2
IC3
IC4
IC5
IC6
D/W

B.O.M.

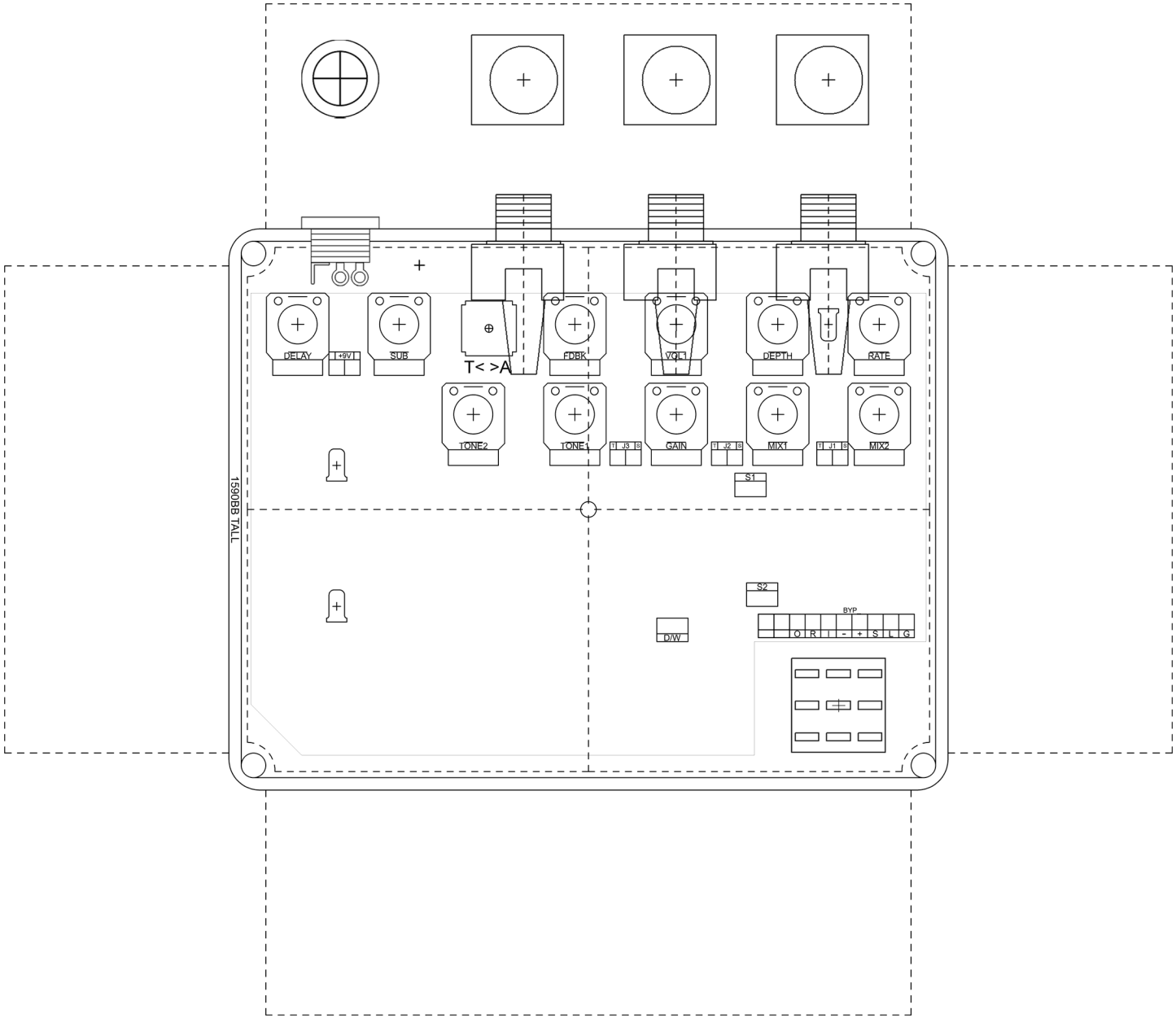
Resistors		Resistors		Caps		Caps		Diodes	
R1	1M	R37	10k	C1	100n	C37	22n	D1	1n914
R2	220k	R38	100k	C2	10pF	C38	220n	D2	LED
R3	100k	R39	100k	C3	100pF	C39	220n	D3	1N5817
R4	22k	R40	1M5	C4	100pF	C40	220n	D4	LED
R5	150k	R41	680k	C5	1uF	C41	1uF NP	D5	LED
R6	1k	R42	22k	C6	1uF	C42	1uF NP	D8	BAT41
R7	22k	R43	1k	C7	100pF	C43	10uF	D9	BAT41
R8	150k	R44	1k	C8	1uF	C44	100n	**Transistors**	
R9	1k	R45	220k	C9	1uF	C45	47uF	Q1	BC550
R10	10k	R46	560R	C10	6n8	C46	100n	Q2	BC550
R11	10k	R47	1k	C11	1n5	C47	100n	Q4	BC550
R12	10k	R48	620R	C12	1n5	C48	10uF	**IC**	
R13	10k	R49	1k	C13	100n	C49	100n	IC1	4558
R14	10k	R50	1k2	C14	100n	C50	47uF	IC2	PT2399
R15	33k	R51	220k	C15	47n	C51	100n	IC3	PT2399
R16	10k	R52	4k7	C16	100n	C52	100n	IC4	TL062
R17	10k	R53	10k	C17	100n	C53	1uF	IC5	TL072
R18	10k	R54	10k	C18	6n8	C54	100uF	IC6	TL072
R19	10k	R55	100R	C19	1n5	C55	100n	**Regulator**	
R20	10k	R56	1M	C20	1n5	C56	10uF	REG	LM7805
R21	33k	R57	1k5	C21	100n	C57	100uF	**Switches**	
R22	4k7			C22	100n	C58	100uF	D/W	SPST
R23	4k7			C23	47n			A/T	DPDT
R24	2k2			C24	100n			**Trimmer**	
R25	4k7			C25	100n			VOL2	100k
R26	2k2			C26	6n8			**Pots**	
R27	1k5			C27	1uF			RATE	1MC
R28	3k3			C28	100n			DELAY	100kB
R29	3k3			C29	6n8			DEPTH	100kB
R30	47k			C30	6n8			FDBK	50kB
R31	22k			C31	470n			GAIN	1MB
R32	1M			C32	1uF			MIX1	50kB
R33	10k			C33	10n			MIX2	50kB
R34	1k			C34	15n			SUB	50kB
R35	12k			C35	100n			TONE1	100kB
R36	10k			C36	1uF			TONE2	10kA
								VOL1	100kA

Shopping List

Value	QTY	Type	Rating	Value	QTY	Type	Rating
100R	1	Metal / Carbon Film	1/4W	1uF	8	Electrolytic	25v min.
560R	1	Metal / Carbon Film	1/4W	1uF NP	2	Electrolytic	25v min.
620R	1	Metal / Carbon Film	1/4W	10uF	2	Tantalum	10v min.
1k	7	Metal / Carbon Film	1/4W	10uF	1	Electrolytic	25v min.
1k2	1	Metal / Carbon Film	1/4W	47uF	2	Electrolytic	25v min.
1k5	2	Metal / Carbon Film	1/4W	100uF	3	Electrolytic	25v min.
2k2	2	Metal / Carbon Film	1/4W	1n914	1		
3k3	2	Metal / Carbon Film	1/4W	BAT41	2		
4k7	4	Metal / Carbon Film	1/4W	LED	1	any color (D2)	3mm
10k	15	Metal / Carbon Film	1/4W	1N5817	1		
12k	1	Metal / Carbon Film	1/4W	LED	2	diffused, green (D4, D5)	5mm
22k	4	Metal / Carbon Film	1/4W	BC550	3		
33k	2	Metal / Carbon Film	1/4W	4558	1		
47k	1	Metal / Carbon Film	1/4W	PT2399	2		
100k	3	Metal / Carbon Film	1/4W	TL062	1		
150k	2	Metal / Carbon Film	1/4W	TL072	2		
220k	3	Metal / Carbon Film	1/4W	LM7805	1	TO-220 style	
680k	1	Metal / Carbon Film	1/4W	SPST	1	mini or regular size	*see notes
1M	3	Metal / Carbon Film	1/4W	DPDT	1	mini size	*see notes
1M5	1	Metal / Carbon Film	1/4W	100k	1	Bourns 3362P	
10pF	1	Ceramic	25v min.	1MC	1	metal shaft	9mm
100pF	3	Ceramic	25v min.	100kB	2	metal shaft	9mm
1n5	4	Film	25v min.	100kA	1	metal shaft	9mm
6n8	5	Film	25v min.	50kB	2	metal shaft	9mm
10n	1	Film	25v min.	1MB	1	plastic shaft	9mm
15n	1	Film	25v min.	10kA	1	plastic shaft	9mm
22n	1	Film	25v min.	100kB	1	plastic shaft	9mm
47n	2	Film	25v min.	50kB	2	plastic shaft	9mm
100n	18	Film	25v min.				
220n	3	Film	25v min.				
470n	1	Film	25v min.				

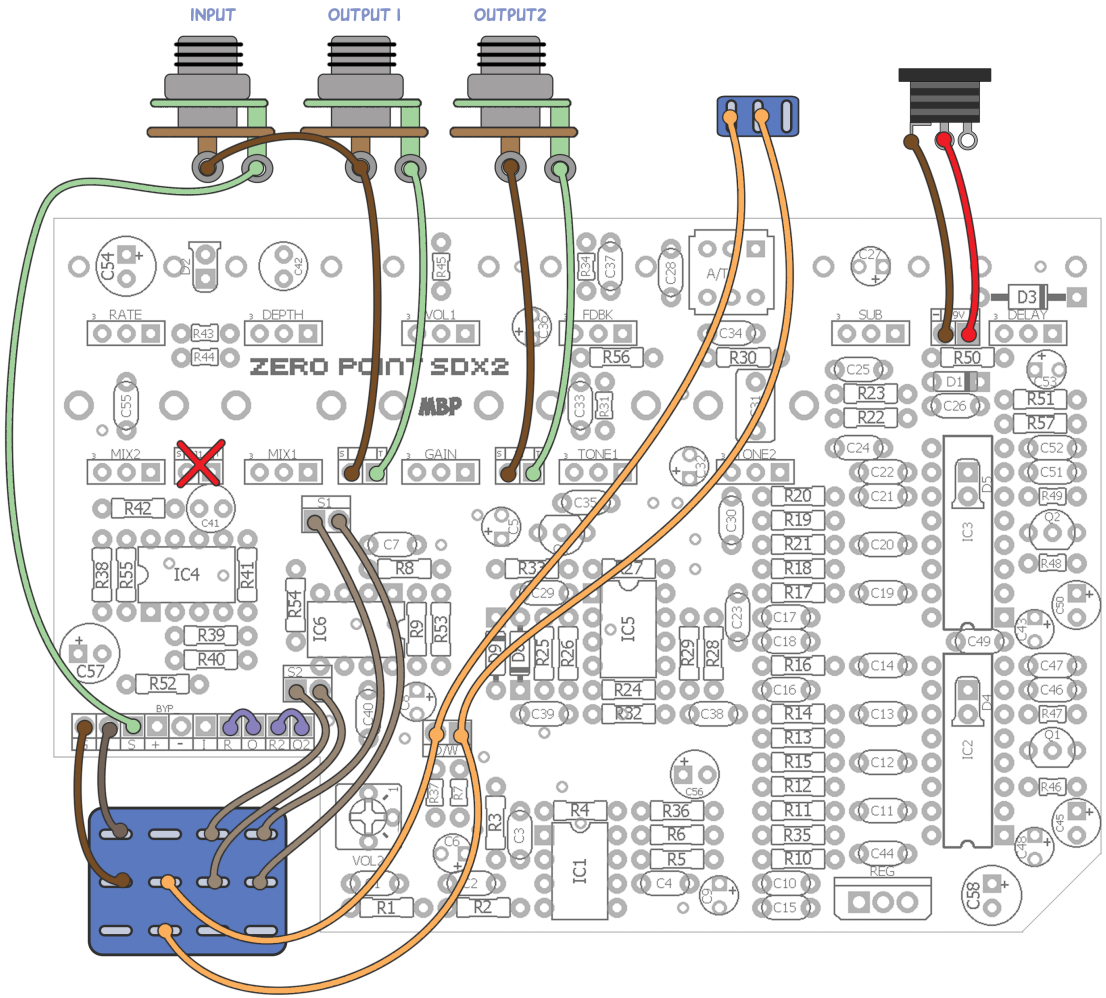
125BB / 1590BB-Tall Drill Guide

7.48” W x 6.47” H



Download the drill template here: http://www.madbeanpedals.com/projects/ZeroPoint/ZPSDX2_DRILL.zip

Stereo Wiring Guide



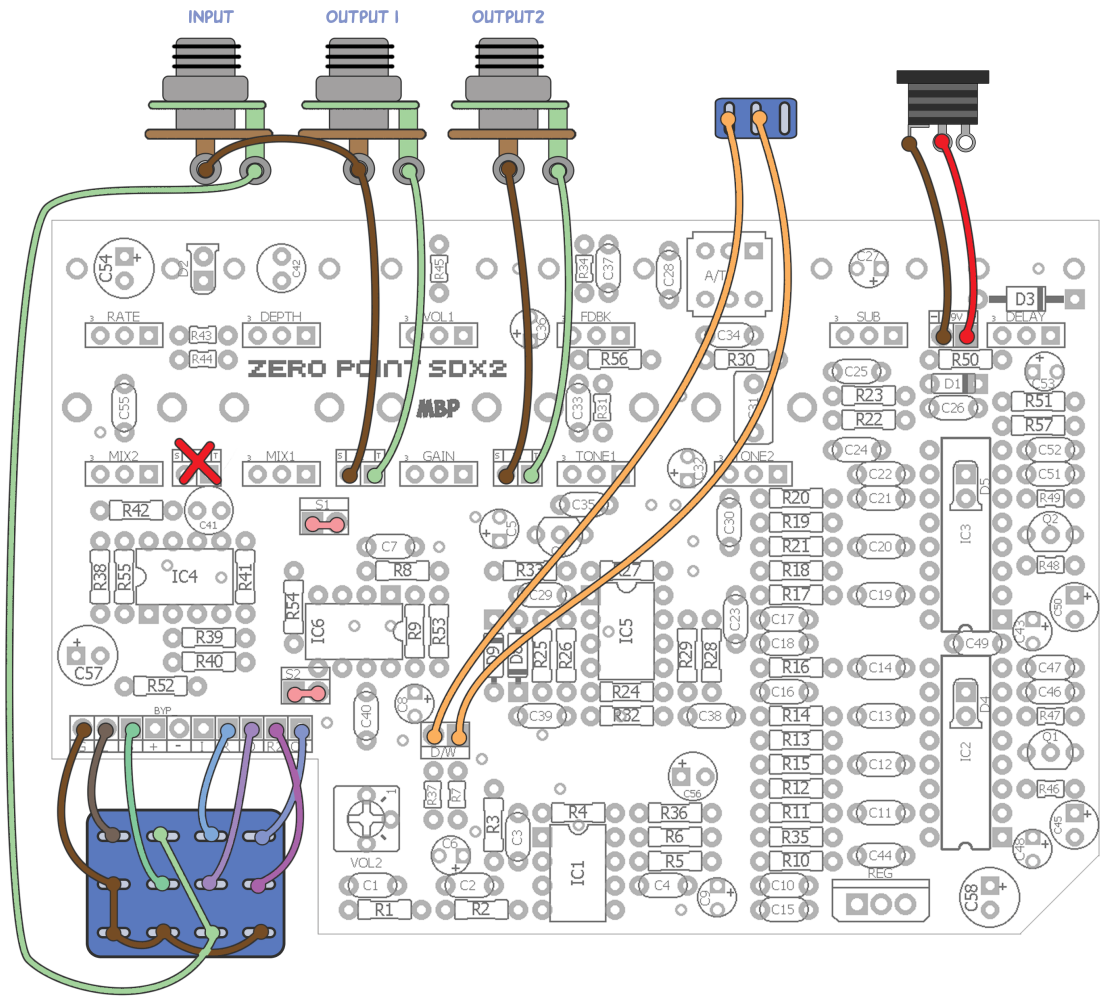
09.12 Correction: J1 input is omitted and the input jack is re-wired as shown.

The first three columns of the 4PDT are wired as normal bypass. The last column grounds the secondary output when the effect is in bypass. With this wiring, the secondary output only works when the effect is on. To have the secondary output active when bypassed, you must wire the ZPSDX2 as non-true bypass (shown below)

If you wish to use mono output only, do the following

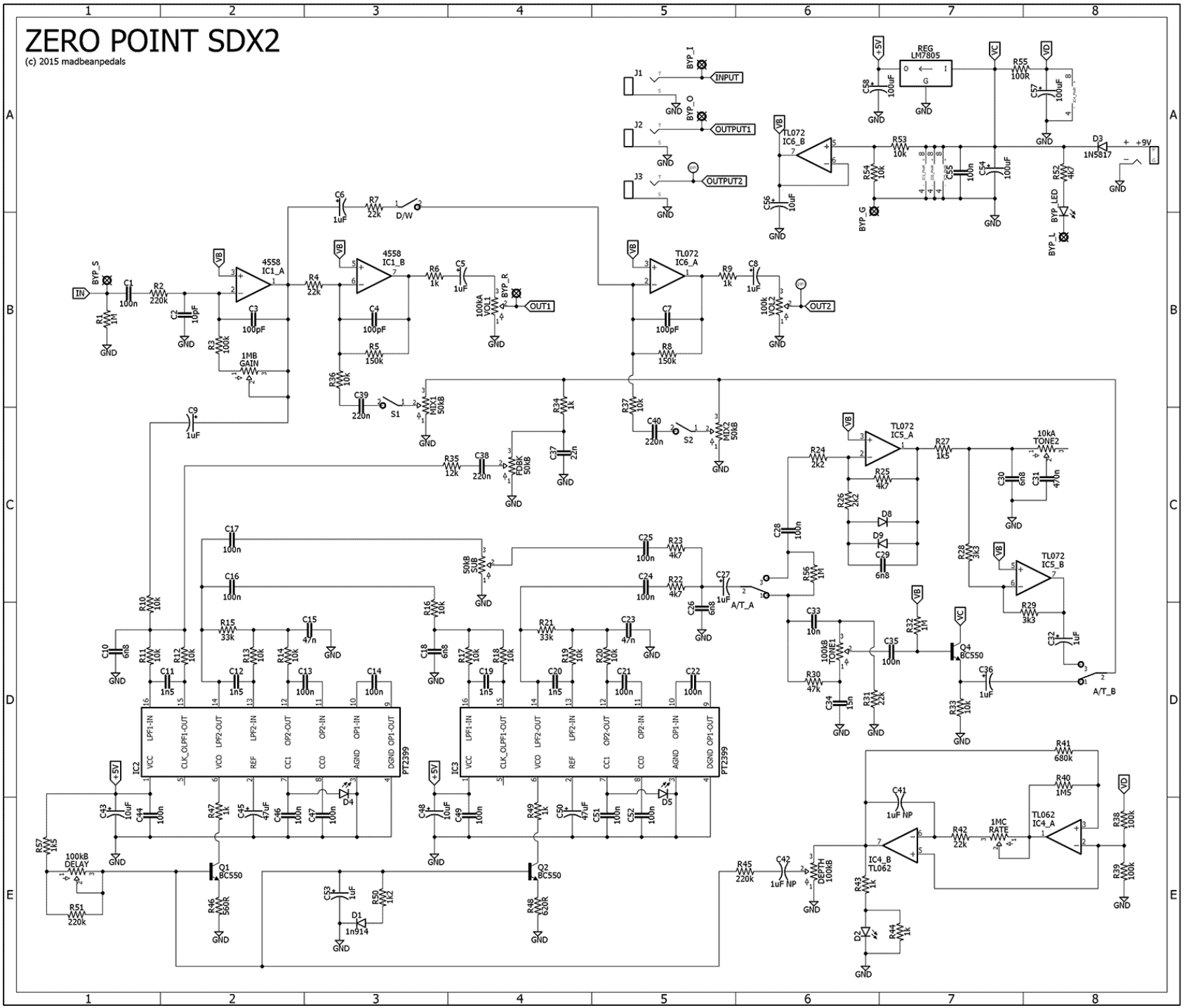
Use a 3PDT footswitch instead of 4PDT. Omit the wiring on the far right column of lugs shown above. Omit C6, C7, C8, C40, R7, R8, R9, R37, the D/W switch and Mix2 pot. You must use IC6, however, since the second half of that IC buffers the Vb rail.

True Bypass Wiring Guide



09.12 Correction: J1 input is omitted and the input jack is re-wired as shown.

In this setup, both outputs are available when the delay is bypassed and you can use the SDX2 to send your guitar to two amps. In bypass Gain, Vol1 and Vol2 are all active and the delay portion disconnects at S1 and S2 as shown on the schematic. Additionally, the D/W switch is shorted so even if you have the second output set to wet only, you will get signal out. If you choose to use this setup, you should consider making the Vol1 trimmer an external pot. The only reason this was not done on the layout was there was no room left for another PCB mounted pot.


ZERO POINT SDX2
(c) 2015 madbeanpedals
REG LM7805
TL072 IC6_B
TL072 IC6_A
4558 IC1_A
4558 IC1_B
TL072 IC5_A
TL072 IC5_B
TL062 IC4_A
IC4_B TL062
PT2399
IC2
IC3
INPUT
OUTPUT1
OUTPUT2
OUT1
OUT2
BYP_I
BYP_O
BYP_S
BYP_R
BYP_G
BYP_LED
BYP_L
1MB GAIN
100kA VOL1
100kA VOL2
50kB MIX1
50kB MIX2
50kB SUS
10kA TONE1
10kA TONE2
100kB DELAY
100kB DEPTH
1MC RATE
D/W
S1
S2
A/T_A
A/T_B
BC550
1N5817
1n914
+9V
+5V
VB
VC
VD
GND

Notes on parts

9mm Right Angle, Metal Shaft: http://smallbear-electronics.mybigcommerce.com/alpha-single-gang-9mm-right-angle-pc-mount/
9mm, Right Angle, Plastic Shaft: http://smallbear-electronics.mybigcommerce.com/alpha-single-gang-9mm-right-angle-pc-mount-w-knurled-plastic-shaft/
On/On DPDT mini switch: http://smallbear-electronics.mybigcommerce.com/dpdt-on-on-0223/
On/On SPDT mini switch: http://smallbear-electronics.mybigcommerce.com/spdt-on-on-mountain-10tc410/
4PDT foot-switch: http://smallbear-electronics.mybigcommerce.com/switch-green-4pdt-stomp/
125BB / 1590BB Tall Enclosure: http://smallbear-electronics.mybigcommerce.com/125-bb/
LM7805: http://www.mouser.com/ProductDetail/Fairchild-Semiconductor/LM7805CT/?qs=sGAEpiMZZMtdAabcSkQOlwJydEoyhc9b
BAT41: http://www.mouser.com/ProductDetail/STMicroelectronics/BAT41/?qs=sGAEpiMZZMtQ8nqTKtFS%2fD9SVzsgHTKGVhtfSAF%252bRj4%3d
Bourns 3362P: http://www.mouser.com/ProductDetail/Bourns/3362P-1-104LF/?qs=sGAEpiMZZMvygUB3GLcD7l39JMs%2f%2f%2fLOs09gVZSzi2c%3d

- If you are unable to get either of the two mini switches suggested, you may be able to use regular size switches. There is a gap between the top of the PCB and the enclosure wall which might fit one or both of the larger switches. Please be careful if you do this and adjust the drilling template accordingly.

- There are two 10uF tantalum caps listed in the BOM. Tantalum is chosen here because the datasheet recommends them for decoupling the PT2399 chips. If you are unable to get those, just use electrolytic. It will work fine.

- It is imperative that you purchase your PT2399 chips from a reliable source. There are bad chips out there, including fakes believe it or not. I strongly recommend sticking to smallbear or other reliable sources for them. I'm not so sure about Tayda; they are cheaper but possibly some of their parts are out of spec. YMMV.

- There are two non-polar electrolytic 1uF caps listed in the BOM. If you cannot get these use film. You may need to bend leads on film caps to get them to fit, but there should be enough room on the PCB for it to work.

- If you can't get BAT41 for the two Tape mode diodes, use 1n914. Note that these will not saturate as much as BAT41.

- You will want to use small diameter knobs for this build. Here are the two styles I recommend:
  http://smallbear-electronics.mybigcommerce.com/aluminum-vertical-knurl-black-index/?page_context=category&faceted_search=0
  http://smallbear-electronics.mybigcommerce.com/fluted-miniature-black-pointer/?page_context=category&faceted_search=0

Am I insane? Better question: how insane are you? Because this thing has 11 knobs, plus two switches and a bunch of other stuff. Why so much? Well, if you have to ask yourself that then this is not the project for you. This project is for the real die-hard DIY'er; the one that wants everything on the front panel no matter how ridiculous it may look. And, I am right there with you!

Much of the original ZPSDX1 has been re-used, but a good bit has been streamlined for the Zero Point SDX2. New features have been added based on builder commentary and feedback. Here's the drill-down:

- Two PT2399 delay chips in series for about 1 sec. or more of usable delay.
- Longer delay time than the SDX1
- Two repeat modes, Analog and Tape, with individual controls for tone shaping. The analog mode is based on a Big Muff™ tone control. The Tape mode is based on the Ibanez DE-7™.
- Dual-mono output with independent mix controls as well as the option for wet-only on the second output.
- Modulation with Rate and Depth controls.
- Subdivision output for eighth notes.
- Input Gain and Output controls.
- Two bypass methods; one for true bypass and one for "always on" stereo output.
- Easier to build than ZPSDX1 due to the elimination of the rotary switch/daughter board.

Short of tap tempo control, this should be just about everything you would ever need in a PT2399 type delay. And, while this may look like a very complicated build, anyone who has built a PT2399 delay before should be able to handle this without too much distress.

Changes from the prototype

There are two changes in the production SDX2 from the initial prototype board (a few of these were offered for sale during the development phase of this project).

Filtering around the two PT2399 chips was increased. The reason is 1) it reduces noise at longer delay times and 2) it gives the repeats more of a mids focus which will sit better in a full band mix. As with any PT2399 delay, there is always a compromise between noise and delay time. These chips are just plain noisy, with some being more noisy than others. The amount of filtering chosen here sounds like the best compromise between the two to my ears. If you built a prototype board and want to implement the change do the following: increase C10 and C18 to 6n8, C15 and C23 to 47n.

The second change was to reverse the operation of the Tone2 control so that it goes from darkest to brightest like the Tone1 control. The value of the pot was also changed from linear to audio to spread out the range more evenly.

Note: The prototype boards required two other fixes which have been implemented on the production boards.

Controls

There are two rows of controls. The top row has is made up of the most important and most often tweaked controls. This row uses knobs. The bottom row is for the lesser tweaked controls and are the small plastic shaft type pots which require no knobs.

Top Row

DELAY - The total amount of delay from slap-back to about 1sec. or more.
SUBD – The volume level of eighth note subdivisions on the delay repeats.
FDBK – The number of delay repeats from one up to self oscillation.
VOL1 – The total output of wet and dry to the primary output.
DEPTH – The intensity of delay modulation.
RATE – The speed of the delay modulation.

Bottom Row

TONE2 – This changes the tone of the Tape mode. Left is darkest and right is brightest.
TONE1 – This changes the tone of the Analog mode. Left is darkest and right is brightest.
GAIN – Sets the total gain from at the input of the circuit. This can be used to drive the delay section into more saturation.
MIX1 – Sets the volume of the delay and repeats for the primary output.
MIX2 – Sets the volume of the delay and repeats for the secondary output.

There are also two switches and a trimmer

VOL2 – The total output of the wet and dry signal to the secondary output.
D/W – This switch lets you choose between dry/wet or wet only on the secondary output. It can be used to send delay only to a second amp.
A/T – This switch toggles between the Tape and Analog modes. The Tape mode is left and Analog is right.

Build Guide

The two green LED's, D4 and D5, are soldered to the bottom of the PCB. Make sure you solder these in before adding IC sockets for the two PT2399s on top.

R35 sets the maximum amount of feedback for the delay when FDBK is all the way up. Lower this value to make the FDBK control go into self-oscillation at an earlier point. Raise the value to push oscillation further to the right on the control. Note that the point of self-oscillation will also depend on where your tone controls are set. Darker tone settings will oscillate only at very high feedback settings, if at all.

R36 and R37 set the maximum amount of delay *volume* going to output1 and output2. To increase this amount, lower these values. They are set so that the delays can be made slightly louder than the dry signal when the Mix knobs are all the way up. For more output, lower them to 4k7.

R45 sets the minimum intensity of the modulation depth. The Depth control is very sensitive in the first 1/3rd. This allows for a wide range of modulation depth (up to rather absurd amounts). The reason for the wide range is to give small amounts of modulation when the delay is long and

large amounts of modulation when the delay is short (to get chorus type sounds). You can alter the minimum intensity of the modulation by increasing R45. Suggested value is 470k or even 1M.

D2 is the external speed indicator for the modulation. A 3mm diffused is best for fit. Use any color you like here.

You should be able to sub other transistors for the BC550 but *I do recommend them*. Make sure you know the correct orientation if you do sub transistors. The pinout for the BC550 is 180° from 2N5088.

The DPDT is a mini switch and the threads are actually a bit short. If you solder the switch totally flush to the PCB you will have just enough thread for the nut on the top side of the enclosure, but not a washer. This is okay because all the other pots hold everything together. If you want a bit more thread to work with, then put a small spacer under the switch before soldering.

The Delay pot has been increased from 50kB to 100kB for the SDX2. This is further limited by the 220k resistor in parallel with it. The longer delay times are suited for darker settings on the tone controls and can go up to one second or more. More moderate settings on the delay (less than 800ms) will work fine for any of the tone control settings. If you are a real lo-fi junky you can omit the 220k resistor for even more delay but keep it away from small children and hipsters at that point.

I suggest you over-drill the holes for the plastic shaft pots. If you are using a step bit, go over one or two stops (but not more than that). The reason is that just a slight amount of surface contact between the enclosure and the shaft will make it very hard to turn. Overdrilling it a bit will ensure this is not a problem. Also, you should deburr the drilled holes with a tool or an Xacto knife.

As with any complicated effects project there are multiple opprotunites to mess it up. Take your time and check your component values *before* you solder them. Do a cusory voltage check when you first fire it up. And most of all – DON'T BOX IT UNTIL YOU KNOW IT IS WORKING!

Voltages

IC1		IC2		IC3		IC4		IC5		IC6	
1	4.57	1	4.94	1	4.94	1	vaires	1	4.56	1	4.56
2	4.57	2	2.39	2	2.39	2	4.4	2	4.56	2	4.56
3	4.57	3	0	3	0	3	vaires	3	4.56	3	4.56
4	0	4	0	4	0	4	0	4	0	4	0
5	4.57	5	2.88	5	2.88	5	4.4	5	4.56	5	4.56
6	4.57	6	2.37	6	2.37	6	4.44	6	4.56	6	4.56
7	4.6	7	0.71	7	0.71	7	vaires	7	4.56	7	4.56
8	9.13	8	0.73	8	0.72	8	8.8	8	9.13	8	9.13
		9	2.39	9	2.39						
		10	2.39	10	2.39						
		11	2.39	11	2.39						
		12	2.39	12	2.39						
		13	2.39	13	2.4						
		14	2.37	14	2.37						
		15	2.39	15	2.39						
		16	2.39	16	2.39						

The base and emitter voltages on the two current sink BC550 transistors will change with different delay settings, but the collectors should read about 2.29vDC.

Bonus: you can run the SDX2 at 18vDC if you followed the recommend capacitor ratings. Try it out!