Construction of an Experimental Tetrahedral Ambisonic Microphone

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Exp2 Construction Documentation:

The Experimental 2 Tetrahedral Ambisonic Microphone construction documents are posted for the benefit of anyone who wants to build an experimental surround microphone, to hear how the air molecules around them really vibrate, and to have the opportunity to capture those sounds.

Order of Construction

The document download order is the suggested construction order and is the order assumed in writing the documents. Occasionally, there are hints or suggestions which might make more sense if this order is followed. That said, the order of stuffing the printed circuit boards before taking on the tetrahedral (or needing a mental break from building or wiring the tetrahedral) or machining the enclosures is up to the builder. Furthermore, I suggest that you at least brief all of the documents before beginning any of the construction.

Metric vs Inches

Although I have travelled greatly in the land of the metrics, I have yet to attain a working knowledge of the metric system in the form of standard machine screw and wire sizes. I would appreciate someone interpreting/making metric conversions so I can list equivalent wire, screw, and nut, sizes alongside the English values; otherwise, it will just be on the list of future work.

Parts List

One of the issues with sending out a parts list with sources is that sources are subject to the trends of the marketplace. I have attempted provide source suggestions which is current, reliable, and consistent, although it always will remain a work in progress. Some items, like screws and nuts, may depend upon your local suppliers. Finding odd things like the adapter flange and the 1/4-inch ID (internal diameter) pipe may seem like a challenge, but I found these at a local lamp shop. Surely there is a metric equivalent. If not, send me an email, and I will see what I can do. Please don't give up just because a couple of parts are not readily available.

I am not familiar with ordering parts from outside of the United States. However, the sources listed on the parts list will ship outside of the U.S. Shipping and duty fees will add somewhat to the cost.

Note on resistors: the power rating used in the parts list is the *commercial* rating, not the *military* power rating. If you order 1/4-watt military rated resistors, you will get ½-watt sized resistors; similar results from 1/8-watt. The resistors on the list are of the correct size for the printed circuit boards. Hopefully, you will not be using your microphone at temperatures much above 80^{o} C!

Printed Circuit Board

The files provided for the printed circuit board were developed on free software from ExpressPCB . I suggest that you download their software which contains both the schematic and the PCB development software (for a PC). Load the Exp2 PCB file into ExpressPCB, and you can view the double preamp board. Sorry, at this time they do not offer a Mac version.

To order the pc boards, open the ExpressPCB software, load the Exp2 PCB file, go to *Layout*, then to *Order Boards Via the Internet*. Follow the trail, and after entering your shipping information, a drop-down will ask for the type of service desired. Choose *MiniBoard Service*. On the next step, select *MiniBoard Pro*, the green solder mask is a good choice. Note that you will get 3 pc boards with MiniBoard Pro service, but it is the best price. Complete the shipping method, pay up, and the pc file is uploaded for manufacture.

You may also wish to view and print the schematic diagram. Note that the schematic file shows only one channel (one of 4 microphone capsules and one of four preamps) and the complete power section for the microphone. If you try to compare the schematic with the pc board using the software design checker, you will get errors because the component labels are the same for each preamplifier, thus duplicated for each pc board, and not all of the parts on the schematic are on the pc board.

Windscreen(s)

The Panasonic capsules are susceptible to wind in outdoor environments, and I have had experiences with air conditioning wind as well. I suggest ordering both the foam and furry windscreens from TheWindCutter.com . Order them as a set so they fit together. (See the parts list for the model numbers at http://www.thewindcutter.com/shop/index.php?main_page=advanced_search_result&search_in_description=1&keyword=SG200 .) There is a choice of furry ones. I suggest either the Soundmaster or the Stormchaser versions with the Windtech SG-200 foam windscreen.

Acknowledgements

I want to acknowledge several people who have been so important in this project.

History tells of **Alan Blumlein** wanting the actor's voice to follow movement across the film screen. Blumlein saw the need and came up with the theory of what became known as the Blumlein array.

The late **Michael Gerzon**, a man I never met though born the same year as I, and **Peter Craven**, who I did meet at the 2010 AES Convention in London. As developers of the Soundfield microphone and the psychoacoustics surrounding it, the option to have a single point capsule has so many advantages over the more vulgar arrangement of placing microphones mapped to the location of the speakers: the ability to record once and later make mathematical adjustments to allow 2- or 3-dimensional playback in multiple venue arrangements, the ability to "drive" the microphone about the soundfield, the ability to derive multiple output configurations from a single set of prerecorded files; thanks for their work and their enthusiasm to educate the audio community.

Thank you, Peter, for your continuing work in the audio field and for your spirit of sharing your knowledge and wisdom so others can learn and understand.

Allucquère Rosanne "Sandy" Stone, the director of the Advanced Communications Technologies Laboratory in the Communications School, now a professor emeritus, at the University of Texas at Austin. Sandy first introduced me to surround recording; in 5.1 with 5 individual microphones I mapped to the dimensions of the speakers in the ACTLab Studio. I had to learn how to remotely record outdoors (during a season of exceptionally regular Texas-style thunderstorms) in this mode, to learn how to edit the 5 tracks and derive the LFE track, and to learn Adobe Premiere and Dolby Digital to produce a playback medium. With the help of **Teaching Assistant Joey Lopez**, now Dr. Joey Lopez at Incarnate Word University in San Antonio, we must have burned a dozen DVDs to discover the right combination of Dolby parameters, an experiment-and-test style of education which teaches what works and what does not. Sandy believes in learning by doing and by taking risks to create new media in the true creation sense of try and improve and try again. Sandy believes in "develop and demonstrate" for projects. I often heard my completed projects for the first time in full surround at the same time my fellow ACTLabbies heard it during my presentation.

And, thanks to Sandy and the **Advanced Communication Technology Laboratory (ACTLab)** for the disc space and for hosting these documents.

Bruce Pennycook, the professor who introduced me to the word "ambisonic" and sent me on my way to make discoveries and to return with results. Dr. Pennycook must have a file drawer full of my recordings, though more from Experimental 1. Thanks, Bruce,

for your encouragement, your critical ear, and for your playback system on which to listen to the recordings.

Mark Sarisky, former Professor in the Recording Arts Program in the Butler School of Music at the University of Texas at Austin and now the Director of the new Recording Technology program at the Art Institutes of Austin, who let me run my own leash while developing my versions of the experimental ambisonic microphones. He listened to my recordings, comments, struggles, and desires, agreed or disagreed, and let me run on my leash again. I am grateful for his very long leash and very good ear.

Mark encouraged me to write the papers for the Munich and London AES Conferences. He opened a few doors to allow me to record concerts and recitals with a forest of microphone stands between the performers and their audience, a greatly improved situation with Experimental 2.

From **Henry Walmsley's** "cheap soundfield" website, http://homepage.ntlworld.com/henry01/cheap_soundfield/cheap_soundfield.htm . Exp1 was derived from Henry's circuitry and his tetrahedral form and his suggestion of the Panasonic microphones. I am following Henry's format of putting information out for the interested to see, try, and enjoy.

To **David McGriffy**, whose VVMic program I have used for conversion of the a- and b-format recordings both experimental microphones (as well as my CoreSound TetraMic and the Soundfield MKV and SPS422B) to the multitrack files I have used for playback and demonstration of the capabilities of ambisonic microphones from monaural to 9.1.

To **Siegfried Linkwitz**, for his contribution of the idea of transforming the Panasonic electret capsules from 2-terminal devices to 3-terminal devices, I thank you. The result yields improved SPL capabilities and greater output and extended frequency response on each end. His contribution allowed this project to move from beginner experimental to one that can stand proud in the concert hall without missing a beat, or, perhaps I should say, without shutting down on the tympani, the big bass drum, or the grand finale at the fireworks shows.

There are many professors, musicians, audio engineers, and students who have contributed comments and ideas about the original Exp1 and the newer Exp2. They have allowed me the privilege of recording their student's recitals and orchestral performances, even allowed my microphone in the midst of their quartet or quintet. One suggested that I build a new Exp2 for permanent use in Jessen Auditorium, one of the Butler School of Music performance venues.

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