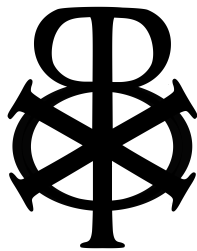


SYNCUSSION SY-1M

BUILD DOCUMENT and BILL of MATERIALS

rev. 2.0

PSYCO X



Please note that this document relates to the second run of SY-1M kits. (PCB's are labelled "SYNCUSSION SY-1M^{R2}")

**If you have a kit from the first run,
please refer to Build Document v1.3**

KIT CONTENTS

- 1 x Voice Board Immersion Gold (ENIG) PCB
- 1 x Control Board Immersion Gold (ENIG) PCB
- 1 x Powder Coated / Screen Printed Metal Enclosure
- 2 x 10k Slide Potentiometers (Audio Taper)
- 6 x 100k Slide Potentiometers (Audio Taper)
- 6 x 100k Slide Potentiometers (Linear Taper)
- 2 x 500k Slide Potentiometers (Audio Taper)
- 16 x Slide Potentiometer Caps
- 1 x Pre-programmed ATMEGA328 MCU
- 1 x 47uH RF Choke
- 2 x 22 pin, press fit, breakaway header strips
- 7 x M3 x 3mm screws
- 4 x Adhesive Rubber Feet

Bill Of Materials

For certain items the Mouser shopping cart may contain more pieces than required. This is because it is often cheaper to buy 100 x1k resistors (for example) than it is to buy 56.

Resistors

Mouser Part (Click to View)

1Ω 2W	x 1	660-SPRX2C1R0J
100R	x 8	603-CFR-25JT-52-100R
220R	x 1	603-CFR-25JB-52-220R
560R	x 2	279-CFR25J560R
680R	x 4	603-CFR-25JR-52-680R
1k	x 56	603-CFR-25JR-521K
2k2	x 3	603-CFR-25JR-522K2
4k7	x 14	603-CFR-25JR-524K7
5k6	x 1	603-CFR-25JR-525K6
10k	x 28	603-CFR-25JR-5210K
22k	x 10	603-CFR-25JR-5222K
27k	x 2	603-CFR-25JR-52-27K
33k	x 11	603-CFR-25JR-52-33K
47k	x 46	603-CFR-25JR-5247K
56k	x 4	603-CFR-25JR-5256K
100k	x 99	603-CFR-25JR-52100K
150k	x 3	603-CFR-25JR-52150K
220k	x 16	603-CFR-25JR-52220K
330k	x 6	291-330K-RC
470k	x 6	603-CFR-25JR-52470K
1M	x 6	603-CFR-25JR-521M

Trimmers

100k	x 7	652-3362P-1-104LF
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Capacitors (Film & MLCC)

15p	x 1	80-C316C150J1G
22p	x 2	810-FG18C0G1H220JNT6
100p	x 1	810-FG18C0G1H101JNT6
1n	x 15	871-B32529C102J189
2n2	x 2	871-B32529C222J189
10n	x 3	871-B32529C103K289
22n	x 2	871-B32529C223J289
33n	x 2	871-B32529C1333J289
47n	x 2	871-B32529C1473J189
100n	x 4	871-B32529C1104J189
100n	x 3	810-FG18X7R1H104KNT6
470n	x 1	810-FG24X7R1E474KNT6

Capacitors (Al Electrolytic)

u47/16V	x 4	647-USP1HR47MDD
1u/50V	x 10	647-USR1H010MDD
10u/16V	x 9	UMA1C100MDD1TP
22u/16V	x 1	ECE-A1VKA220
100u/16V	x 1	ECE-A1CKA101
100u/16V	x 2	MAL202190538E3
220u/16V	x 5	75-516D227M016MM6AE3

Capacitors (Tantalum)

u47/35V	x 4	80-T491B474K035
2u2/35V	x 2	74-TR3B225K035C2500

Semiconductors & IC's

1N4148 (Diode)	x 17	512-1N4148
BC547 (NPN)	x 29	512-BC547BBU
BC557 (PNP)	x 24	512-BC557BTA
BCM847 (Matched NPN)	x 18	771-BCM847DS135
BCM857 (Matched PNP)	x 8	771-BCM857DS135
BF256B (JFET)	x 2	512-BF256B
CD4069 (Hex Inverter)	x 6	595-CD4069UBE
LM1458 (Dual Op Amp)	x 4	926-LM1458N/NOPB
RC4458 (Op Amp)	x 9	595-RC4458P
TL082 (Dual Op Amp)	x 3	595-TL082CP
MCP4822 (12 bit DAC)	x 2	579-MCP4822-E/P
6N137 (Opto Isolator)	x 1	859-6N137
TL497 (Switching Reg)	x 1	595-TL497AIN or 595-TL497ACN
LM7808 (8V Reg.)	x 1	511-L7808CV
78L05 (5V Reg.)	x 1	511-L78L05CZ
3mm LED (Red)	x 5	604-WP710A10ID

Switches

12 Way Rotary Switch	x 2	105-CK1049 (you will need to file a flat)
OFF-ON	x 4	642-MHS122K
ON-OFF-ON	x 4	642-MHS233K or 642-MHS123K
Momentary Push OFF-(ON)	x 2	611-D6R90LFS

Rotary Potentiometer

10k (9mm Rotary)	x 2	858-P090L01T15BR10K
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Connectors

14 pin (2 x7) female header	x 4	517-929975-01-07-RK
3 pin female header	x 2	517-929974-01-03-RK

Connectors cont.

4 pin (2x2) female header	x 2	517-9602046202AR
3.5mm Stereo jack socket	x 5	502-35RAPC2BH3
1/4" Mono jack socket	x 2	550-10201
DC Barrel jack socket	x 1	502-RAPC722X

Miscellaneous components

16MHz Crystal	x 1	449-LFXTAL058383BULK
Ferrite Bead	x 2	81-BL01RN1A1F1J
220uH Inductor	x 1	815-AIUR-05-221K
IC sockets 28 pin	x 1	575-1104732841001000
IC sockets 14 pin	x 7	575-1104731441001000
IC sockets 8 pin	x 19	575-1104730841001000

Hardware

5mm M3 M/F Spacer	x 7	855-R30-3000502
20mm M3 F/F Spacer	x 7	855-R30-1002002
12mm M3 M/F Spacer	x 7	855-R30-3001202
12mm M3 F/F Spacer	x 2	855-R30-1011202
M3 x 5mm Screws	x 15	534-9191-3
Knob for Osc. Mode Switch	x 2	Any 20mm knobs of your choice (6mm shaft)
12V DC 300mA Wall wart	x 1	2.1mm centre pin (Centre positive)

Tools and Supplies

Most builders will already have the required tools and supplies in their arsenal, but for those new to Synth DIY, this list describes everything you might need in order to complete a successful build.

- Soldering Iron (Preferably temp. controlled. Check the required temperature for your chosen solder)
- Solder (I use Loctite Crystal400)
- Liquid Flux Dispensing Pen (such as Chemtronics CW8100)
- Soldering Tip Cleaner (Keep it clean and tinned !)
- Fine Tweezers (Invaluable for the SMD transistors and capacitors)
- De-soldering Pump (Hopefully, you won't need it)
- Digital Multimeter (DMM) (Always check resistors before fitting!)
- Masking tape (For holding things in place and marking)
- Small Flat Screwdriver (For trimming)
- Posi Screwdriver (For the final assembly)
- Small Flat File (To create a flat side on the Rotary switch shaft)
- Focus and a little patience (Have these, and you're good to go!)

Build Guide

One of the most time consuming aspects of building even a sparsely populated PCB, can be that of merely seeking out individual component locations. In order to speed up the process there are, towards the end of this document, colourised location maps of many (although not all) components. Each component section of the guide has direct links to the relevant maps. Click on the page number in the "Goto" link to jump to the relevant map.

If, in the build list the component name is not colour highlighted, there is no map and the locations should be easy to find.

Components are listed in suggested order of fitting.

Be sure to follow standard precautions when handling static sensitive parts.

Voice Board

SMD Transistors.

8 x **BCM857** Goto [p17](#)

18 x **BCM847** Goto [p17](#)

I would suggest fitting the all of BCM847's first followed by the BCM857's (or the other way round if you prefer). Either way, don't get them mixed up because they aren't easy to distinguish.

Both components have 180° rotational symmetry and can therefore be fitted in either orientation.

If you are new to SMD soldering, check out some of [John Gammell's YouTube videos](#) for expert technique. Better still, get somebody to solder the SMD parts for you!

Check for solder bridges with your Loupe (or other magnifier) before moving on.

SMD Caps (Tantalum)

Be sure to align the dark band on the device with the marking on the silk screen

2 x **u47/35V** Goto [p18](#)

Resistors

2 x **100R** Goto [p18](#)

2 x **560R** Goto [p18](#)

46 x **1K** Goto [p18](#)

8 x **4K7** Goto [p19](#)

Resistors cont.

18 x	10K	Goto	p19
8 x	22K	Goto	p19
4 x	33K	Goto	p20
40 x	47K	Goto	p20
70 x	100K	Goto	p20
2 x	150K	Goto	p21
6 x	220K	Goto	p21
4 x	330K	Goto	p21
6 x	470K	Goto	p22
4 x	1M	Goto	p22

Diodes

14 x	1N4148	Goto	p22
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(The dark line on the diode must be aligned with the line on the silk screen!)

IC Sockets TIP! - Use masking tape to hold sockets in place while your turn the board over.

6 x 14 pin

6x 8 pin

Trimmers

2 x 100k (VC02 Offset)

Film Capacitors

14 x 1n Goto p23

2 x 2n2 Goto p23

TO-92 Transistors

10 x BC547 Goto p24

20 x BC557 Goto p24

Aluminium Electrolytic Capacitors

8 x	1u/50V	Goto p25
4 x	10u/16V	Goto p25
4 x	220u/16V	Goto p25

Connectors

4 x	3.5mm Mono jack sockets	(CV and Trigger inputs)
2 x	14 pin female pin sockets	(Board inter-connect)
1 x	4 pin female pin socket	(Board inter-connect)
1 x	3 pin female pin socket	(Board inter-connect)
2 x	1/4" Mono jack sockets	(Audio Outputs)

Potentiometers

2 x	10k 9mm Rotary	(Trigger Sensitivity)
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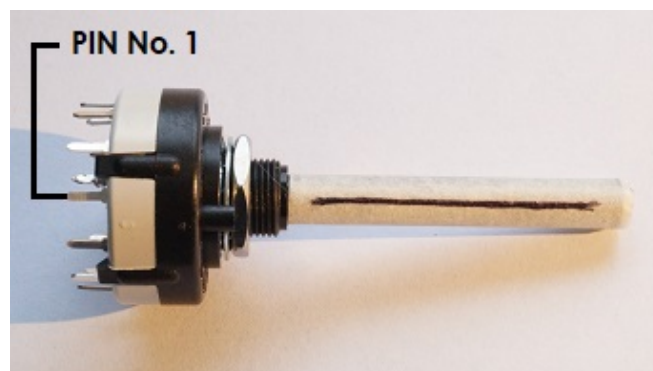
Switches

2 x	12 Way Rotary	(Oscillator Mode Selector)
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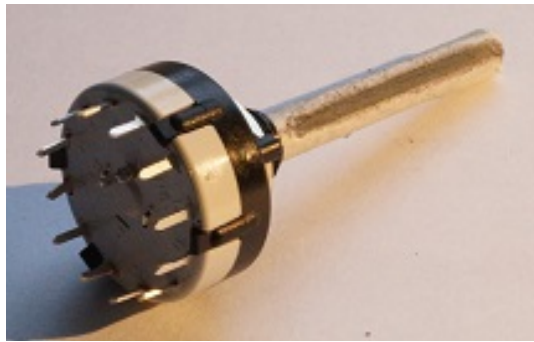
BEFORE FITTING -

First of all the stop washer needs to be set to the correct position. To do this, remove the hex nut, locking washer and stop washer. Turn the switch **fully anti-clockwise** until the last click and then re-fit the stop washer with the small lug inserted into the slot labelled "6". Refit the locking washer followed by the hex nut. Check that there are 6 positions (5 clicks in either direction)

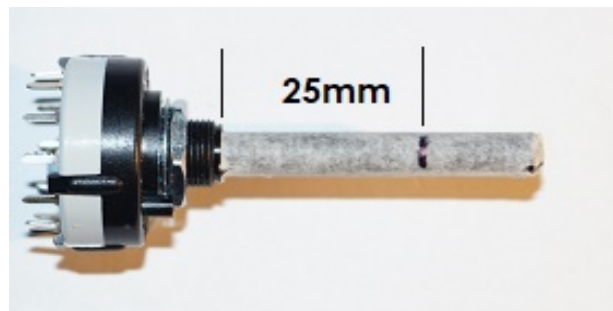
To prevent the switch knob from turning on the shaft you will need to file a flat. With the switch rotated **fully anti-clockwise** wrap a piece of masking tape around the shaft and mark it in line with Pin No. 1



File the line away to create the flat. You don't need to file much, just enough for the cap lug screw to sit flat against and stop the cap from turning on the shaft.



The shaft will also require cutting down. To achieve the correct length, wrap a piece of masking tape around the shaft and mark it at 25mm from the top of the bushing.



Grip the end of the shaft in a bench vice and cut with a small hacksaw.

The switch is now ready for fitting.

IC's (MAKE SURE TO GROUND YOURSELF WHEN HANDLING STATIC SENSITIVE DEVICES)

6 x **CD4069** Hex Inverters Goto [p26](#)

2 x **4558** Dual Op Amp Goto [p26](#)

4 x **1458** Dual Op Amp Goto [p26](#)

That completes the build for the Syncussion SY-1M Voice Board.

Control Board

SMD Capacitors

2 x **u47/35V** Goto [p27](#)

2 x **2u2/35V** Goto [p27](#)

Resistors

6 x **100R** Goto [p28](#)

1 x **220R** Goto [p28](#)

4 x **680R** Goto [p28](#)

10 x **1K** Goto [p29](#)

3 x **2K2** Goto [p29](#)

6 x **4K7** Goto [p29](#)

1 x **5K6** Goto [p30](#)

10 x **10K** Goto [p30](#)

2 x **22K** Goto [p30](#)

2 x **27K** Goto [p31](#)

7 x **33K** Goto [p31](#)

6 x **47K** Goto [p31](#)

4 x **56K** Goto [p32](#)

29 x **100K** Goto [p32](#)

1 x **150K** Goto [p32](#)

10 x **220K** Goto [p33](#)

2 x **1M** Goto [p33](#)

2 x **Ferrite Beads** Goto [p33](#)

Diodes

3 x 1N4148

IC Sockets (Make sure the notch on the socket is aligned with the silk screen)

1 x 28 pin DIL Socket

1 x 14 pin DIL Socket

13 x 8 pin DIL Socket

Trimmers

5 x 100k (2 x CV – V/OCT, 2x MIDI – V/OCT, 1 x NOISE Trim)

Film Capacitors

1 x 1n Goto p34

3 x 10n Goto p34

2 x 22n Goto p34

2 x 33n Goto p35

2 x 47n Goto p35

4 x 100n Goto p35

MLCC Capacitors

1 x 15p Goto p36

2 x 22p Goto p36

1 x 100p Goto p36

3 x 100n Goto p37

1 x 470n Goto p37

Transistors

19 x BC547 Goto p38

4 x BC557 Goto p38

2 x BF256B Goto p38

Electrolytic Capacitors

4 x	u47/50V	Goto p39
2 x	1u/50V	Goto p39
5 x	10u/16V	Goto p39
1 x	22u/16V	Goto p40
1 x	100u/16V	Goto p40
2 x	100u/16V	Goto p40
1 x	220u/16V	

Voltage Regulators, RF choke and Inductor

1 x	7808	TO-220 8V Regulator	Goto p41
1 x	78L05	TO-92 5V Regulator	Goto p41
1 x	47uH	RF Choke	Goto p41
1 x	220uH	Inductor	

Trigger Buttons

You may wish to solder just two diagonally opposite pins of the four. This will be sufficient for the buttons to operate normally whilst allowing much easier removal and replacement should the need arise.

2 x Momentary Push Buttons (**Be sure to align the flat side with the silk screen**)

Slide Potentiometers

2 x	10K Audio Taper
2 x	500K Audio Taper
6 x	100K Audio Taper
6 x	100K Linear Taper

Switches

4 x	OFF-ON	Goto p42
4 x	ON-OFF-ON	Goto p42
1 x	4 position DIP switch	(Mounts on the bottom side of the board)

Connectors

1 x	3.5mm Stereo Jack Socket	(Mounts on the bottom side of the board)
2 x	14 pin (2x7) socket headers	(Mounts on the bottom side of the board)
1 x	4 pin (2x2) socket header	(Mounts on the bottom side of the board)
1 x	3 pin socket header	(Mounts on the bottom side of the board)
1 x	DC Barrel Jack socket	(Mounts on the bottom side of the board)

LED's

Before we fit the LED's we need to fit a few spacers and the top panel. This will help to ensure that the LED's sit at the correct height and position in relation to the panel.

Take 4 x 12mm M/F spacers and 4 x 20mm F/F spacers and fit them (with the 12mm spacer on the top of the board and the 20mm spacer on the bottom) in the four corner locations.

Insert the LED's into their locations (making sure that the shorter lead goes into the square pad). For the Power LED, the short leg goes closer to the 2k2 resistor. Don't solder anything yet but just let the LED's hang in position.

Place a small piece of masking tape over each LED hole on the front panel and fit the top half of the case with 4 x M3 x 5mm screws.

Turn the assembly over and adjust each LED until it sits in its panel hole and with a finger over the tape and hole, apply a little pressure so that the masking tape holds the LED in place. Cinch the leads slightly and solder in place.

Remove the masking tape and remove the panel.

IC's

1 x	TL497	
7 x	4558	Goto p43
3 x	TL082	Goto p43
2 x	MCP4822	Goto p43
1 x	6N137	Goto p43

IC's Cont.

1 x ATMEGA328

That completes the build for the Syncussion SY-1M Control Board

Board Assembly

7 x M3 x20mm F/F spacers
7 x M3 x12 mm M/F spacers
2 x M3 x12mm F/F spacers
7 x M3 x5mm M/F spacers
2 x M3 x5mm Screws

Fit 7x M3x20mm F/F spacers to the top of the Voice Board using 7x M3x5mm M/F spacers on the underside.

On the top side of the Control Board Fit 2 x M3 x12mm F/F spacers to the 2 middle holes on the long sides using 2 x M3 x5mm screws.

Take the breakaway pin strips provided with the kit and break off;

4 x 7 pins, 2 x 2 pins and 1 x 3pins

Please note that the Pin Connectors provided with the kit are slightly too long. With a pair of sharp snips, trim approximately 2mm from each end of the pins.

Fit the pin strip to either the Control Board headers or the Voice board headers

The two 2 pin pieces are for the square 4 way header.

Plug the boards together.

Fit 7 x M3 x12mm M/F spacers to the remaining locations on the top of the Control Board thus securing the boards together.

Calibration

NOISE

Power up the unit and measure the noise level at point 3

Adjust the trimmer to give 2.5V p-p

VC02 OFFSET (This is described as it is in the original service manual but don't worry about being too precise with this adjustment, It can also be a matter of preference and different offsets will give different results.)

With the power ON set Ch.1 controls as follows:

TUNE - 5
SWEEP - OFF
L.F.O - OFF
S/H - OFF

Connect a frequency counter or tuner to Channel 1, point 1 on the underside of the voice board and adjust Ch1 TUNE so that the counter reads 440Hz.

Connect your frequency counter to point 2 on the underside of the voice board and adjust the VC02 OFFSET trimmer so that the counter reads 450Hz.

Repeat the VC02 OFFSET calibration for Channel 2.

The next two calibrations for the scale tuning should be done with OSC. MODE set to "A" on both channels, with "SWEEP", "L.F.O" and "S/H" switches all in the "OFF" position.

CV -V/OCT

Plug a 1V/Oct source into Ch.1 "Tune" input and adjust the Ch.1 "CV-V/Oct" trimmer to give a doubling of frequency (1 Octave) at the output for a 1 Volt increase at the "Tune" input.

Repeat for channel 2

MIDI-V/OCT (Details of the required MIDI connector are given in the MIDI Document.)

First, a word on the way the SY-1M receives incoming MIDI data.

The DIP switches for setting the MIDI channel always set the MIDI channel for Ch.1

Ch.2 always receives on the next highest channel to that set for Ch.1

For example; If Ch.1 is set to receive on MIDI channel 5, then Ch. 2 will receive on MIDI channel 6 or, if Ch.1 is set to receive on MIDI channel 11, then Ch. 2 will receive on MIDI channel 12.

However, if Ch.1 is set to receive on MIDI channel 16, then Ch.2 will receive on MIDI channel 15.

Refer to the MIDI Document for DIP switch reference chart.

NOTE: The MIDI receive channel is always set on power up so to change channels you need to power down, set the receive channel and power up again.

So, with the unit powered OFF, connect a MIDI source (DAW/ Synth/Controller Keyboard) to the MIDI input.

Switch the MIDI MODE to “2” and set the MIDI channel to “1”, (All DIP switches in the “0” position)

Set your MIDI source to transmit on MIDI Channel 1

Power up the SY-1M

Send alternating notes 2 octaves apart and adjust Ch.1 “MIDI- V/OCT” until you have exactly 2 Octaves between notes. (you may do this over 3 octaves for greater precision)

Set your MIDI source to transmit on MIDI Channel 2 and repeat the process for Ch.2 (The DIP switches should of course still be set to receive on MIDI Channel 1)

That’s it! Let’s get it boxed up.

Final Assembly

Remove all nuts and washers from the I/O connectors.

Slide the board assembly into the bottom half of the case and secure to the base with the 7x M3x3mm screws provided with the kit.

Fit the I/O connector nuts.

Slowly lower the top half of the case onto the assembly making sure that everything is sitting squarely in its panel cut-out.

Fit 9x M3x5mm screws to the top of the front panel .

Fit the 4 remaining M3x5mm screws to the case sides.

Fit the 4 adhesive rubber feet

Fit the 16 Black slider caps and the Rotary Switch Knob.

SMD Caps

2 x

u47/35V

Resistors

2x 100R

2 x 560R

46 x 1k

