Cosmos Delay

Based on:
Sagan Delay Roland Space Echo

Effect type:
Triple Delay

Build difficult:
Advanced

Number of parts:
High, 131 components

Technology:
PT2399 delay

Power consumption:
9V

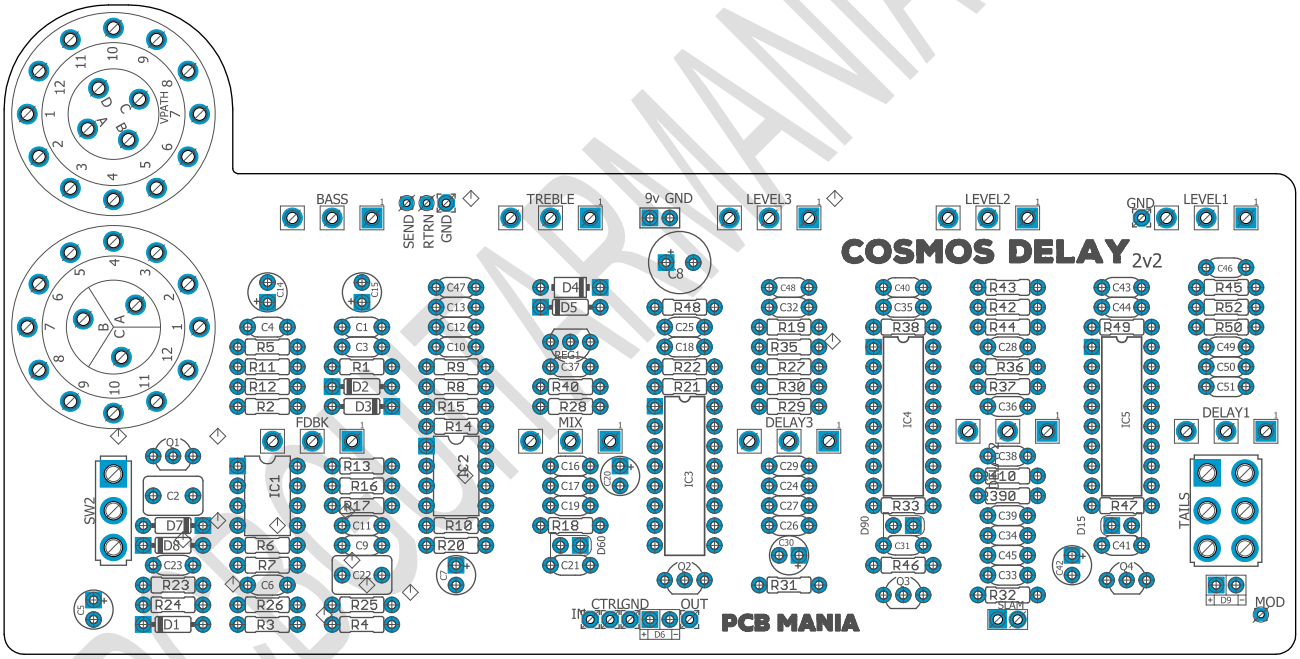
Enclosure type:
1590DD

Get your board at:
Cosmos Delay

Get your kit at:
Das Musikding (Europe)

Project overview:

The Cosmos Delay is a triple-head PT2399 delay, inspired by Roland Space Echo, Designed by Chris Carter. Only available as a PCB Guitar Mania DYI.



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Introduction

The Cosmos delay is a very complex circuit that emulates de features of the Roland Space Echo using PT2399 instead of tape like the original.

Let's explain how this circuit works following the signal path:

- **VPATH switch**: allows you to dial different configurations using the Send and Return loops. Check below for the wiring instructions for the Send & Return jacks.
    - 1st position: Dry signal goes to the first opamp unaffected, while SEND-RETURNloop is enabled right before the mix pot.
    - 2nd position: Dry signal goes first through the send return pads before entering the delay circuit. Great for using some reverbs in front of the delay.
    - 3rd position: Bypasses the send return pads and goes directly into the delay circuit. To access this position, you must place jumpers in between pads 3 to 6 and 9 to 12.

    You can connect basically any effect you want on the loop, including:

    - Phaser
    - Reverb
    - Chorus
    - Flanger
    - Whammy
    - Octave
    - Overdrive
    - Fuzz
    - Envelope filter
    - Or even more delays for extra madness!

- **Dry Kill Switch (SW2):** Cuts off the clean signal path, leaving only the delay sounds audible.

- **Buffered Bypass & Tails switch:** The Cosmos Delay features a buffered bypass that allows you to have a "tails" effect even when the pedal is switched off. **THIS SWITCH HAS TO BE PLACED OFF-BOARD.**
  You can also wire this pedal as a true bypass and keep some sort of tails feature, as we explain below in the wiring guide (link to this section on the document).

- **Slam switch**: Momentary SPDT footswitch' When engaged, this footswitch temporarily sets the delay feedback to its maximum, enabling you to dive into the wormhole of self-oscillation madness.

- **Mod pad:** This pad is great for experimentation with an LFO circuit and includes external controls for modulation, such as, Rate, depths and square wave. We will soon prepare an external board for this and we might do another revision of the cosmos featuring this on board.
  The connection is made directly to the first PT2399 chip. When all the delay chips are synchronized, the modulation will impact all of them. However, if a PT2399 chip operates independently from the first one, its current will remain unaffected.

- **3 independent delays in series with time and level controls**:
  The PT2399 delay times are regulated through current mirroring when they are synchronized with each other. However, the real magic happens as each successive PT2399 receives its input signal from the output of the preceding PT2399, beautifully emulating the staggered playback heads of a Roland Space Echo.
  To further enhance the versatility, each PT2399 output comes with its own dedicated LEVEL pot. While the Space Echo relied on a rotary selector to determine which tape heads were used, this innovative design offers a more nuanced approach. It allows for a wider range of volume options per delay chip, granting you the ability to create intricate and subtle delay rhythms that go beyond simple on/off functionality.

- **Delay sync rotary switch (SW1):** allows you to select which delays are synchronized with the first PT2399 chip. When one or both of the subsequent PT2399s are synced to the first chip, their delay parameters are controlled by the DELAY knob of the first PT2399. Unsynced PT2399 retains its own independent control using its dedicated DELAY pot.
  This functionality can be likened to the ability to manipulate individual tape heads on a Space Echo, resulting in intricate and funky rhythmic patterns. By experimenting with the DELAY SYNC feature, you can introduce captivating swing and add interesting variations to your delay line.

  Here is how the rotary works in practice:
  - 1st position: All delays are un-sync; each delay pot works independently.
  - 2nd position: All delay heads are in sync. Use delay 1 to control all of them.
  - 3rd position: delay 1 and 2 synchronized, delay 3 independents
  - 4th position: delay 1 and 3 synchronized, 2 independents.

- **Symmetrical clipping diodes:** The wet signal out of the delay section passes through clipping diodes to add some grit and dirt on the sound that resembles the quality of old tapes.

- **Baxandall EQ:** This section provides a significant reduction in highs and a subtle boost in lows for the delay signal. The TREBLE pot's aggressive cut introduces a warm, worn tape sound while also helping to control the digital noise produced by the PT2399s at longer delay times. The BASS control adds body to your wet signal.

- **Mix control:** At the end of the circuit, the wet signal passes once more through the VPATH rotary before landing on the MIX Pot, along with the clean signal before the final output.

Controls

Potentiometers

- Bass
- Delay1
- Delay2
- Delay3
- FDBK
- Level 1
- Level 2
- Level 4
- Mix
- Treble

Switches

- DCTRL
- DRYKILL
- VPATH
- Slam

Bill of materials

Resistors	
Part	**Value**
R1	22k
R2	1m
R3	1k
R4* **	**Empty**
R5	3k9
R6	470k
R7	1m
R8	2k2
R9******* **	**3k6**
R10	10k
R11	10K
R12	10K
R13	820r
R14	1k5
R15******* **	**33k**
R16	10k
R17	10k
R18	1k
R19	7k5
R20	7k5
R21	10k
R22	10k
R23	5k1
R24	10k
R25	10k
R26	10K
R27	20k
R28	2k2
R29	10k
R30	10k
R31	560r
R32	560r
R33	1k
R35	10k
R36	10k
R37	20k
R38	10k
R40	2k2
R42	10k
R43	10k
R44	10k
R45	7k5
R46	560r
R47	1k
R48	2k2
R49	20k
R50	10k
R52	10k
R390	10k
R410	10k

Capacitors	
Part	**Value**
C1	82n
C2	1u
C3	6n8
C4	100n
C6	100n
C9	100n
C10	3n3
C11	220p
C12	100N
C13	220n
C16	100n
C17	100n
C18	1n
C19	100n
C21	100n
C22	1u
C23	220n
C24	100n
C25	100n
C26	100n
C27	100n
C28	1n
C29	1n
C31	100n
C32	47n
C33	100n
C34	47n
C35	100n
C36	1n
C37	100n
C38	100n
C39	100n
C40	4n7
C41	100n
C43	100n
C44	1n
C45	100n
C46	47n
C47	100n
C48	100n
C49	1n
C50	100n
C51	100n

Electrolytic Capacitors	
Part	**Value**
C5	10u
C7	1u
C8	220u
C14	47u
C15	47u
C20	47u
C30	47u
C42	47u

Potentiometers	
Part	**Value**
BASS	100k B
DELAY1	500k A
DELAY2	500k A
DELAY3	500k A
FDBK	500k A
LEVEL1	10k B
LEVEL2	10k B
LEVEL3	10k B
MIX	50k B
TREBLE	100k B

IC	
Part	**Value**
IC1	TL072
IC2	TL072
IC3	PT2399
IC4	PT2399
IC5	PT2399

Transistors	
Part	**Value**
Q1*	**2N5457**
Q2**	**BC550**
Q3**	**BC550**
Q4**	**BC550**

Switches	
Part	**Value**
SW1	3PDT ROTARY
SW2	SPDT On/On
VPATH	4P3T ROTARY
TAILS*****	**Empty**
SLAM****	**SPDT MOMENTARY FOOTSWITCH On/On**

Voltage Regulators	
Part	**Value**
REG1	LM78L05

Diodes	
Part	**Value**
D1	1n4148
D2	1n914
D3	1n914
D4	1N4001
D5	1N4148
D6	3mm LED
D7	1n914
D8	1n914
D9***	**Empty**
D15***	**3mm LED**
D60**	**Empty**
D90**	**Empty**
LED	3mm LED

Shopping list

Resistors		
Qty	**Value**	**Parts**
21	10k	R10, R11, R12, R16, R17, R21, R22, R24, R25, R26, R29, R30, R35, R36, R42, R43, R44, R50, R52, R390, R410
4	1k	R3, R18, R33, R47
1	1k5	R14
2	1m	R2, R7
3	20k	R27, R37, R49
4	2k2	R8, R28, R40, R48
1	3k9	R5
1	470k	R6
3	560r	R31, R32, R46
1	5k1	R23
3	7k5	R19, R20, R45
1	820r	R13
1	22k	R1
1	33k	**R15**********
1	10k	R38
1	3k6	**R9**********

Capacitors		
Qty	**Value**	**Parts**
25	100n	C4, C6, C9, C12, C16, C17, C19, C21, C24, C25, C26, C27, C31, C33, C35, C37, C38, C39, C41, C43, C45, C47, C48, C50, C51
8	1n	C2, C22, C18, C28, C29, C36, C44, C49
2	220n	C13, C23
1	220p	C11
1	3n3	C10
3	47n	C32, C34, C46
1	6n8	C3
1	4n7	C40
1	82n	C1

Electrolytics Capacitors		
Qty	**Value**	**Parts**
1	10u	C5
1	1u	C7
1	220u	C8
5	47u	C14, C15, C20, C30, C42

Potentiometers		
Qty	**Value**	**Parts**
2	100k B	BASS, TREBLE
3	10k B	LEVEL1, LEVEL2, LEVEL3
4	500k A	DELAY1, DELAY2, DELAY3, FDBK
1	50k B	MIX

IC		
Qty	**Value**	**Parts**
3	PT2399	IC3, IC4, IC5
2	TL072	IC1, IC2

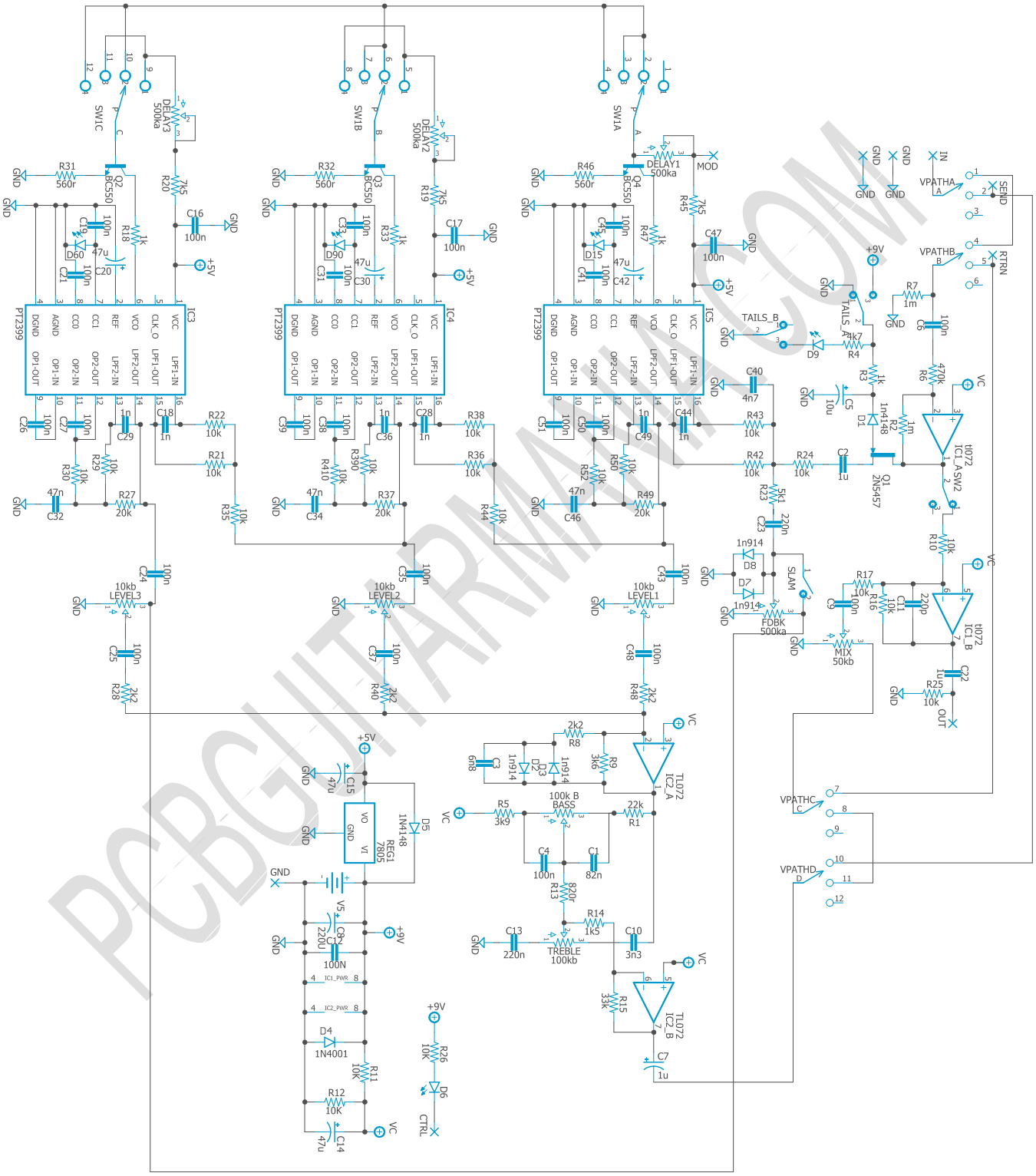
Transistors		
Qty	**Value**	**Parts**
1	2N5457	**Q1***
3	BC550	**Q2, Q3, Q4****

Switches		
Qty	**Value**	**Parts**
1	3PDT ROTARY	SW1 - DCTRL (Delay Sync)
1	SPDT On/On	SW2 - DRYKILL
1	4P3T ROTARY	VPATH
1	SPDT MOMENTARY FOOTSWITCH On/On	**SLAM******

Voltage Regulator		
Qty	**Value**	**Parts**
1	LM78L05	REG1

Diodes		
Qty	**Value**	**Parts**
2	1n4148	D1, D5
4	1n914	D2, D3, D7, D8
1	1n4001	D4
3	3mm LED	LED, D6, **D15*****

Schematic


SW1C
SW1B
SW1A
DELAY3 500ka
DELAY2 500ka
DELAY1 500ka
MOD
IC3
IC4
IC5
PT2399
LEVEL3 10kb
LEVEL2 10kb
LEVEL1 10kb
FDBK 500ka
MIX 50kb
BASS 100k B
TREBLE 100kb
TAILS_B
TAILS_A
VPATHA
VPATHB
VPATHC
VPATHD
IN
SEND
RTRN
OUT
SLAM
CTRL
IC1_ASW2
IC1_B
IC2_A
IC2_B
REG1 7805
D4 1N4001
D5 1N4148
D6
Q1 2N5457
GND
+5V
+9V
VC
PCBGUITARMANIA.COM

Components Recommendations

As many people like to experiment with some pedals with higher voltage, always ensure your **electrolytic capacitors'** max tolerance is over 25v.

This board has been tested using Film box capacitors for most of the values over 1nf and ceramics discs for those under 1nf. However, high-quality components such as Wima's Capacitors and Panasonic's electrolytics can deliver a better performance.

All the resistors used for testing this project are 1/4W Metal Film.

The BOM and Shopping list are exclusive regarding this project. It doesn't include all the hardware like the 3PDT bypass switch, audio/dc jacks, enclosure, etc.

Build Notes

If this is one of your first projects, I recommend you to take a look at our Pedal Building Guide.

For a successful and tidy build, it's recommended the following order:

1. Resistors & diodes
2. Capacitors, starting with the smaller ones and the ceramic ones.
3. Electrolytic capacitors (always check the polarity)
4. Transistors
5. Wires
6. Potentiometers and switches
7. Off-board wiring

Q1*

This JFET controls the On-off tails function. Feel free to experiment with others similar to J201, PF5102.

Q2, Q3, Q4**

This board has been designed for using BC550. However, you can place 2n3904, 2n2222, 2n5088, etc.; just flip 180 degrees to the silkscreen.

IF YOU ARE GETTING SHORT DELAY TIME YOU PROBABLY PLACE IT THE WRONG WAY. This applies to 2v2 and 2v1, in 2v0 is the other way around.

R4 and D9 Go unpopulated***

We are going to use the classic status led for the job.

D60 and D90****

D60 and D90 are actually not needed and can be omitted since D15 limits the clipping at the first delay chip.

D15*****

D15 should be placed on the pot side of the PCB.

SLAM******

Switch off-board.

TAILS SWITCH*******

Empty. Read the wiring guide below for more details.

R9 and R15********

The value of R9 determines the amount of gain and clipping on the wet signal. Adjust the value of this resistor to get more “tape saturation” magic and set it to personal preference. Feel free to play in range of 1k5-4k. For this build we set on 3k6.

Higher values of R9 result in more noticeable gain and clipping effects. Going beyond 10k or even adding a pot instead could get you somehow close to the DBA style of effects territory. Lower values will reduce the grain of the delayed signal, but it might end up sounding a bit sterile.

R15 boosts the volume of IC2-B. In case you lower the value of R9, you might need to compensate with a higher value at R15 to increase the overall signal level.

Wiring Diagram

All our projects include a free 3PDT Board to make the wiring easier and tidier. Also, all of our PCBs feature the status LED on board.

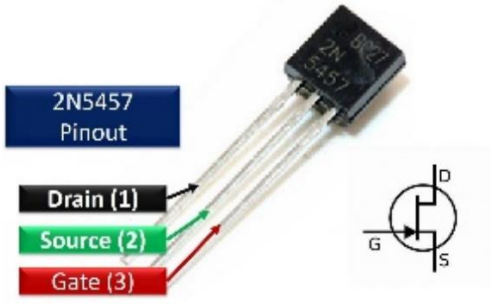
The pad named “Ctrl” or “LED” is the one that controls the status of the led; wire it to the “LED” pad on the 3PDT board or in the control slug of your 3PDT.

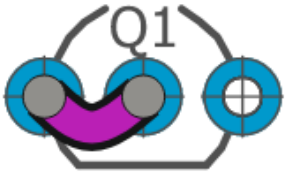
This board has been designed to match our EZ 3PDT PCB; check it here to access our Pedal Wiring Guide.

Bypass wiring guide

This basic true bypass wiring diagram works for versions 1v, 2v, 2v1 and 2v2.

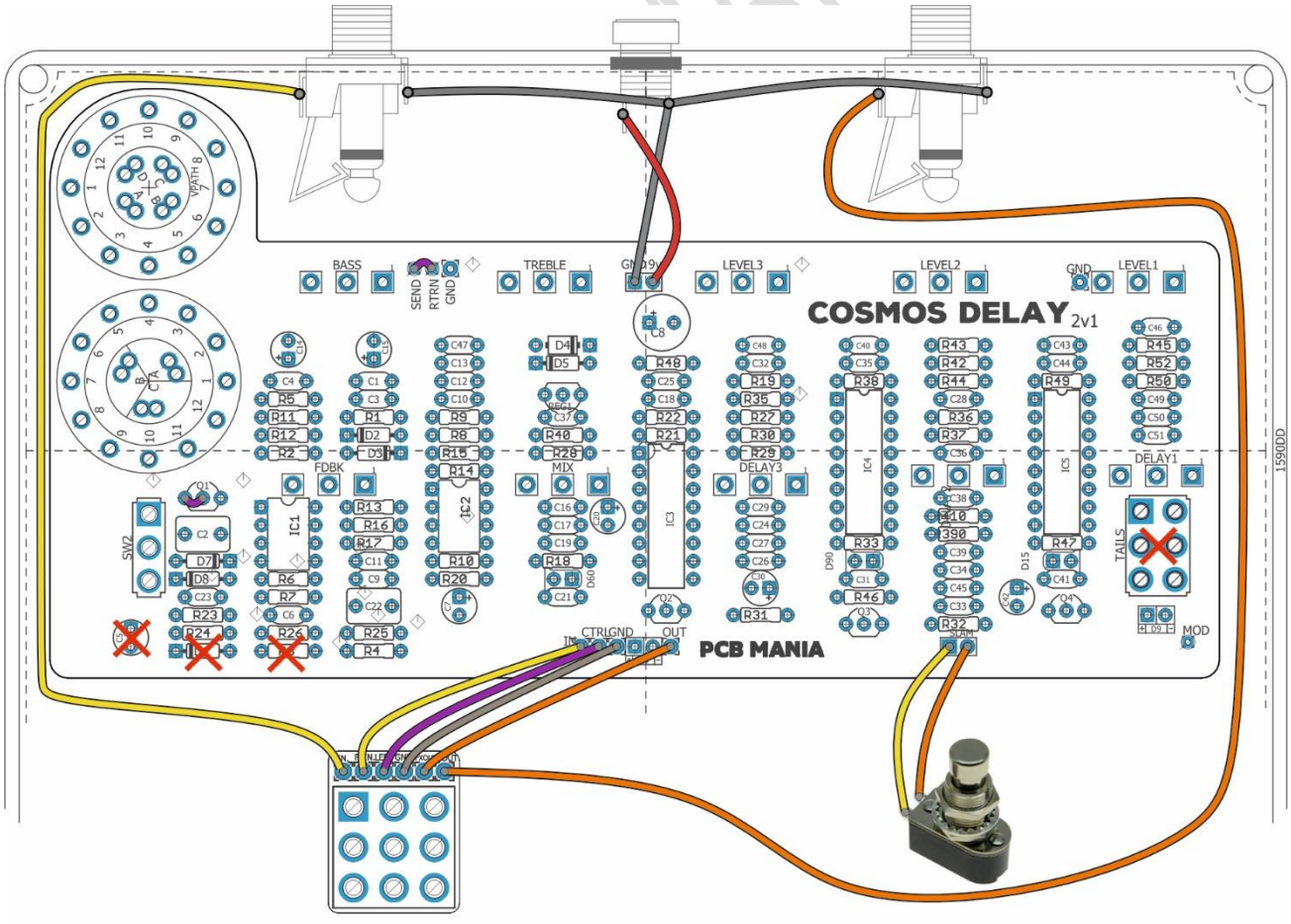
- If you're not using additional Jacks, you need to place a jumper between send and return.
- Place a jumper between the DRAIN and Source of Q1 as shown below.





- Leave the following parts empty:

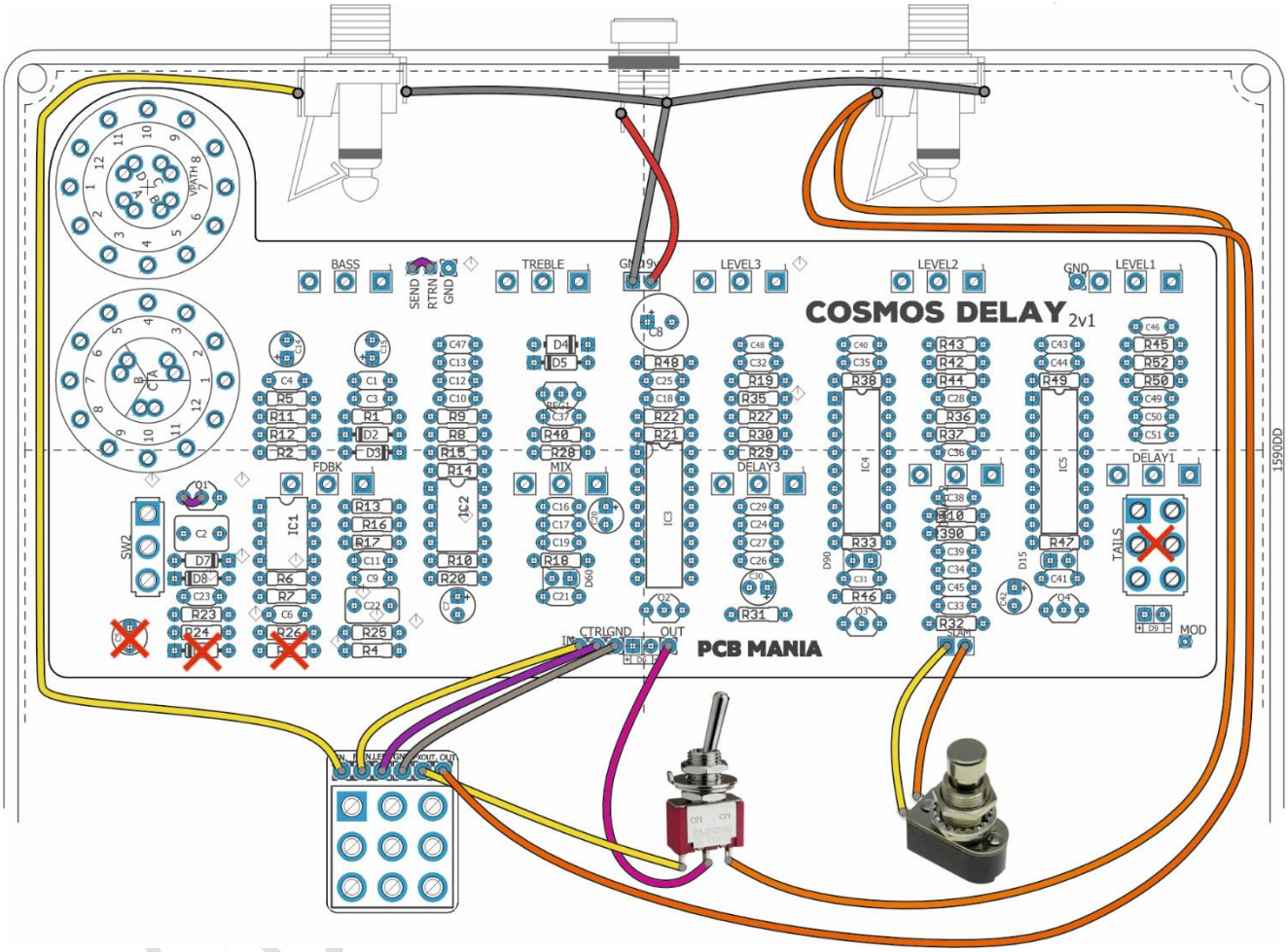
D1	R3	Tails
C5	Q1	switch



Bypass wiring guide – Alternative tails

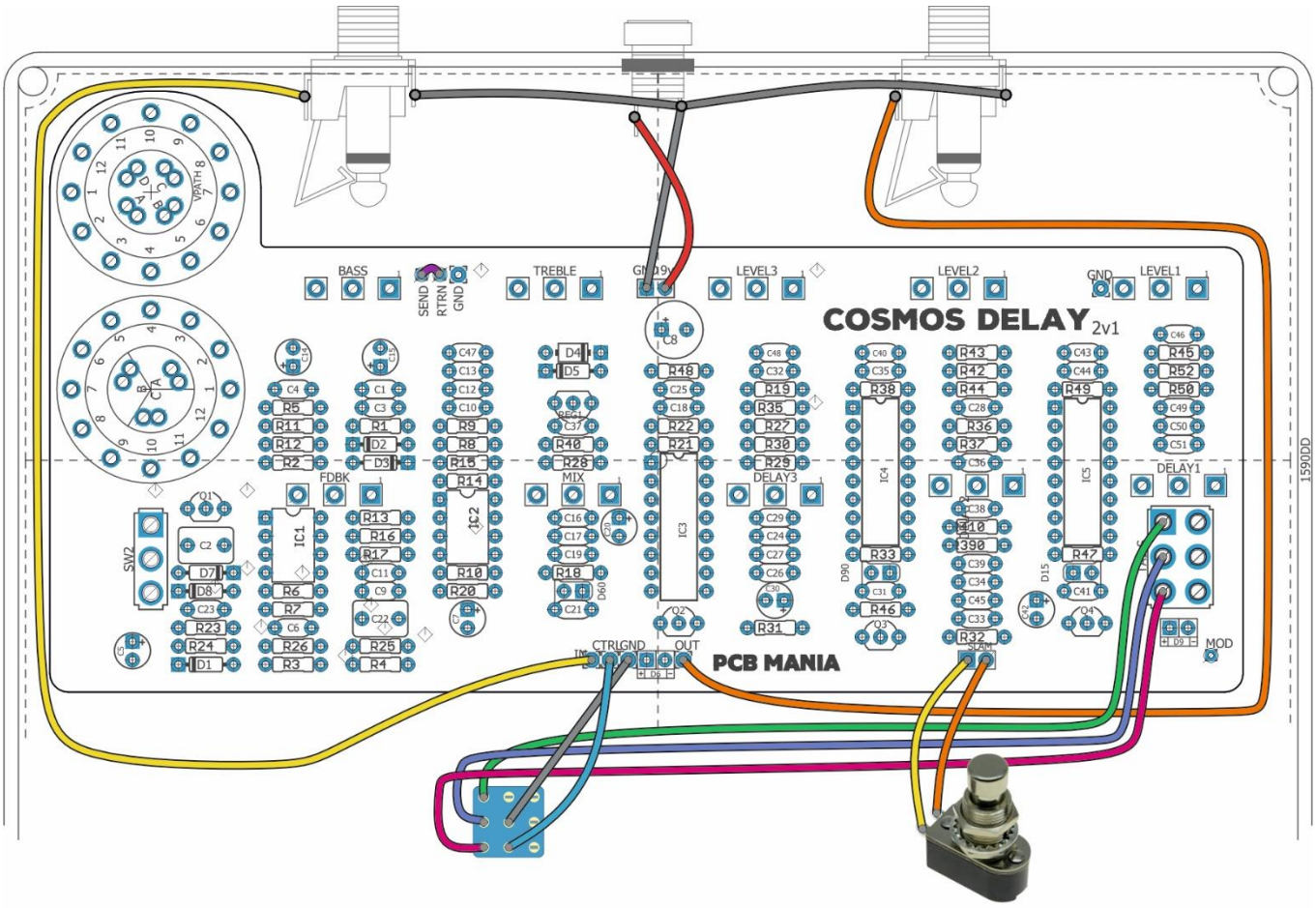
Do the same as in the true bypass and:

- From OUT place a wire to an SPDT switch pad 2.
- From the SPDT switch pad 1, Place a wire to the output jack.
- From Spdt pad 3 Connect it to FX out in the EZ3PDTboard.



Buffered wiring guide - JFET as a gate

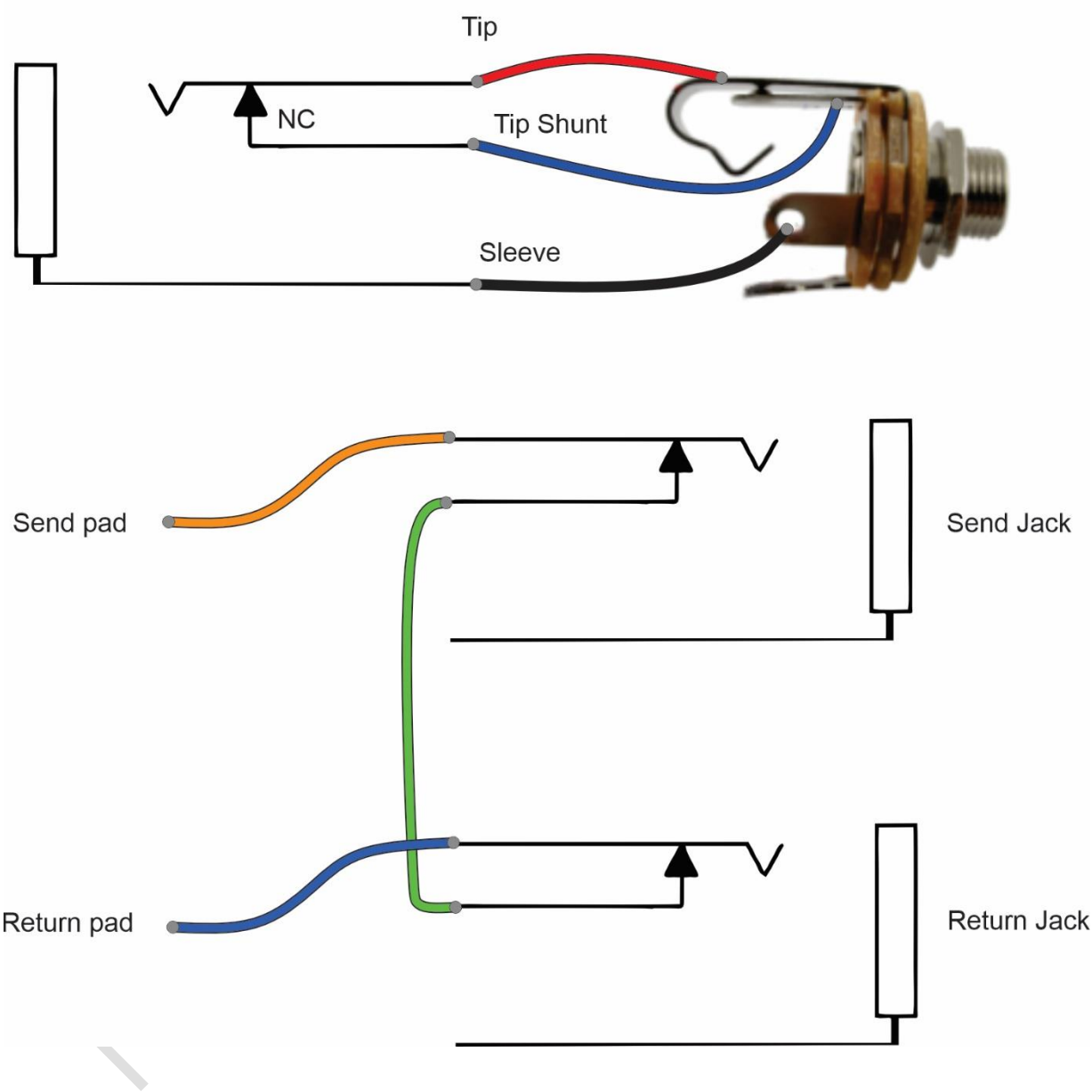
- In and out pads straight to input and output jack.
- From tails switch to 3pdt following the same pater (to a1, a2, a3).
- Ctrl to b3, GND to b2.



Always place the 3PDT like this!

Send Return Wiring Instructions

The jacks for the effect send/return need to be switching jacks and wired in a way that the signal goes from the send to the return pad when there is no effect plugged into the jacks. Check the diagram below:



1) Connect the jack tips to their respective send or return pads on the PCB.

2) Connect the jack sleeves to ground.

3) Connect the jack tip shunts to one another.

Use the Send Return version of the Drilling template, that includes the holes for the extra jacks.

Mod Pad

Coming Soon.

Drill Template

This Project has been planned to fit into a 1590DD enclosure type.

Check the Attached “Drilling templates” to drill the box properly. The files are on Scale 1:1, ready to print on an A4 page.

Licensing and Usage

We really appreciate your trust and support in buying this PCB, as well as your will to dive into the DIY electronics world. For us, that's why you can make this project work properly and enjoy not only the building process but also experiment and play with it on your rig.

We try to reply to every question we receive on our email or our social media. Still, we try to encourage all our customers to join our PCB Guitar Mania – Builders Group on Facebook to post all your doubts, issues, suggestions, or requests, share your builds, and have some feedback from other fellow builders and us!

We tested all our projects following this same guide on their standard configurations. Although, not all of the variations and mods have necessarily been checked. These are suggestions based on the schematic analysis and the experiences and opinions of others. Feel free to share with us your views and recommendations regarding the mods your personal experimentation.

These boards may be used for commercial endeavors in any quantity unless expressly noted. No attribution is necessary, though accreditation or a link back is always much appreciated.

If you are a builder planning to make your own run of pedals, we also offer the service of custom-made boards with your brand and logo, design according to your specifications.

The only usage restrictions are that, first, you cannot resell the PCB as part of a kit without prior arrangement with us, and second, you cannot scratch off the silkscreen or other way of trying to hide our logos and the source of the PCBs. Like it's written above, if you want to have your designs with your brand and logo, we could undoubtedly reach an agreement.

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