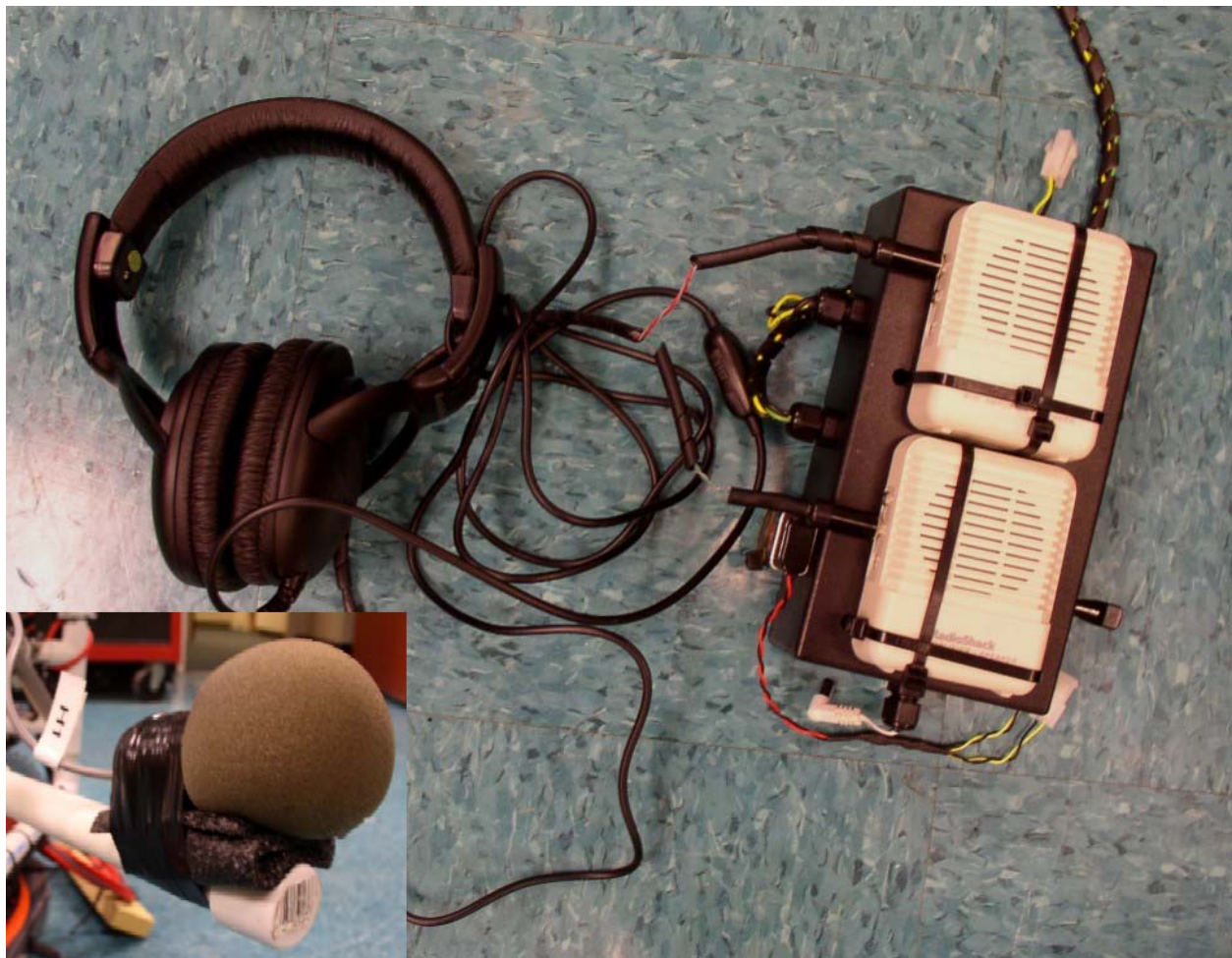


Advanced Sea Perch Stereo Hydrophone *Construction Manual*



Stereo Hydrophone Construction

A stereo hydrophone system can be used to hear the sounds surrounding your submerged ROV as if you were on-board. You will not only be able to hear what is going on around your ROV, but should be able to hear what direction a sound is coming from. For this system, we construct two separate hydrophones and hook them both up to a pair of stereo headphones. The hydrophones are mounted on the ROV in a manner that simulates the positioning of human ears, but adjusted for the speed of sound in water.

Step 1: Construct two mono hydrophones as described in the “How to build a Hydrophone” materials from the University of Rhode Island. These materials are available through a link on the Sea Perch website: <http://omp.gso.uri.edu/dosits/teacher/activity/activity.htm - hydro>. A copy of these instructions is attached at the back of this manual. Note that the instructions indicated use of a 1.5 volt battery for the microphone supply. For better sound, try using three 1.5 volt batteries in series (for 4.5 volts total), or even a 9 volt.

Step 2: Position the two Hydrophones on the ROV so that they reproduce sound as if you were hearing it with your ears. In order to do this, we need to take into account the difference between the speed of sound in air (approximately 350 m/s) and the speed of sound in water (approximately 1500 m/s). Note that these numbers vary with temperature and salinity. The ratio of the two is about 4.3 (1500 / 350). We multiply this by the distance between your ears, which is approximately 6 inches, and get spacing for the hydrophones of about 26 inches ($4.3 * 6$). Therefore, we place the hydrophones about 26 inches apart on the ROV to mimic the stereo effect created by your ears. Padding the hydrophones from the frame helps reduce noise from the thrusters, vibration, and other sources.

Step 3: Purchase or construct a dual-mono to stereo “Y” adapter. The basic wiring of such an adapter is shown in the diagram on the following page. These adapters can be purchased at Radio Shack (Item # 42-2495), or can easily be constructed with two 1/8” male mono plugs, one 1/8” female stereo jack, some wire, and a little soldering.

Step 4: Plug the two mono plugs of the Y adapter into the headphone sockets of the two hydrophone amplifiers. Plug your stereo headphones into the stereo jack of the Y adapter, and slowly and carefully turn on the amplifiers.

Step 5: Check that the left and right channels are correct. Tap one hydrophone and then the other and make sure that the left hydrophone shows up in the left ear, and the right hydrophone in the right ear. If it is reversed, simply switch the plugs on the Y adapter from one amplifier to the other.

Note: In order to minimize electrical noise in the hydrophone system, it is advisable to keep the cords and power supplies for the hydrophones and amplifiers separate from those for the thrusters and other systems.

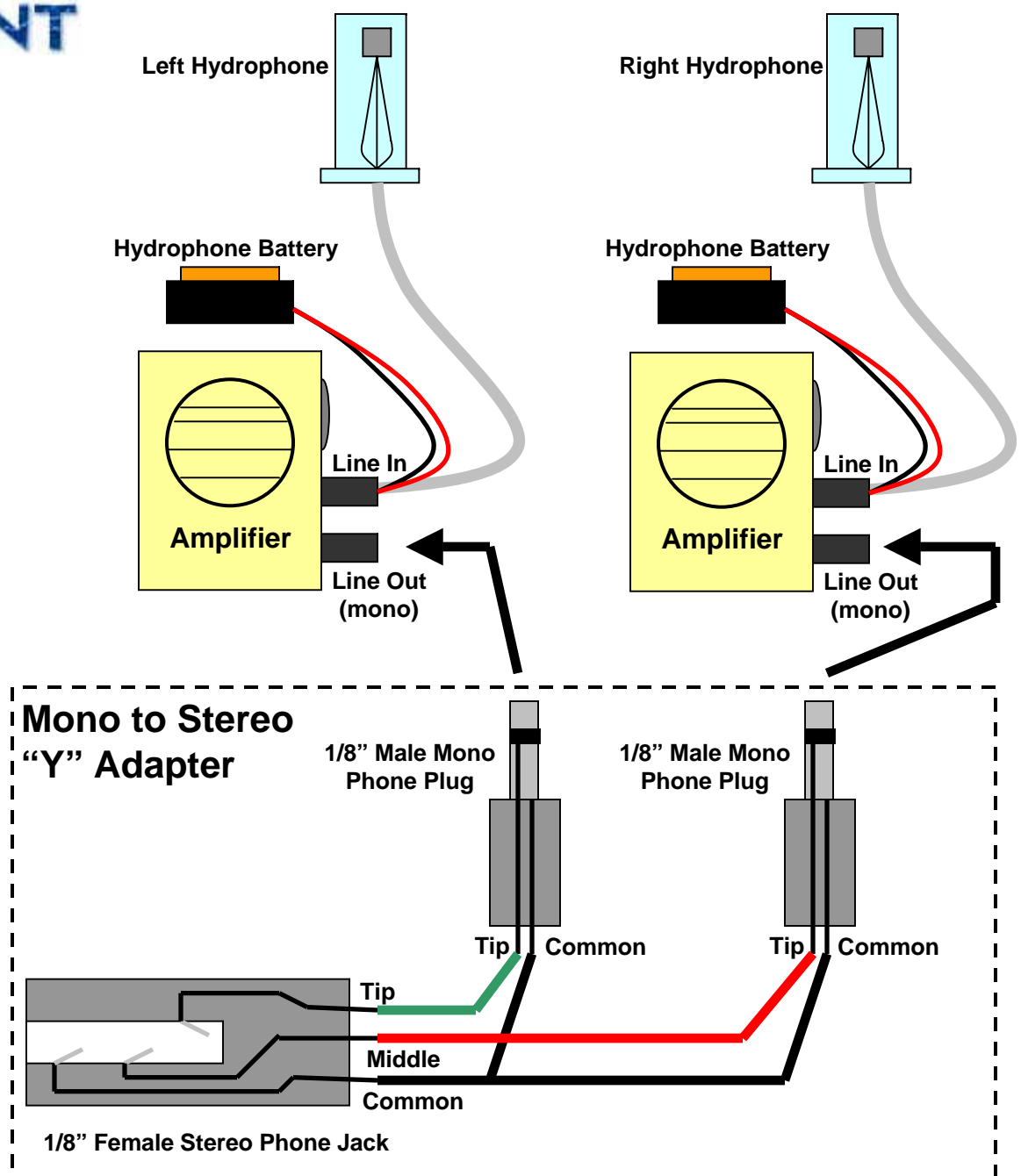
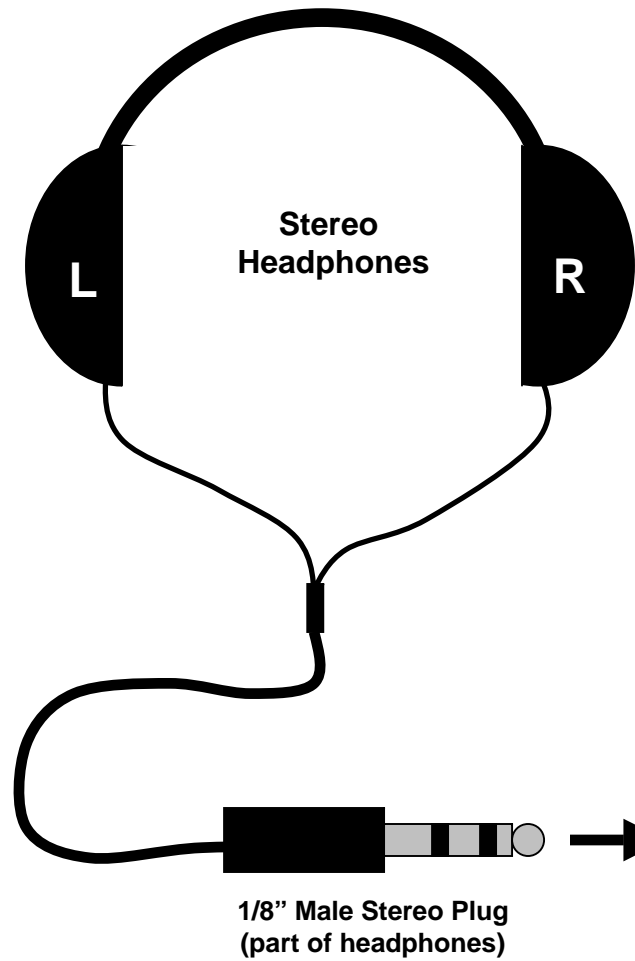


Stereo Hydrophone system headphones and amplifiers mounted on control box.



Dual Hydrophones mounted on Sea Perch frame, with foam covers.

Stereo Hydrophone Wiring Layout



How to Build a Hydrophone

Introduction:

It was once thought that the oceans were a silent place. However, if you were to drop a hydrophone or underwater microphone into the water, you would soon discover that the underwater world is quite noisy. A hydrophone picks up acoustic signals and then transfers the sounds into a receiver that allows you to hear them. The following instructions allow you to inexpensively (under \$40) build your own hydrophone. Use this hydrophone to hear sounds in your aquarium or go down to the beach and drop it in the water.

Materials:

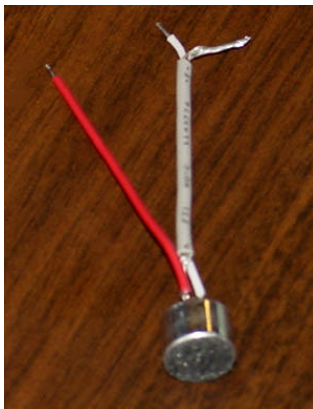
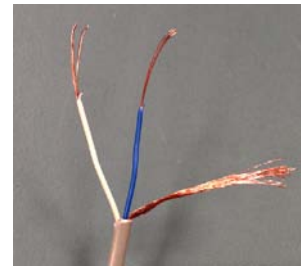
Quantity	Radio Shack Item #	Description
1	270-092c	Condenser Microphone Element**
1	278-513	Audio Cable, 2 conductors (#24) plus shield** 25+ feet
1	274-286a	two conductor, 1/8" mono phone plug**
1	277-1008c	Mini Audio Amplifier/Speaker**
1 roll	64-2352	black tape, rubber electrical (NOT PVC tape!)
1	270-402	Battery holder, fits 1 "C" cell**
1	23-871	Battery, "C" cell, Alkaline**
3 ft	NA	Wire, Insulated, #24. 1 ft of orange, white, blue**
1	NA	35mm plastic film canister
1/4c	NA	Vegetable or mineral oil
1	NA	9V battery for amplifier/speaker**
1	NA	Soldering iron and solder**
1	NA	Wire stripper**
1	NA	Silicone Seal

** These Items can be found at Radio Shack



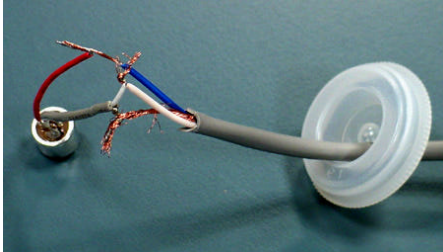
Instructions:

1. Strip the end of the audio cable so the three wires are exposed (blue, white & ground {copper}). Strip the ends of the two wires (blue & white) about 1 cm.

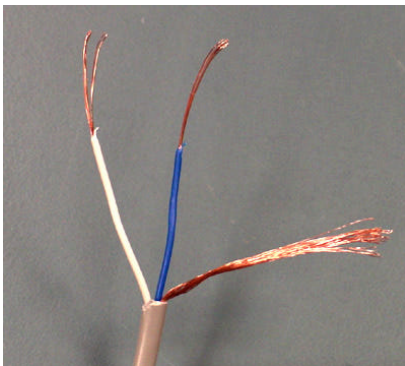
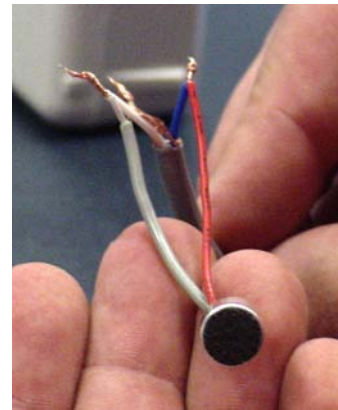


2. Strip the ends of the wires connected to the microphone element, so that three wires are exposed (red, white & ground {copper}).

3. Make a hole in the lid of the film canister about the width of the audio cable and thread the audio cable through the hole.



4. Connect the wires by twisting the two together, as follows:
- Signal from the audio cable to the signal from the microphone element (white to white)
 - Power from the audio cable to the power from the microphone element (blue to red)
 - Ground wire from the audio cable to the ground wire from the microphone element

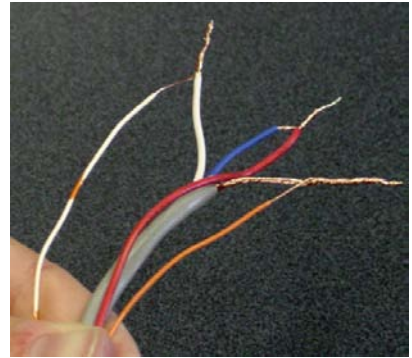
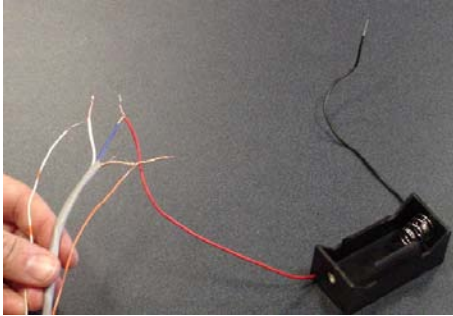


5. Strip the other end of the 25ft audio cable so the three wires are exposed. Strip the ends of the two wires (blue & white).

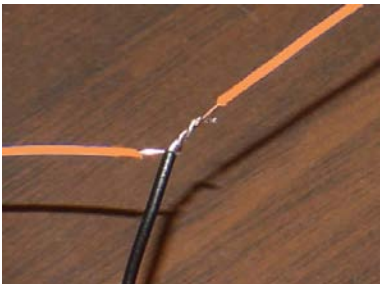
6. Strip both ends of the two insulated #24 wires (make sure you have two different colors, i.e. orange and white).

7. Connect the wires as follows:

- One end of the insulated #24 wire to the audio cable signal wire (white to white)
- One end of the other colored insulated #24 wire to the ground wire from the audio cable (orange to ground)
- Power from the audio cable to the wire from (+) end of the battery pack (blue to red)

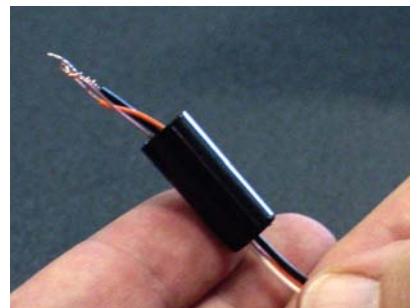


8. Strip a centimeter long piece in the middle of the 2nd insulated #24 wire (orange, ground) about an inch down from the end.



9. Connect the wire from the black (-) end of the battery pack to part of the orange, ground insulated #24 wire (black to orange).

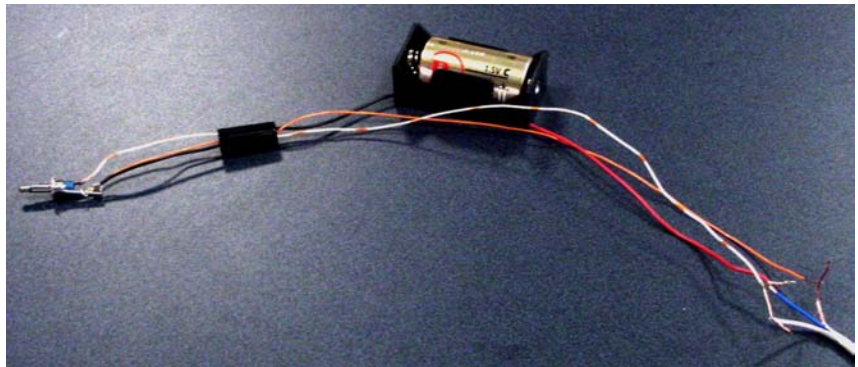
10. Feed the ends of the two insulated #24 wires through the cover of the phone plug.



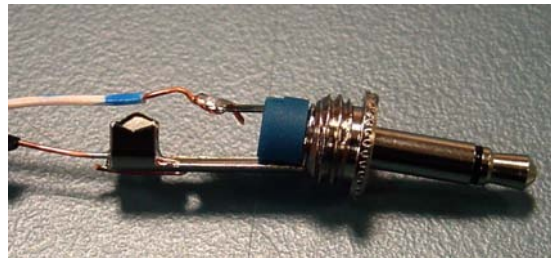
11. Connect the signal insulated #24 wire (white) to the smaller piece of the phone plug (white to phone plug), by feeding it through the little hole in the phone plug and twisting.

12. Connect the ground wire (orange) to the longer piece of the phone plug (orange to phone plug).

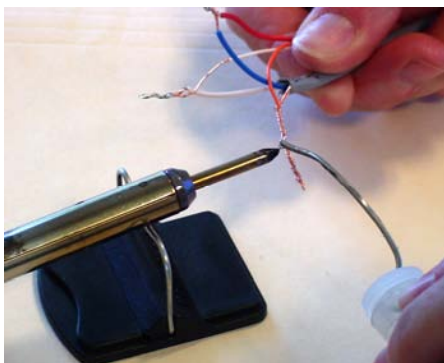
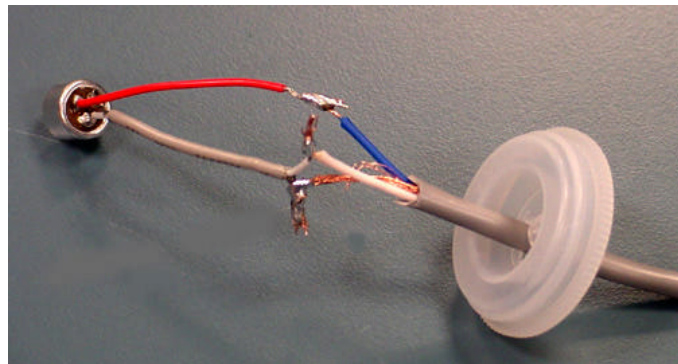
13. Add batteries to the battery pack and speaker/amplifier, put the phone plug into the speaker and test connections.
**Remove batteries and continue if it works, if not, find the wiring fault.



14. Solder the ends of the 2 insulated #24 wires to the phone plug (white and orange).



15. Put the cover onto the phone plug.



16. Solder all wire connections.

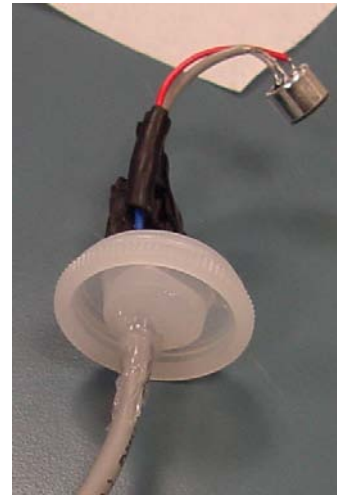
17. Using the black rubber electrical tape, tape around each of the soldered ends, so that no piece of the wires is exposed.



18. Put silicone seal over the end of the audio cable, which connects with the end of the microphone element (these ends should already be soldered and taped).



19. Put silicone seal underneath the lid of the film canister where the hole was made for the audio cable. Put a blob of silicone seal on the top of the lid as well.



20. Fill the film canister to the top with mineral oil.



21. Place the lid onto the film canister, trying not to get any air bubbles. An air bubble may cause the film canister to compress and change shape due to the pressure in deep waters. This should be done over a sink so excess mineral oil can spill over.

22. Wipe the film canister down with soap and water to remove excess mineral oil.

23. Using the black tape, tape the lid onto the film canister.

24. Plug phone plug into the amplifier/speaker.

25. Attach a weight to the film canister. This will allow the film canister to sink.



Finished Hydrophone:



Notes:

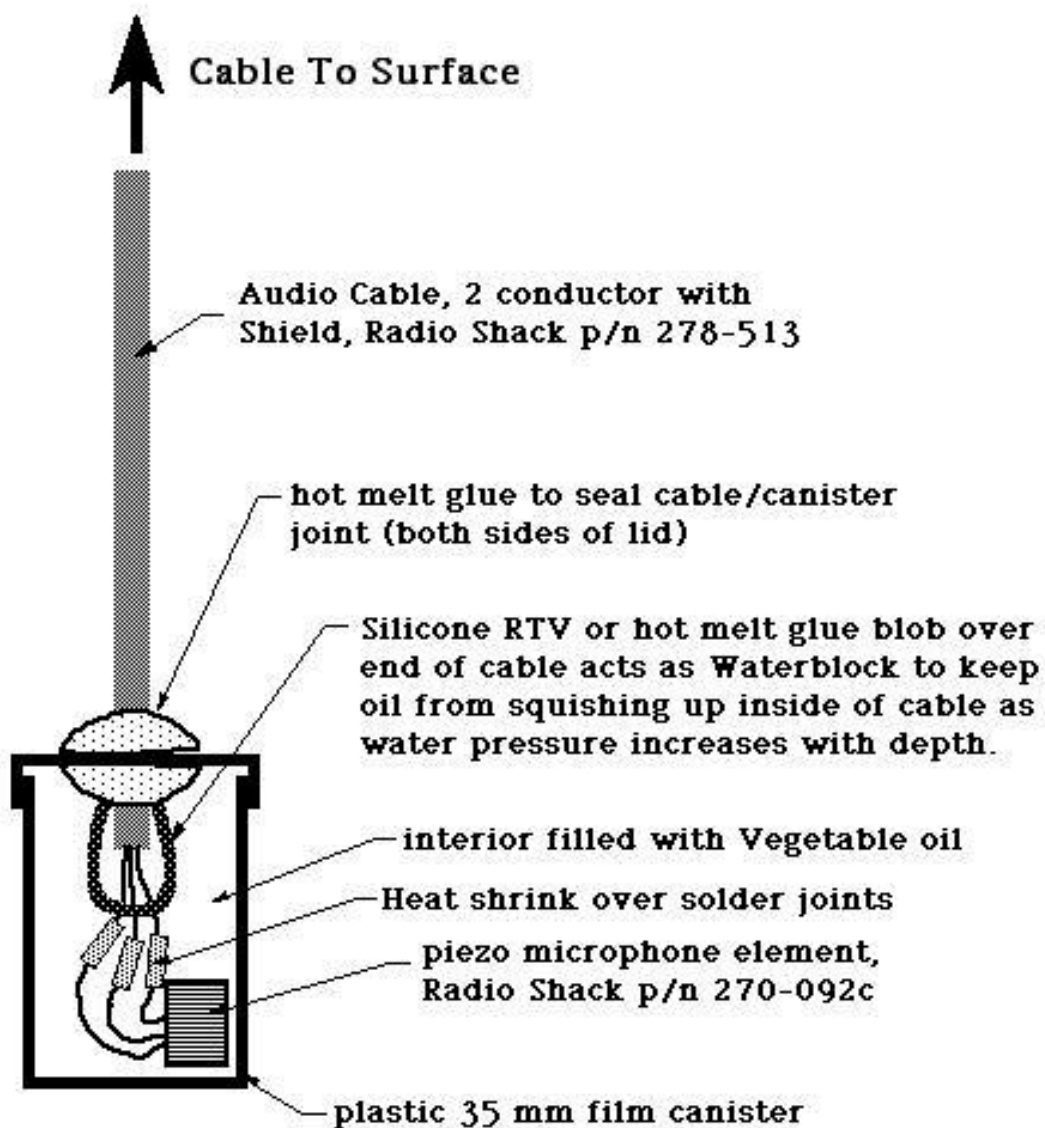
- The first couple of times the hydrophone is placed into water, a little of the oil may leak from the lid of the film canister. This is leftover oil from the assembly process. Place the hydrophone into a container of water to get rid of this leftover oil before putting it into the a fish tank, seawater, etc.
- It is important to attach a weight a little above your hydrophone. The oil in the canister allows the hydrophone to float therefore a weight (heavy rock, lead fishing weight) will enable the hydrophone to be pulled to a good depth.

References:

Watlington, F., 1979. How to Build & Use Low Cost Hydrophones. TAB Books, Blue Ridge Summit, PA (currently out of print)

Acoustics and Sonar Information Resources
<http://www.aticourses.com/acoustics.htm>

Acoustic Thermometry of Ocean Climate, Scripps Institution of Oceanography/UCSD
<http://atocdb.ucsd.edu/>

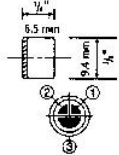


BUILD A HYDROPHONE
HYDROPHONE MECHANICAL SCHEMATIC
 Kevin Hardy
 Scripps Institution of Oceanography/UCSD
 000218

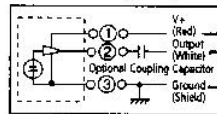
**Battery, 1.5v (C or AA)
(Remove from
Battery Holder
to turn off.)**

Condenser microphone features wide-range response and omnidirectional pickup pattern.

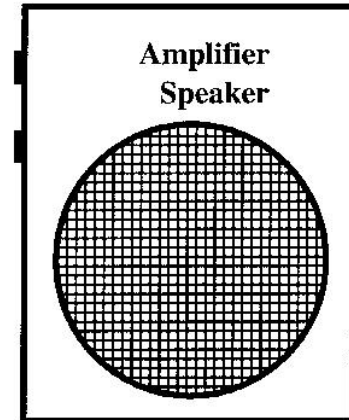
Outer Dimensions



Wiring Diagram



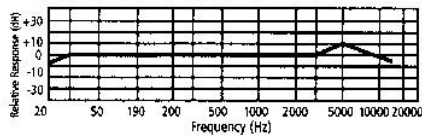
Plug



Electrical Characteristics

Supply voltage: (V+) 1.5 to 10VDC
 Nominal supply: 4.5VDC
 Current drain: 0.5mA (max)
 Signal/noise: 40dB (min)
 Sensitivity: $-65 \pm 4\text{dB}$
 (0dB ref 1V/ μbar at 1kHz)
 $V_{CC} = +4.5\text{V}$, $R_L = 1\text{k}\Omega$
 Output impedance: 1k Ω (max)

Typical Frequency Response



Made in Taiwan
 Custom Packaged in USA for RadioShack
 A Division of Tandy Corporation, Fort Worth, TX 76102

BUILD A HYDROPHONE

HYDROPHONE ELECTRICAL SCHEMATIC

Kevin Hardy

Scripps Institution of Oceanography/UCSD

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