Smoothie

FX Type: **MODULATION**
Build Level: Intermediate
Based On: MXR® Phase45™

Last Updated: June 7, 2024 11:35 AM

Overview

The **Smoothie** is based on the classic MXR® Phase 45™, which is a two stage phaser driven by simple LFO. The input is fed through a filter network and controlled resistively by two JFET transistors. The dry and wet signals are then mixed via R16/17 just before the output. This is the perfect phaser pedal for slow, subtle tone enhancement or fast but gentle swirls.

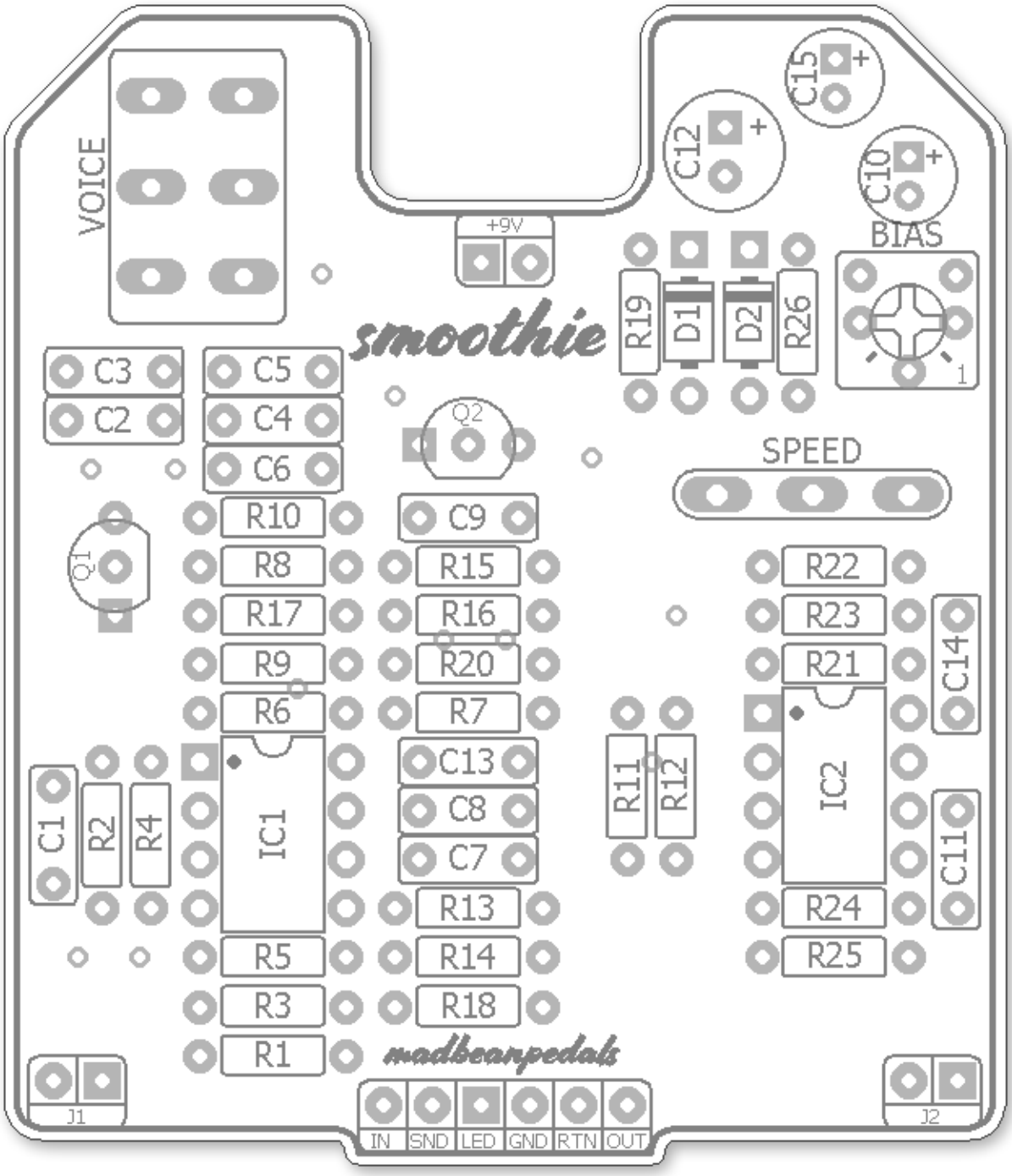
To learn more about how phasers function, please refer to "The Technology of Phase Shifters and Flangers" by R.G. Keen.

This project requires two matched JFET transistors. See the Build Notes for more details.

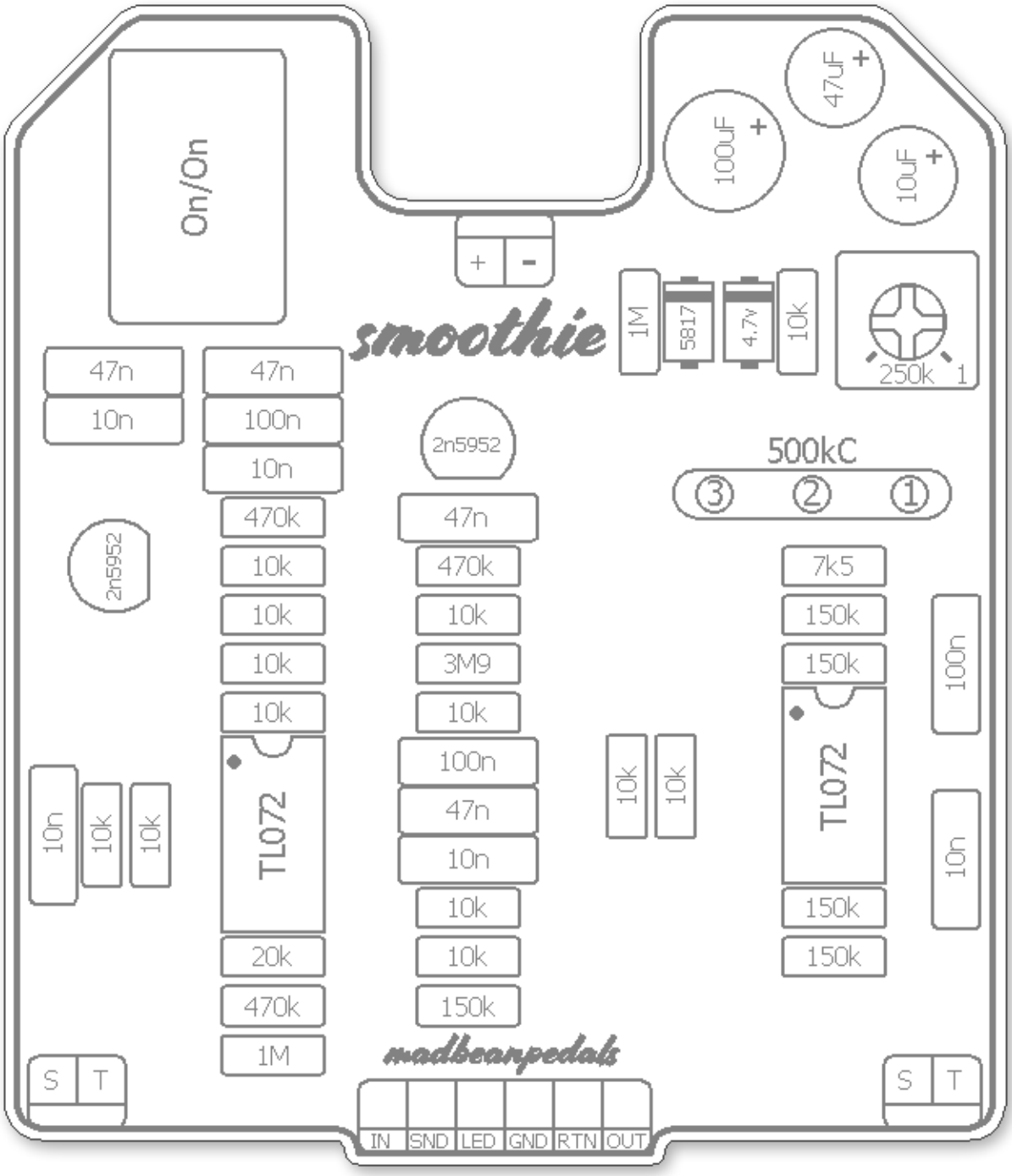
Controls

- **SPEED:** Modulation rate.
- **VOICE:** Selects between the stock phase caps and an alternate "univibe" set.

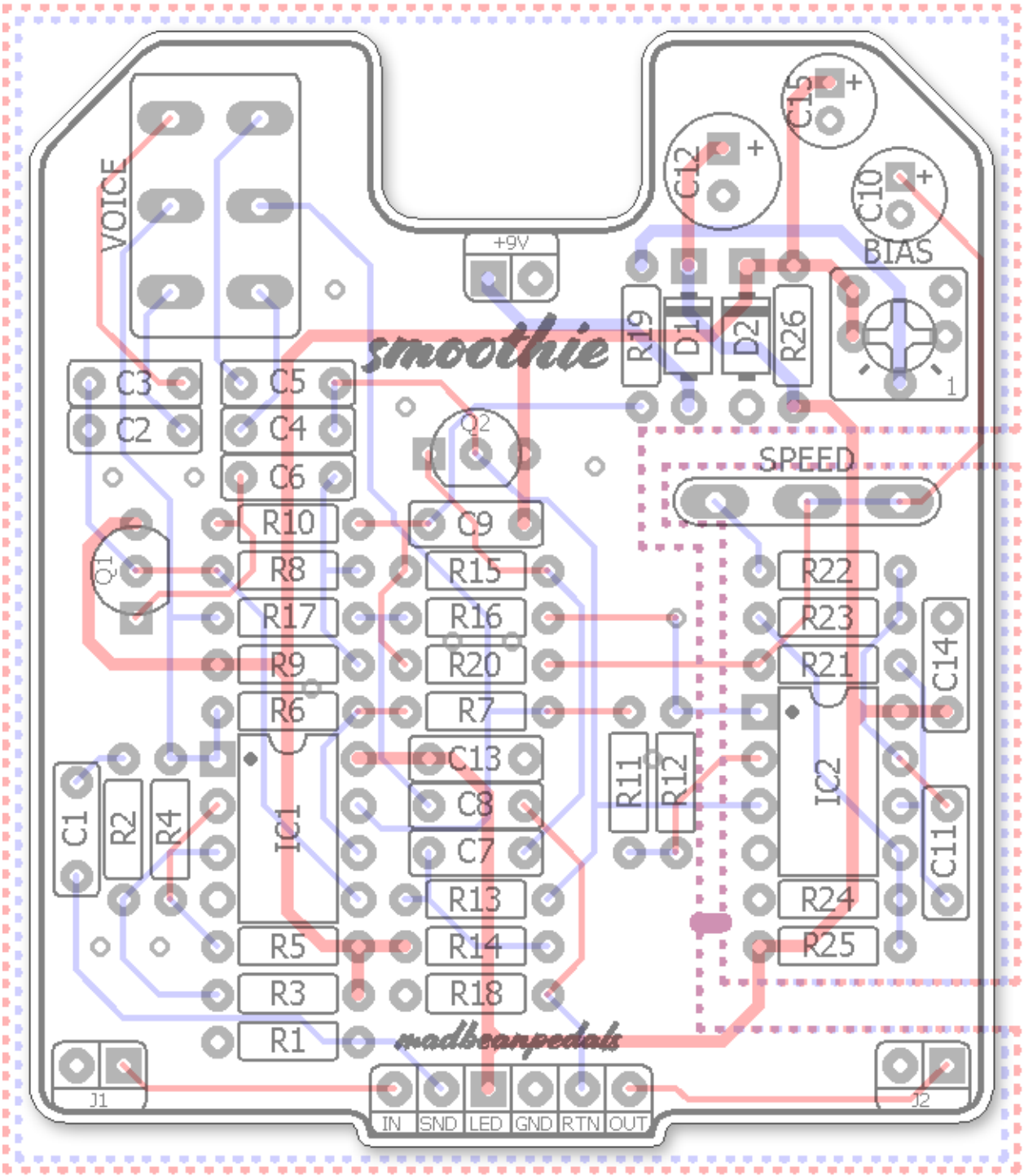
Parts Layout



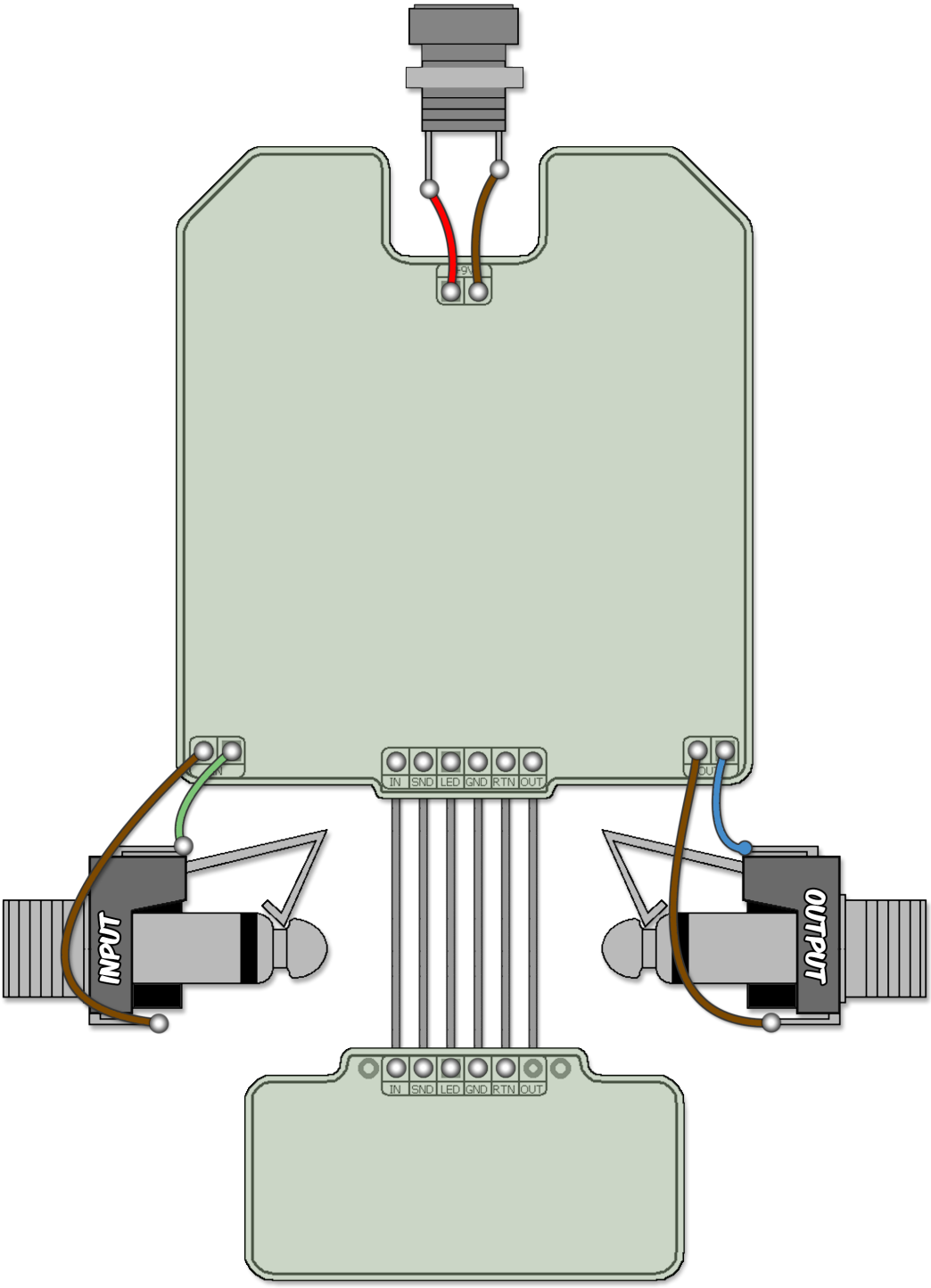
Component Values



Trace Layout



Wiring



Unless otherwise noted, all Standard Series projects have the same wiring regardless of which 3PDT bypass board is used. A 6-pin, 2” ribbon cable is recommended for soldering the connections between the two PCBs.

B.O.M.

Resistors		Caps		Diodes	
R1	1M	C1	10n	D1	1n5817
R2	10k	C2	10n	D2	4.7v Zener
R3	470k	C3	47n	Transistors	
R4	10k	C4	100n	Q1	2n5952
R5	20k	C5	47n	Q2	2n5952
R6	10k	C6	10n	IC	
R7	10k	C7	10n	IC1	TL072
R8	10k	C8	47n	IC2	TL072
R9	10k	C9	47n	Switch	
R10	470k	C10	10uF	VOICE	On/On
R11	10k	C11	10n	Trimmer	
R12	10k	C12	100uF	BIAS	250k
R13	10k	C13	100n	Pot	
R14	10k	C14	100n	SPEED	500kC
R15	470k	C15	47uF		
R16	10k				
R17	10k				
R18	150k				
R19	1M				
R20	3M9				
R21	150k				
R22	7k5				
R23	150k				
R24	150k				
R25	150k				
R26	10k				

Shopping List

Value	QTY	Type	Rating
7k5	1	Carbon / Metal Film	1/4W
10k	13	Carbon / Metal Film	1/4W
20k	1	Carbon / Metal Film	1/4W
150k	5	Carbon / Metal Film	1/4W
470k	3	Carbon / Metal Film	1/4W
1M	2	Carbon / Metal Film	1/4W
3M9	1	Carbon / Metal Film	1/4W
10n	5	Film	16v min.
47n	4	Film	16v min.
100n	3	Film	16v min.
10uF	1	Electrolytic	16v min.
47uF	1	Electrolytic	16v min.
100uF	1	Electrolytic	16v min.
1n5817	1		
Zener	1	4.7v	1W
2n5952	2	matched	
TL072	2		
DPDT	1	On/On, Solder Lug or Pin Mount	
250k	1	Bourns 3362p or 6mm	
500kC	1	PCB Right Angle	16mm

Additional Hardware

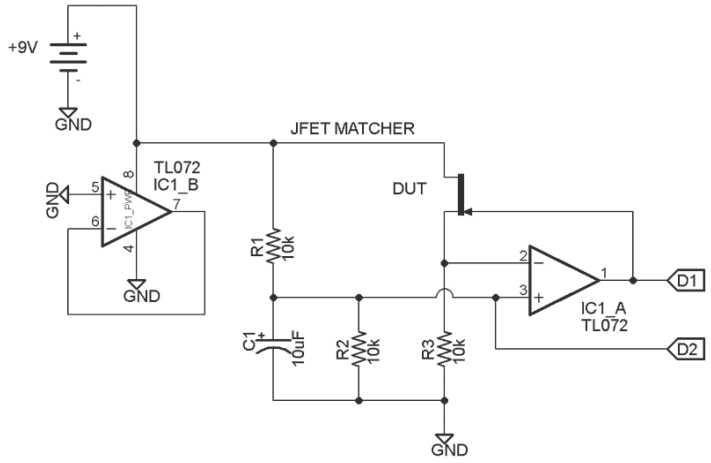
(1) 1590B enclosure
(2) Lumberg 1/4” Compact mono jacks
(1) Slim 2.1mm DC jack
(1) Standard 3PDT footswitch
(1) 5mm LED

Build Notes

Transistors

- The Smoothie requires the 2n5952 transistors to be matched for the phaser effect to work properly. While you may be able to stick a couple of random JFETS in there and get lucky, the best result comes from matching the cutoff voltages for the transistors as closely as possible. This is easy to do, provided you have a quantity of transistors available to work with.

- The process involves placing individual transistors in a test circuit on a breadboard. Each device is then measured with a multimeter to read its gate/source cutoff voltage. This is the measurement you want to match with another transistor. The goal is to find two transistors whose VGS are within just a couple of percent of one another. The closer the match, the better response one gets in the phase circuit. For the 2n5952 (or similarly the 2n5457) the best results tend to come from devices with a VGS of -1.5 to -3.0V.



- You can put this testing circuit on a breadboard in about 5 minutes. Use the probes on your multimeter (set for DC voltage) to test the VGS of each JFET at D1 and D2 testing point. VGS values between -1v and -4v are typical. Try to match two transistors to one or two decimal places. Ex. -1.55v, etc). More info about matching JFETs for phase shifters can be found on the DIYStompboxes forum and R.G. Keen's website: http://www.geofex.com/article_folders/fetmatch/fetmatch.htm

- NOTE: You can also use 2n2457 if you can match them with a similar spec as described above. However, their pinouts are reversed from the 2n5952. The J201 has a much more narrow range of VGS where they will work in phasers, so they are not recommended.

Biasing the phaser section

- Set the Speed control about halfway up. Start with the BIAS trim full CCW and adjust CW until you hear the phase effect. Adjust the Speed control and fine tune the BIAS trim for the most depth of phase attainable. NOTE: this can be a very narrow range on a single turn trimpot, so it may take a couple of tries. Use a multi-turn if you want more precision.

Voice Switch

- This version of the Smoothie includes a switch to toggle between different sets of caps for the two phase stages. The primary set are two 47n (C3 and C5) and the alternate set are a 10n and 100n (C2 and C4). This is the typical "Univibe" mod for the Phase 45. It is a pretty subtle difference, but worthy of the mod. You are free to experiment with alternate sets to get different phase tones. Socket C2 and C4 for experimentation.

Circuit Voltages

IC1	TL072	IC2	TL072
1	3.55	1	3.56
2	5.57	2	3.56
3	3.56	3	3.41
4	0	4	0
5	varies	5	3.56
6	varies	6	3.57
7	varies	7	3.58
8	9.25	8	9.25

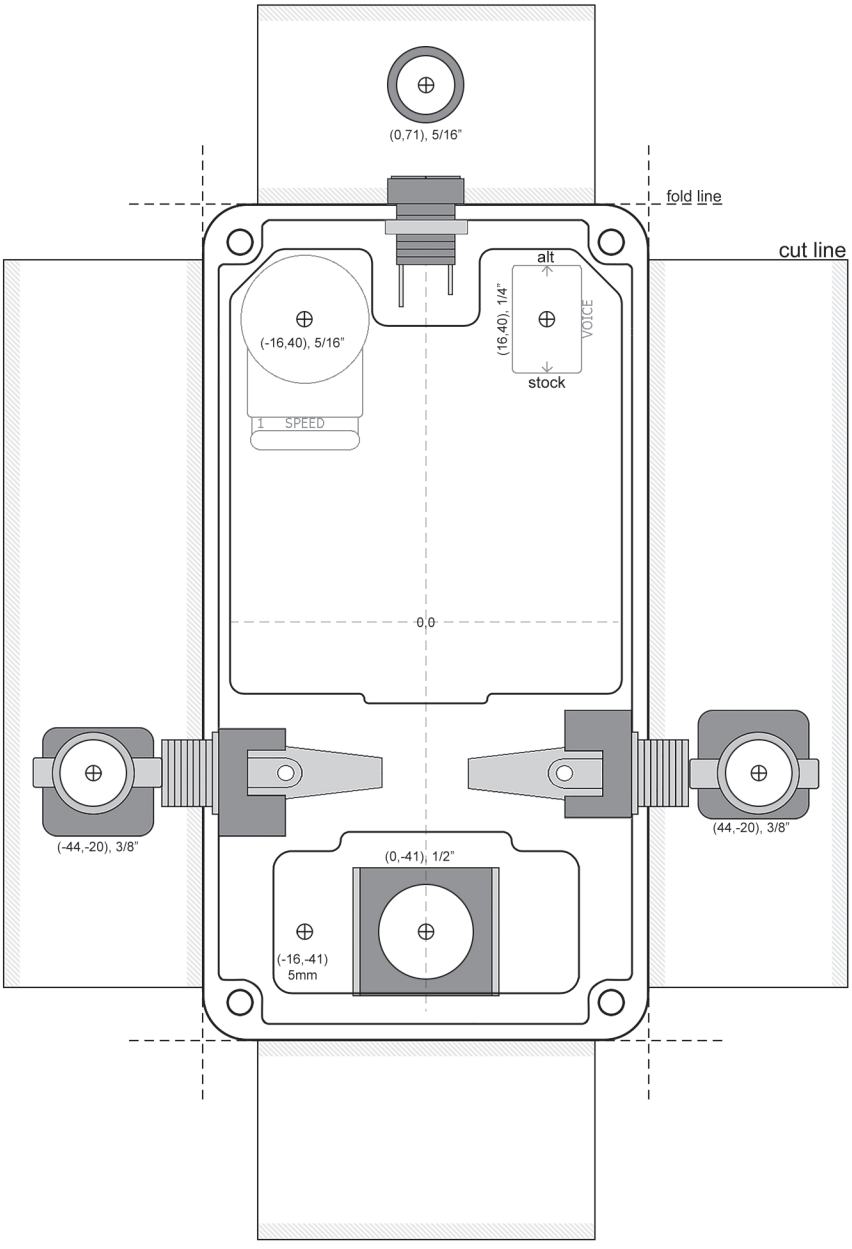
9.44vDC One Spot supply
Current Draw: ~4mA

- Speed at 0, switch down.

1590B Drill Template

Coordinates are denoted in (X,Y), drill size format starting from the center (0,0) location of the enclosure.

Link to Tayda Standard Series master drill template

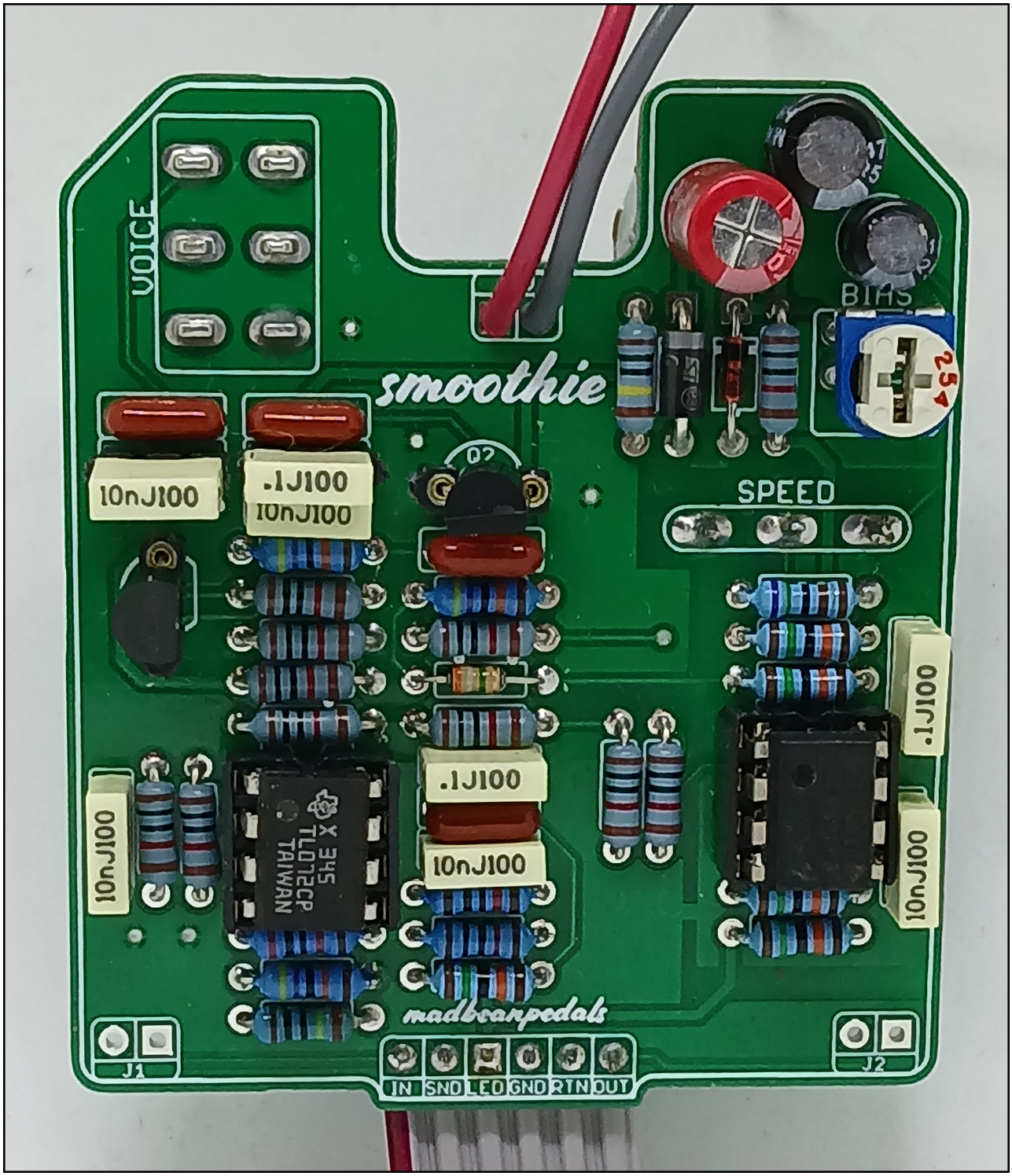


Hardware

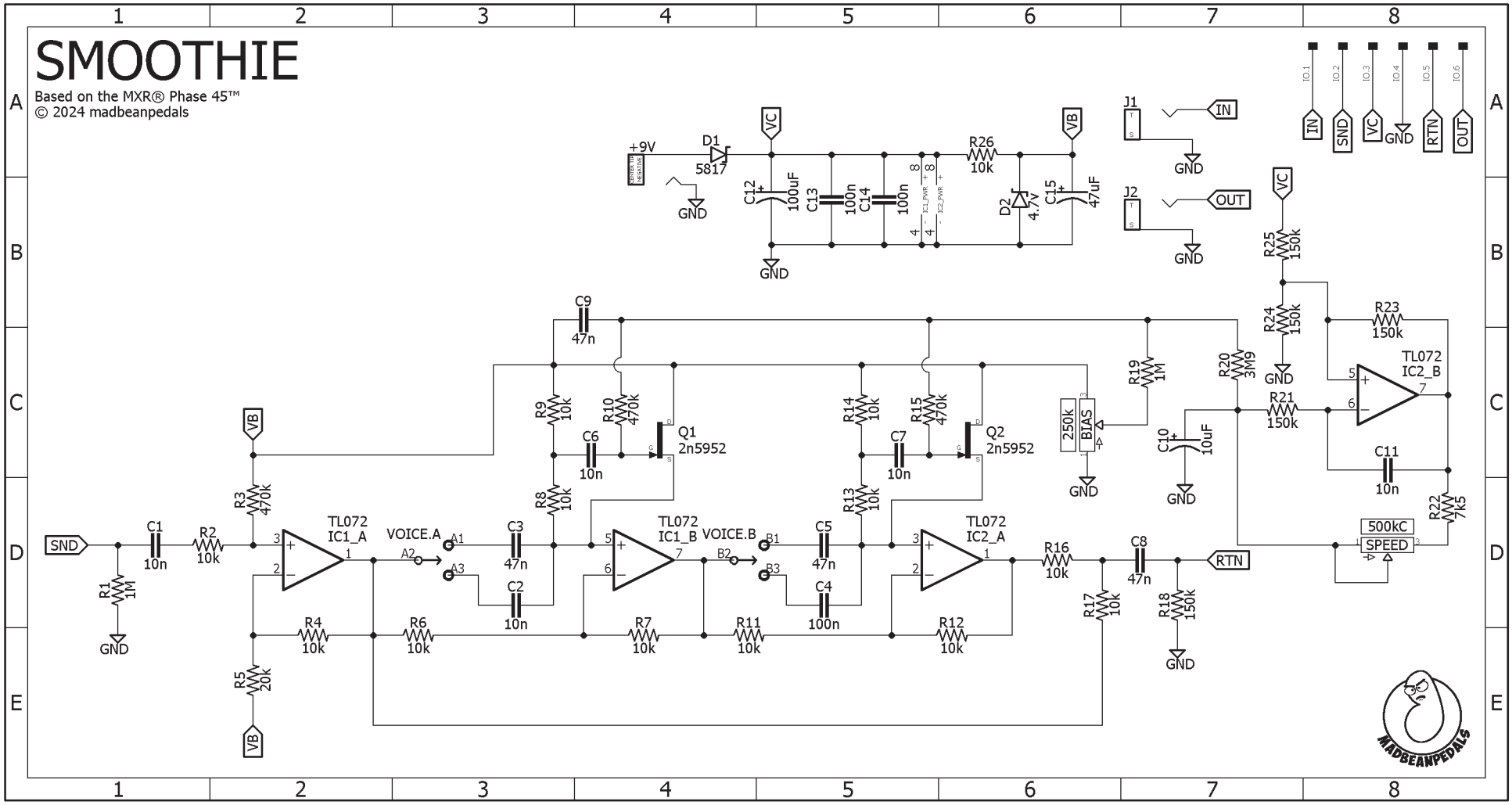
1590B enclosure
Lumberg 1/4” Compact mono jacks
Slim 2.1mm DC jack
Standard 3PDT footswitch
5mm LED

NOTE: Different 1/4” and DC jack styles may require different sized drill holes.

Build Pic


VOICE
smoothie
BIAS
SPEED
10nJ100
.1J100
10nJ100
.1J100
10nJ100
.1J100
10nJ100
TL072CP
TAIWAN
madbeanpedals
J1
J2
IN
SND
LEO
GND
RTN
OUT

Schematic


SMOOTHIE
Based on the MXR® Phase 45™
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+9V
D1
5817
VC
VB
GND
C12
100uF
C13
100n
C14
100n
C15
47uF
R26
10k
D2
4.7V
J1
IN
J2
OUT
IO.1
IO.2
IO.3
IO.4
IO.5
IO.6
SND
RTN
R25
150k
R24
150k
R23
150k
R21
150k
R20
3M9
R19
1M
C10
10uF
250k
BIAS
C9
47n
R9
10k
R10
470k
Q1
2n5952
C6
10n
R14
10k
R15
470k
Q2
2n5952
C7
10n
TL072
IC2_B
C11
10n
R22
7K5
500kC
SPEED
R3
470k
R8
10k
R13
10k
TL072
IC1_A
TL072
IC1_B
TL072
IC2_A
VOICE.A
VOICE.B
A1
A2
A3
B1
B2
B3
C1
10n
R2
10k
C3
47n
C5
47n
C2
10n
C4
100n
R1
1M
R4
10k
R6
10k
R7
10k
R11
10k
R12
10k
R16
10k
C8
47n
R17
10k
R18
150k
R5
20k
MADBEANPEDALS