AC-30 Simulator Layout from GEO

By request, I've done a layout of Stephan Moeller's AC-30 Simulator circuit, as shown at <http://www.angelfire.com/blues/stmoeller/All-Cirquits/all-cirquits.htm> and at <http://sound.westhost.com/project47.htm>. Actually, this is the third iteration, so it's been checked pretty well now.

Stephan wants a signed statement that the circuit won't be used commercially, so you'll have to follow the instructions in the web pages to get his schematic values.

Because his schematic notations overlap and are not sequential, it makes them tough to follow on a PCB, so I used a single numbering scheme per PCB (there are two) and made a translation list of my numbers to his designations. You'll have to fill in the values next to his numbers with the values you get from him, then use my numbers in the same row to populate the PCB. Sorry, but that preserves Stephan's wishes.

Note that I have not signed a release to Stephan, so I don't know the exact physical parts that go on the PCB, just that the spaces should be OK for the most commonly available parts. Builders are encouraged to tell me where the PCB spacing does not fit properly with Stephan's parts, and I'll touch up the PCB layout.

Stephan's circuit is not a complete design as shown in the publicly available information, as there are some other things which must be added to get it working. I've added what I think are the minimal necessary parts, and made it possible to substitute on the PCB for parts that I think will be hard to find.

One problem I think I've addressed is that Stephan's circuit has no tone/volume stack. Stephan set the values from the tone/volume stack to his favorite values and then substituted resistors for the pots. I have reverse-engineered the equivalent tone/volume control stack from on-line schematics of the AC30 to insert into the signal chain. It looks like Stephan just scaled the impedance of the tone controls down by a factor of 100, dividing the resistors and multiplying the capacitances by this number.

Getting the tone and volume controls brought out to the card edge proved a fairly formidable task. I spent as long reworking the layout for this final iteration as I did laying out the original.

Notes on parts lists:
(1) Rq1 on Moeller schematic is shown as a resistor to a voltage source or 1.65V. Instead of making another voltage source on the board, R13, R14, R15 synthesize this from +Ub (+15V) by the Thevenin equivalent: Veq = Vsource* (R14/(R14+R13) = 1.65V and Req = (R14*R13)/(R14+R13). You'll have to do this calculation from Stephan's specification for Rq1. If this doesn't come out to a standard value, the parallel value of R13 and R14 should be set to convenient values that give the specified 1.65V, but a lower parallel resistor value and then insert R15 in series to bring the total series resistance up to the specified value of Rq1, whatever that is. If R15 is to be used, cut the trace shorting the ends of R15.
(2) Reverse engineering the tone stack showed that CK1 should be two 2.2uF caps, not one 4.4uF.
(3) 2N2907 is the PNP complement of 2N2222. These are TO-18 small metal cans. Because this is hard to find, I printed on the board a pattern for a standard TO-92 plastic package as well. Be sure to follow the pinout notations on the parts diagram. The pads should work for either the EBC pattern of TO-92 package or the original TO-18.
(4) The schematic specifies what are clearly electro caps, but does not mention them being non polarized. I believe they have to be NP to work properly, so I've shown them that way here. The output cap will be difficult to find, 100uF NP. It's still not clear to me why the output resistor is so low (82 ohms) but that's clearly the reason for the big output cap.

Possibly Workable Substitutions:
BZX794V7 = 1N5230 = 1N750 (1/2W zener, 4.7V)
BZX795V6 = 1N5232 = 1N752 (1/2 W zener, 5.6V)
BZX792V7 = 1N5223 = 1N4371 (1/2 W zener, 2.7V)
BAT45 = 15V, 30ma superfast Schottky signal diode; it's worth trying any low current Schottky
AA119 = 1N542 germanium point contact diode; a 1N34A might work, as might OA47, OA91, etc.
2N2907 = MPS2907 = PN2907; maybe a 2N3906 would work

I also put two different footprints on the board for two parts. C9 is listed as a 100uF part, and it really should be NP. I put an extra pad on the board so you could use a 0.4" diameter part with 0.2" lead spacing, or the smaller 0.1" lead spacing, depending on what you find. Finally, Q1 is specified as a PNP metal can part. The flat sided outline and pads are for a plastic part, such as the PN2907, MPS2907, or 2N3906. The collector, base and emitter pads are marked (C, B, E) for which ever part you use.

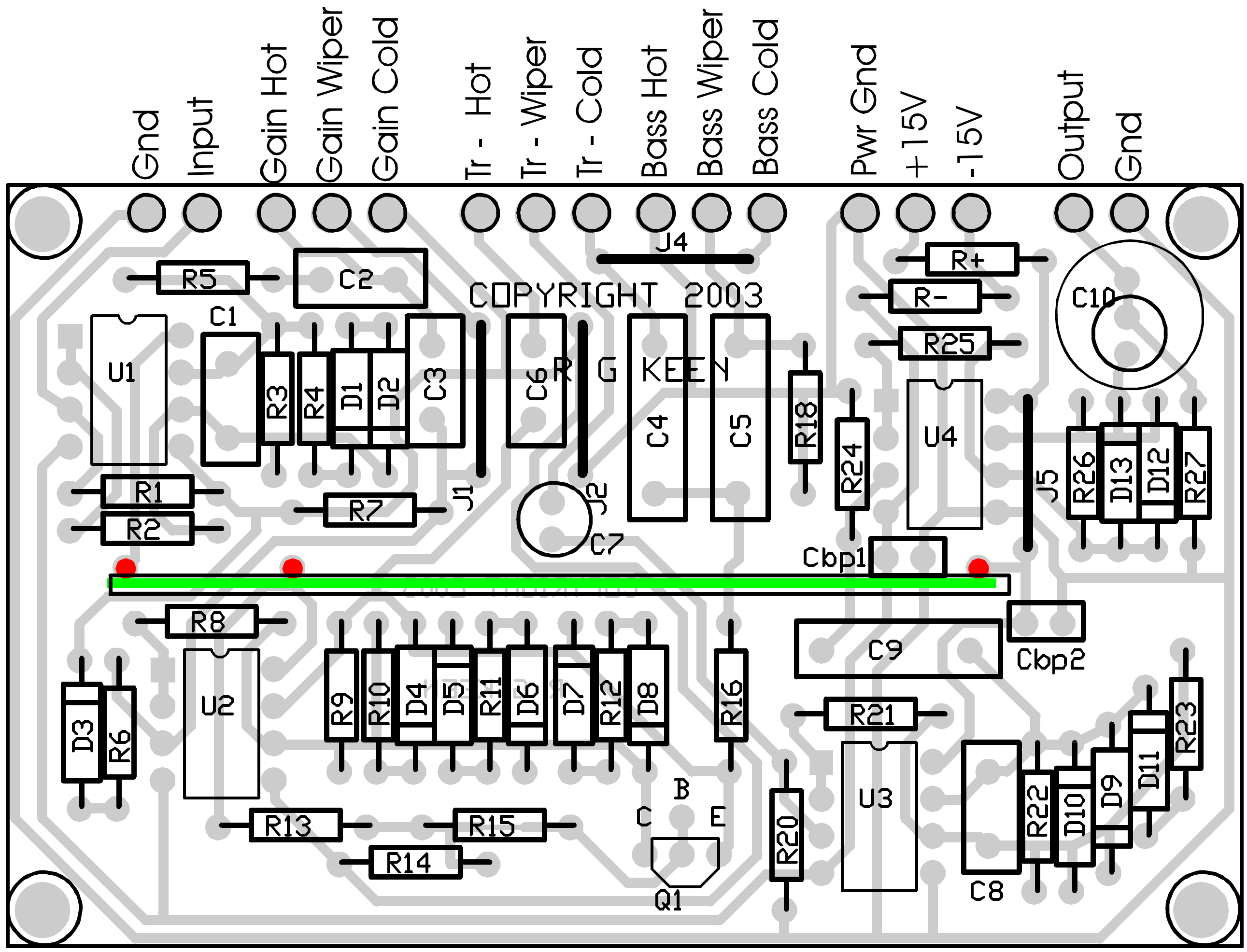
On the preamp board, the conversion for tone/volume controls made routing power and ground very difficult, so I used a power distribution buss. This is a 1/8" to 1/4" wide strip of PCB material shown as a thick green line on page 3, the parts diagram, with component leads soldered to it and through the board to the pads marked by red dots. This let me get the power distributed without even more jumpers. Solder the upwards pins first, then place the PCB strip on the top of the board and solder to it.

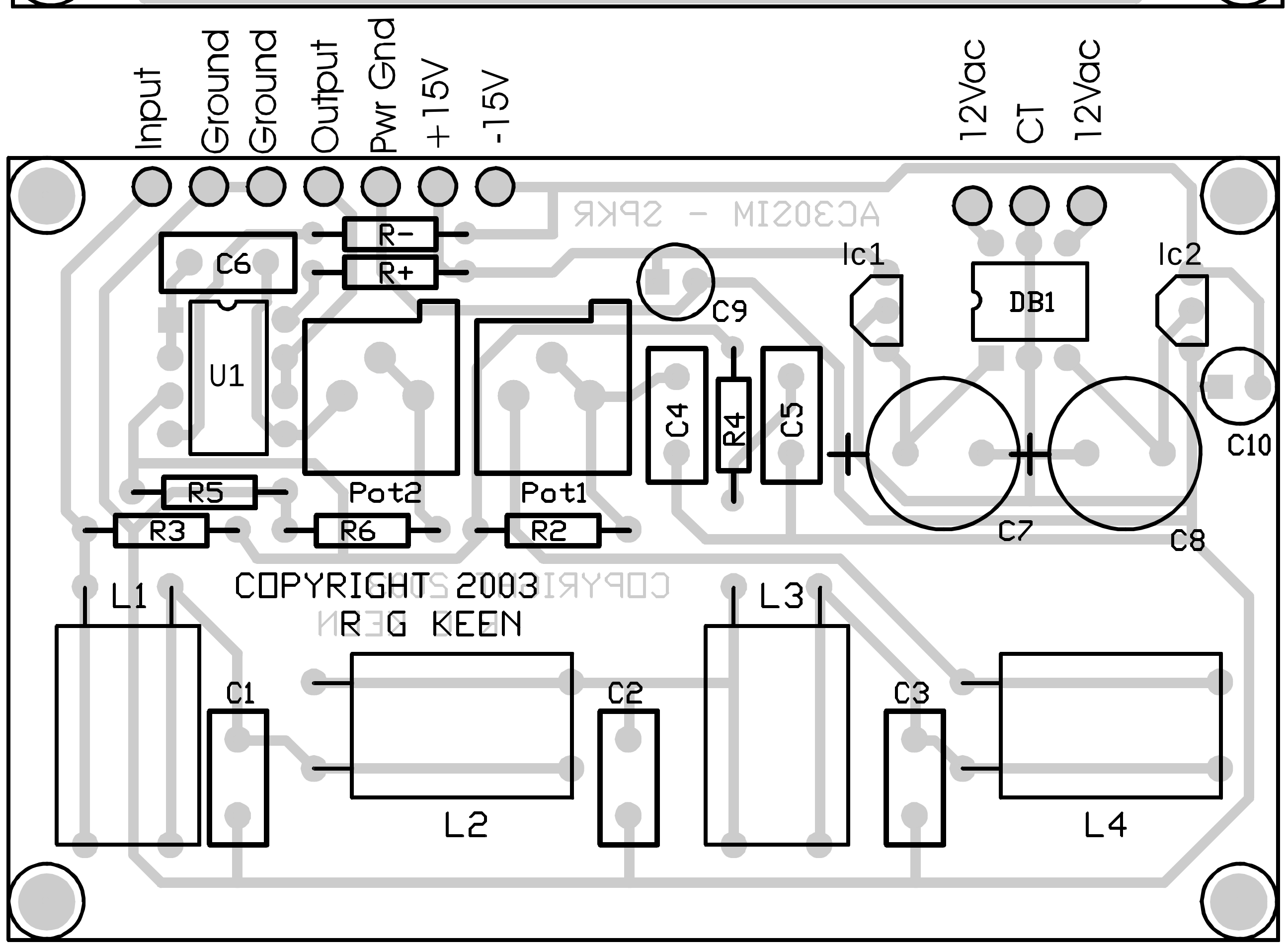
Input Preamp Page						
Geo Layout	Moeller Schm	Value		Geo Layout	Moeller Schm	Value
R1	Rin	1M		C1	Cp1	470pF
R2	R2			C2	C1	470pF
R3	R1			C3	n/a	100pF
R4	Rd12			Cbp1,2	n/a	0.1uF Cer
R5	Ra1			D1	D1	BZX794V7
R6	Rdx			D2	D2	BZX795V6
R7[1]	Re2 [1]	500K		D3	Dx	BAT45
R8	R4			D4	D8	AA119
R9	R5			D5	D4	1N4148
R10	Rd2			D6	D3	BZX792V7
R11	Rd1			D7	D6	BZX792V7
R12	Rd6			D8	D5	1N4148
R13	Part of Rq1[2]			Q1	Q1	2N2907 (3)
R14	Part of Rq1[2]			U1	U1	OPA2134
R15	Part of Rq1[2]			U2	U2	OPA2134
Second Preamp Page						
Geo Layout	Moeller Schm	Value		Geo Layout	Moeller Schm	Value
R16	RK1	1K		C4	Part of CK1[3]	2.2uF
n/a [5]	RK3	4.3K		C5	Part of CK1[3]	2.2uF
R18	RK4	100 R		C6	CK2	5.6 nF
n/a[5]	RK2	5.5K		C7	C1	10uF NP [4]
R20	Re	4.3K		C8	Cp3	470pF
R21	R2			C9	Ce2	1uF NP [4]
R22	R1			C10	Cout	100uF NP [4]
R23	Rd9					
R24	Re4	24K		D9	D3	1N4148
R25	R13			D10	D2	1N4148
R26	R14			D11	D4	AA119
R27	Rout	82 R		D12	D1	1N4148
R+	R+	68 R		D13	D5	1N4148
R-	R-	68 R		U3	U3	OPA2134
				U4	U4	OPA2134

[1] R7/Re2 is replaced by a Gain Control of 500K log taper.
[2] See text for how to calculate R13, R14, R15
[3] Ck1 is the parallel combination of two 2.2uF caps in the scaled-down tone network; see page 5.
[4] Although these are not shown as NP on the public schematic, they should be.
[5] Treble control and Bass control are 10K Log taper pots. The treble control replaces Rk2 and Rk3. The bass control is in addition to the other parts shown.

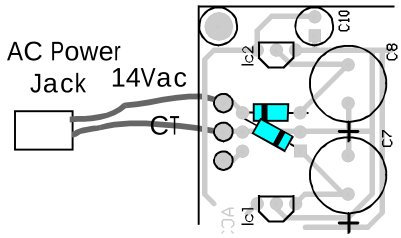
Speaker Simulator Page						
Geo Layout	Moeller Schm	Value		Geo Layout	Moeller Schm	Value
R1	R1			C1	C1	
R2	R2			C2	C2	
R3	R3			C3	C3	
R4	R4			C4	C4	
R5	R5	500K		C5	C5	
R6	R6			C6	C6	
R+	R+	68 R		C7	N/A	1000uF 25V
R-	R-	68 R		C8	N/A	1000uF 25V
L1	L1			C9	N/A	10uF 25V
L2	L2			C10	N/A	10uF 25V
L3	L3			DB1	N/A	DF04M
L4	L4			IC1	N/A	78L15
U5	U5	OPA2134		IC2	N/A	79L15
Pot 1	Pot 1	10K		Pot 2	Pot 2	250K

AC-30 Simulator - Amplifier and Speaker Emulator Boards

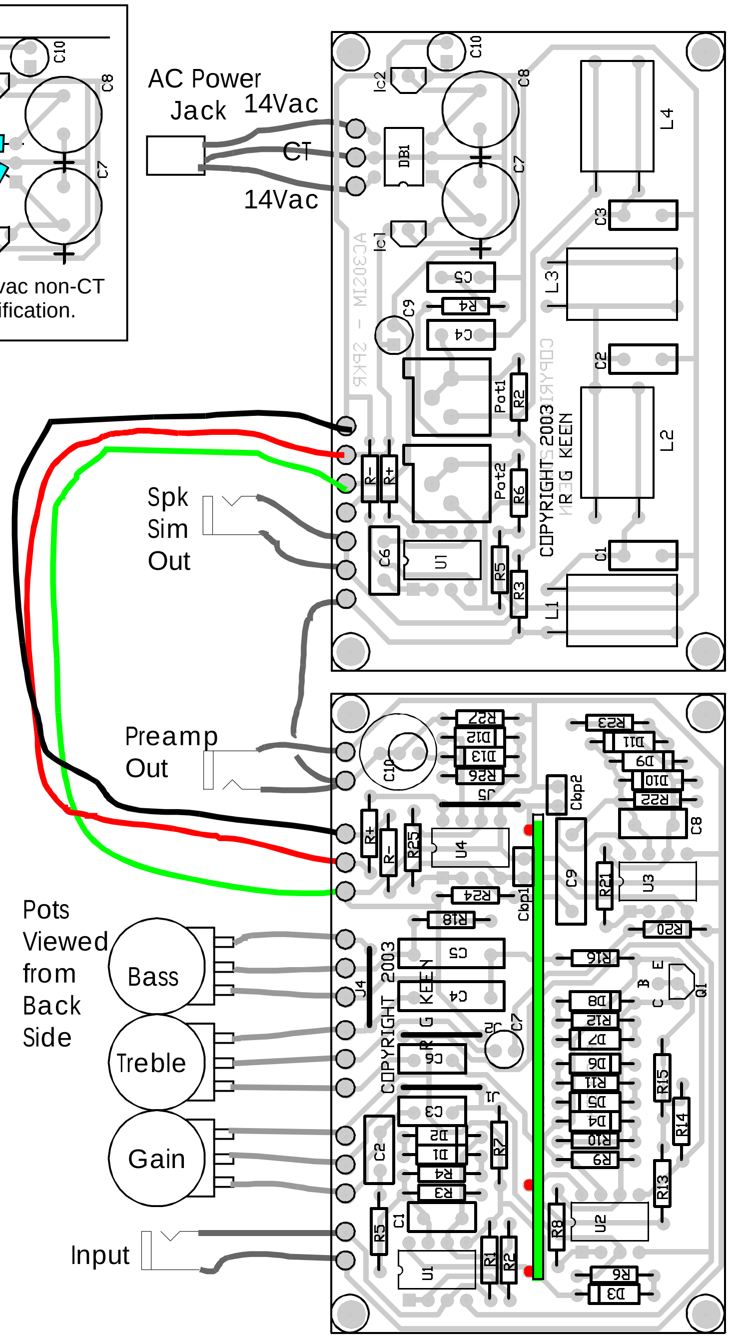


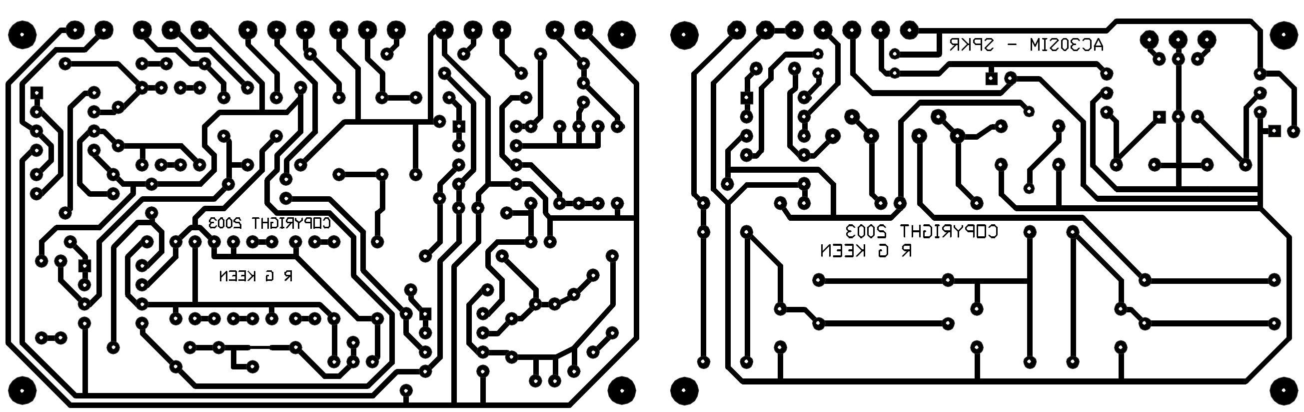


AC-30 Simulator - Wiring Diagram and Toner Pattern

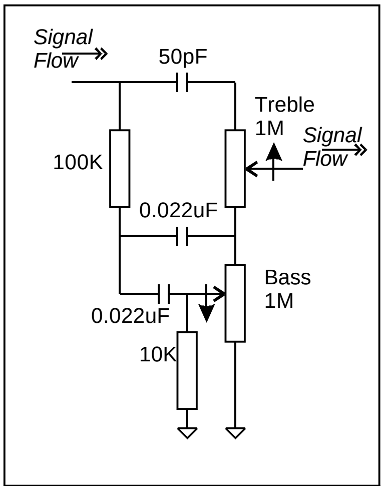


Alternate Population for 14vac non-CT power. Uses half wave rectification.

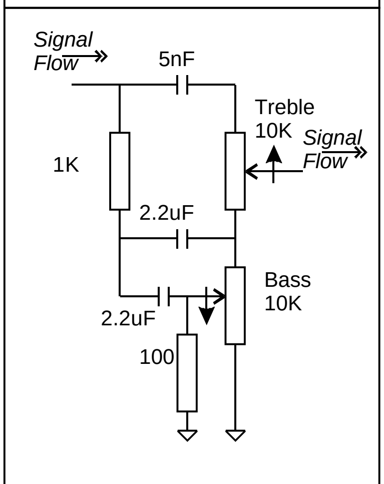




Development of the Treble/Bass Controls on the AC-30 Sim Board

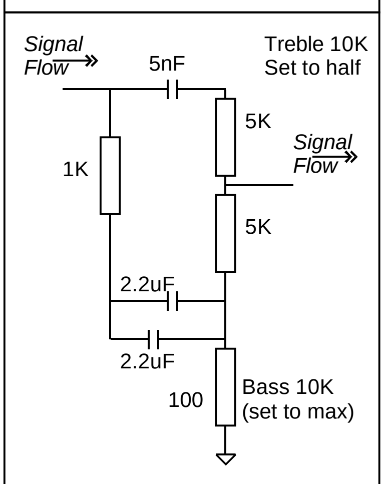


This is the original AC-30 Top Boost Treble/Bass control section, as documented in many schematics of the AC-30.

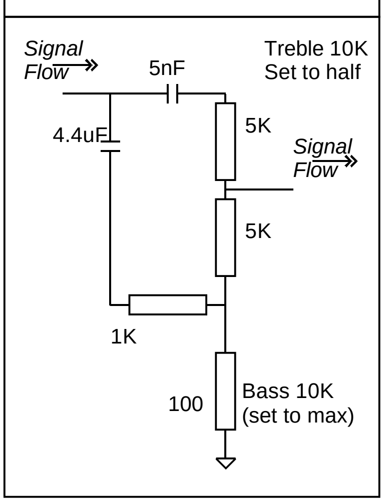


In this version, the impedances have all been scaled down by a factor of 100. That means that all resistors are 1/100th as large, and all capacitors are 100 times as much capacitance.

This is the version of the Treble/Bass circuit I implemented in my circuit board so we could use the treble/bass controls instead of having only a fixed position.



By setting the Treble control to half way and the bass control to max, and then replacing the pots with the equavalent fixed resistors, we get this circuit. The bass control becomes 10K in parallel with 100 ohms, and so it's effectively open circuit, and the 100 ohm resistor dominates the combined resistance.



Final manipulation. The two 2.2uF caps are combined to one 4.4uF cap and the 1K driver resistor is swapped with the two parallel caps. This is a perfectly fair manipulation. Two elements in series can be swapped with no effect outside the series string.

This gets us to Stephan's public version of the tone control circuit as shown.