

Bill Of Materials for JH. FS-1A Frequency Shifter (PCB mount components listed only.)

Errors excepted, subject to modifications.

Parts marked with *) required for on-board PSU only.

Quantity	Part name	Remarks
	Semiconductors	
3	OP-07	
3	TL074	
13	TL072	
4	TL071	
1	LM358	
2	MC1496	or LM1496
3	LM13600	or LM13700 or NE5517
1 *)	LM317 T	TO220 package; needs a small heat sink
1 *)	LM337 T	TO220 package; needs a small heat sink
1	SSM2019	or SSM2017, or THAT1510 Only needed if Microphone Amp is required.
2	BC550C	or BC550B
2	BC560C	or BC560B
2	BF245A	
3	2SA733	or similar small signal pnp with ECB pinout. Attention! One of these transistors (the right one) has a different orientation than the others. (See package outline printed on PCB.) The right + middle transistor can be replaced with a 2SA1349 pair in 7-pin package, with its middle pin cut off.
6 *)	1N4002	
13	1N4148	
4	Z-Diodes 5.1V 500mW	marked as "ZF5V1" on PCB
	Tempco Resistor	
1	1k Ohm, 3000 ... 3600 ppm/K	Connect between the two contacts marked "TC" to the left and right of the 3 2SA733 transistors. Keep resistor body in close proximity to the transistor packages. May be replaced with a simple 1k resistor, if temperature compensated 1V/Oct tracking is not required. (Tracking is not overly good anyway.)
	Capacitors SMT	
35	100nF, 35V or higher, 0805	soldered on all locations that are not labelled otherwise
4	22pF, 35V or higher, 0805	"2 x 22p" etched in copper next to SMT pads
	Capacitors, Electrolytic	Polarized – note orientation! Higher voltage than specified is ok, as long as fits into the PCB space!
6	10uF, 35V	
2 *)	10uF, 25V (Tantal preferred)	near LM317 and LM337
10	22uF, 35V	
2	100uF, 25V	

2 *)	470uF, 35V	105 deg C version if available
	Capacitors, Polyester	Wima MKS, Siemens MKT, or similar
2	10nF	7.5mm
6	15nF (or other value; experiment!)	7.5mm or 5mm; marked "CAP" on PCB 2
1	22nF	7.5mm
1	33nF	7.5mm
3	100nF	7.5mm
2	100nF	7.5mm or 5mm
1	220nF	7.5mm
2	220nF	7.5mm or 5mm
3	1uF	10mm or 7.5mm or 5mm
	Capacitors, Polystyrene 5%	
2	1nF	C6 and C7 on main board
	Capacitors, Ceramic	
7	33pF	2.5mm
2	100pF	2.5mm
3	220pF	2.5mm
1	10nF	2.5mm
	Capacitors, exact value measured, or 1% Tolerance	There is no need to use 1% caps, or even the spec'ed value at all. Measure the exact value of these capacitors, and calculate the required resistor values, using the spread sheet from my web site: http://www.jhaible.heim.at/fs1a/jh_dome_filter_example.xls
1	330p	CB6, polystyrene preferred
1	1nF	CA6, polystyrene preferred
1	1.2nF	CB5, polystyrene preferred
2	2.2nF	CA5 and CB4, polystyrene preferred
2	4.7nF	CA4 and CB3, polystyrene if small enough to fit in – Polyester otherwise
1	8.2nF	CA3, polystyrene preferred
2	10nF	CA2 and CB2, polystyrene if small enough to fit in – Polyester otherwise
1	22nF	CB1, polystyrene if small enough to fit in – Polyester otherwise
1	100nF	CA1, polystyrene if small enough to fit in – Polyester otherwise
	Resistors 1%, calculated	No values can be specified for these Resistors, as they are calculated depending on the capacitor values from above. Spreadsheet for calculation available at http://www.jhaible.heim.at/fs1a/jh_dome_filter_example.xls
24	calculated	RA11, RA12, RA21, ... , RB62
	SIL Resistor Arrays	near the TL074's on PCB 2
6	10k	You need 8-pin Arrays with 4 independent Resistors.

	(or 22k or 33k or 47k)	(Don't mix them up with 8-pin arrays that contain 7 resistors with a common connection !!) You can replace each array with 4 separate resistors that are mounted vertically (a little cramped, stomp-box style, but possible).
	Trimpots, single turn	Rectangular Cermet version preferred. Check PCB layout to see what fits in.
2	10k	
5	100k	
	Trimpots, multi turn	Vertically mounted multiturn pots with set screw on top. Check PCB layout to see what fits in.
1	10k	marked "103" (code goes: 10, with 3 zeroes added. This is often printed on the actual trimpots, too.)
1	20k (or 22k)	marked "203" (code goes: 20, with 3 zeroes added.)
7	100k	marked "104" (code goes: 10, with 4 zeroes added.)
	Resistors, 1% or 2%	Metall film types.
(1)	optional, chosen	Marked "RG1" for R Gain: This is only used when you want a fixed gain in the Microphone amp. If you connect a potentiometer to the Mic_Gain connector, RG is omitted. For choosing a certain fixed gain, consult the SSM2019 data sheet for the required RG1 value.
6	10k (or other values: experiment!)	Marked "RAP" on PCB 2 for R All Pass. Defines the pole locations for the extra all pass filter stages, together with "CAP" capacitor values.
4	10	10 Ohm
5	100	100 Ohm
2	150	
2 *)	240	...
3	330	
4	430	
7	470	
9	620	
9	1k	1 kOhm
1	2k2	2.2 kOhm
2 *)	2k7	
2	4k3	...
1	4k7	
2	5k1	
2	6k2	
4	6k8	
1	7k5	
10	10k	10 kOhm
6	15k	...
2	18k	
12	20k	
1	22k	
6	27k	
18	30k	
2	36k	
1	43k	

1	51k	
1	62k	
3	68k	
2 *)	82k	
33	100k	
1	150k	
1	160k	
2	180k	
1	200k	
4	220k	
5	270k	
2	330k	
11	1M	1 MegOhm ("M" may look more like an "N" on PCB) One vertically mounted 1M Resistor is unmarked, between SigCos and Input connector on PCB 1
5	4M7	4.7 MegOhm ("M" may look more like an "N" on PCB)
	Board Connectors	Of course you can solder the wires directly to the board, and then don't need any connectors! Here's what connectors I used (from Reichelt):
28	2-pin	PSS 254/2G (2pin, 2.54mm spacing)
10	3-pin	PSS 254/3G (3pin, 2.54mm spacing)
1 *)	5-pin	PSS 254/5G (5pin, 2.54mm spacing)
1	MOTM connector (optional)	only when on-board PSU is not used. Important! Module must be close to PSU to keep oscillator bleedthru low.
1	Synthesizers.com connector (optional)	only when on-board PSU is not used. Important! Module must be close to PSU to keep oscillator bleedthru low.