

BALANCED MICROPHONE PREAMP PROJECT

As I said in my cheapo digital audio project document, I was going to build a microphone preamp to attach a Behringer ECM8000 measurement microphone to line input of my minidisc deck. After scanning the web to see if similar projects existed, I basically found three kinds - ones that used transformers (ie. pretty expensive to start with) and some even followed those with tubes and another transformer (damn expensive). Then there were couple of textbook implementations using SSM2017 chip in pretty much datasheet configuration, and finally, some projects based on op-amps.

After toying with idea to use SSM2017 (Analog Devices has discontinued the part, THAT 1510 is a compatible chip) I put it aside as too much trouble and expense to order the parts via Elfa catalogue which carries the part, as I did not have anything else going at a time. So, op-amp version it was.

Most electronically balanced input preamps have largely similar design for input circuitry - the phantom power is fed to microphone via two 6.81k resistors (these should be matched pair), DC is then blocked with caps and op-amp is then wired to amplify the differential signal. A circuitry is usually added in a form of zener limiter to protect op-amp inputs from large transients when the microphone is connected/disconnected or power is turned on/off.

Schematics

Well, it's pretty much a PAiA preamp - usual input circuitry followed by one half of dual op-amp rigged in fixed 20dB amplification circuitry, followed by second stage which is adjustable for up to 40dB amplification, for up to 60dB total.

The schematics shows NE5532 op-amp which I was unable to get when I shopped for parts, so I used an ancient JRC4558D op-amp which I scavenged from PCB of old Yamaha synth (some people seem to be very fond of this chip, maybe some day someone will tell me why?). Nice thing about these dual op-amps in DIP8 package is that pin layout is pretty much standard and you can just drop in a different one if you want to. So feel free to experiment, look towards op-amps with low noise and big allowed differential input voltage.

The power supply is a simple affair, supplying +-12V using 7912 and 7812 regulators. As ECM8000 is happy with only 15 volts of phantom power, I added a 7805 which I referred to +12V instead of ground - resulting in 17V output which I used for phantom power. Two things - as the circuit uses only a negligible amount of power, the regulators may need an extra load resistor across outputs for proper regulation. about 2k should be fine (the power-on led does it for 7912). Another thing which is actually related benefit - you can pretty safely raise the input voltage for regulators to get more voltage for phantom power, just use higher output voltage regulator instead of 7805 (or raise it using a zener). Make sure you stay below allowable input/output difference limit for 7812, tho (usually 40V).

Unfortunately, precision resistors are need to achieve a good CMRR using op-amp. I did not have these, so I used regular 5% ones and added small value resistors in series to adjust for exact values. On schematic drawing precision resistors are marked with asterisks. I also did not have metal film resistors which you may want to use in first stage due their smaller noise. Anyway, I did not build it for recording mic, so I used usual carbon resistors and even put two regular electrolytic caps in signal path. I will probably replace the opamp some day, but I'm happy with a current version for my purpose as it is.

Parts

I initially planned to build the whole thing using scavenged parts, but as I missed some I went shopping. Then I decided to do it differently this time to see how much the project will cost when built from off-the shelf parts (no exotic stuff like metal film resistors and polymer caps this time, remember). Two most expensive parts were a power transformer (3.7W, 230V primary, 2x15V secondaries, PCB mountable version) and a piece of breadboard (I only used less than half of it). Enclosure (plastic, easy to work with) and accessories like power switch, power cord and it's connector on a back plate were also significant cost raisers. The table below shows parts and their prices in Estonian kroon and DEM, as we have 18% sales tax in here, it is added at a bottom of table. The shop where I bought the stuff (Tevalo) is certainly not the cheapest place to buy parts, but as it was saturday others were closed. The point was to see how much the project would cost approximately, so here we go:

			eek	dem
transformer 230/2x15	1	106.38	106.38	13.30
breadboard	1	86.00	86.00	10.75
encluseure	1	38.14	38.14	4.77
power switch	1	34.92	34.92	4.37
100k pot	1	25.42	25.42	3.18
power cord	1	23.73	23.73	2.97
ne5532n	1	19.00	19.00	2.38
xlr socket female	1	18.00	18.00	2.25
rectifier	1	16.94	16.94	2.12
rca jack	1	14.40	14.40	1.80
1000u	2	9.32	18.64	2.33
power jack	1	8.47	8.47	1.06
7912	1	7.63	7.63	0.95
7812	1	7.63	7.63	0.95
7805	1	7.63	7.63	0.95
fuse holder	1	4.24	4.24	0.53
10u	3	2.12	6.36	0.80
fuse	1	1.70	1.70	0.21
dip8 socket	1	1.70	1.70	0.21
47u	1	1.70	1.70	0.21
4,7u	2	1.27	2.54	0.32
100n	3	0.85	2.55	0.32
6.2v zener	4	0.84	3.36	0.42
6k81	2	0.43	0.86	0.11
1k	5	0.43	2.15	0.27
10k	4	0.43	1.72	0.22
100ohm	1	0.43	0.43	0.05
			462.24	57.78
		with 18% tax	545.44	68.18

I also took me about 12 hours to design, assemble and debug the thing (that includes drilling and cutting holes in enclosure, assembling the schematics with point-to-point soldering using wirewrap wire, and putting it all together with some screws and hot glue). If you value your time highly, then it's probably wiser to buy a cheap preamp from a store. Of course, you'll miss all the fun of tinkering. All-in-all it was a nice weekend project for me, your mileage will vary, of course.

Subject: JRC4558
Date: Tue, 30 Jan 2001 00:44:33 +0100
From: Coen Wolters <mailto:coen@coenwolters.com> To: mast@nomad.ee

Hi,

I stumbled upon your page when I was looking for info on building a tube mic. pre-amp. You wondered why people are so fond of JRC4558 IC's. I can tell you why:
The JRC4558 was used in the Ibanez TS-808 tube screamer (an overdrive foot pedal for guitarists). This pedal has become somewhat of the holy grail for Blues/rock guitarists and everybody is trying to convert thier TS-9 tube screamer pedals into TS-808's.

