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**ANG-2200**

**Acoustic Noise Generator**

**Owner's Guide**

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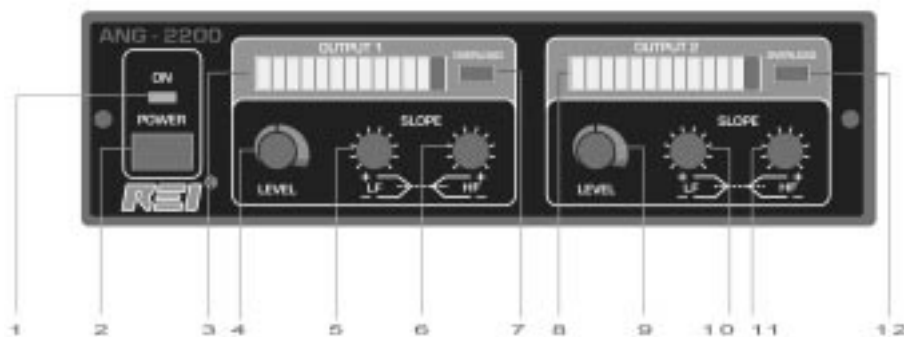
**ANG2200**

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REI would like to thank you for purchasing the ANG-2200 acoustic noise generator. The ANG -2200 is designed to help in the defense against listening devices undetected by conventional countermeasures. The combination of the ANG-2200, proper transducer and speaker installation, and an educated user makes a strong perimeter of protection.

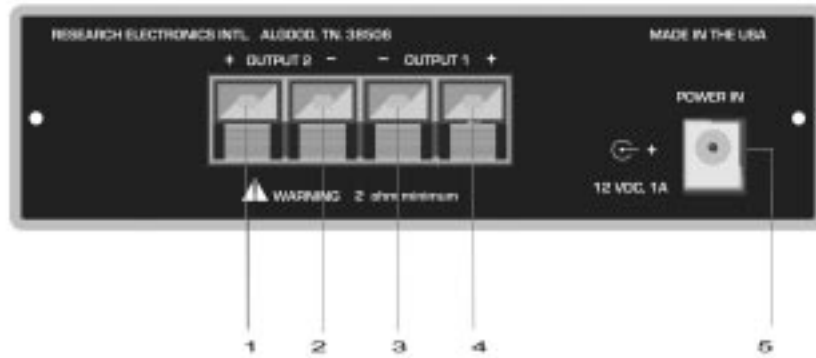
This instruction manual covers the installation, wiring, and testing of the ANG-2200.

REI recommends a thorough countermeasure's sweep accompanied by a physical search be performed prior to the installation of the ANG-2200.



**Figure 1**

1. On Indicator
2. Power Switch
3. Level Indicator – Output 1
4. Level Control – Output 1
5. Low Frequency Control – Output 1
6. High Frequency Control – Output 1
7. Overload Indicator – Output 1
8. Level Indicator – Output 2
9. Level Control – Output 2
10. Low Frequency Control – Output 2
11. High Frequency Control – Out put 2
12. Overload Indicator – Output 2



**Figure 2**

1. Positive Terminal – Output 2
2. Negative Terminal – Output 2
3. Negative Terminal – Output 1
4. Positive Terminal – Output 1
5. DC Power In – 12Vdc, 1A

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## ACOUSTIC EAVESDROPPING

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Sound vibrates surfaces such as walls, glass, and doors. A contact microphone can pickup these vibrations and transmit the information along wires or modulate it onto radio waves to be received by an unwanted listener residing outside the room. Laser and microwave beams reflected off these surfaces are modulated with the information and pose the same threat.

Vibrations caused from talking in a room can be transferred along air ducts, plumbing, walls, ceilings, etc. These vibrations can have the ability to be intercepted and monitored by persons several floors or rooms away. This means that even though a room has been cleared of eavesdropping devices, the voice information from within that room may still be vulnerable.

The ANG-2200 system sets up a perimeter of noise around a room that creates a sound barrier to disrupt voice leakage. The TRN-2000 transducers are designed to inject masking noise onto the room surfaces while the OMS-2000 speakers are used to provide protection in open air spaces such as in closets, above ceiling tile, and in crawl spaces. This method provides a much greater masking noise envelope while producing less obtrusive noise in a room than a loudspeaker.

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## TRULY RANDOM NOISE

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The ANG-2200 contains two separate random noise generators. There are several products in a host of markets that use noise generators, but most of these use pseudo-random noise. Pseudo-random noise is generated by a mathematical formula or a precalculated list of values and is in most cases predictable. This predictability allows for the chance of a sophisticated eavesdropper correlating on this predicted noise and extracting the room's information. True random noise is completely unpredictable and eliminates this threat.

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## VOICE MASKING

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The human voice produces a myriad of frequencies when producing speech. The frequencies and their strengths are dependent on the individual and the sound he or she is making. The spoken word typically produces frequencies in the range of 100Hz to 6000Hz. Intelligible speech resides in the range of 300Hz to 3000Hz. This means that though the voice has lower and higher frequencies, the ability to understand the differences in sounds in order to create speech consists of a smaller frequency range. The ANG-2200 shapes its noise spectrum to allow for more energy within the intelligible frequency band. This shape allows for greater efficiency, better protection, and a lower obtrusive noise level.

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## OPERATION

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The ANG-2200 uses a combination of transducers and speakers placed strategically throughout a target area to create a blanket of masking noise that covers private conversations from eavesdropping. Each transducer utilizes adapters for mounting to a variety of surfaces such as walls, windows, ductwork, plumbing, etc. When transducers are mounted to surfaces, the surface's material can change the shape of the ANG-2200's frequency spectrum, altering the effectiveness of the noise. The LF and HF slope controls are used to equalize the noise back to the correct shape that is required to mask intelligible speech. The two separate channels allow the user to tailor the noise for separate surface materials, allowing greater flexibility and increased protection.

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**COUNTERSURVEILLANCE**

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*Attn: Devices, which are planted in close proximity to the target speaker's voice, may not be masked by the ANG-2200 because it is designed to protect the perimeter of the target area. A sweep and physical search are still recommended on a regular basis.*

Countersurveillance is a continual challenge for security. The security individual must constantly be on guard for new techniques and technologies. Only through routine education and state of the art tools, can security feel confident about the job that they perform. Research Electronics believes and promotes this idea by hosting regular courses at their TSCM hands-on classroom facility and offering new cutting edge products. Make sure to regularly check the web site at <http://www.research-electronics.com>.

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**INTRODUCTION**

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The ideal installation would be accomplished during construction or remodeling where sensitive points in the structure can be protected with transducers built into the building's structure. If this is not possible, the transducers can be placed directly onto wall surfaces. If visual appearance is a problem, the transducers should be disguised or covered accordingly.

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**QUANTITY REQUIRED**

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Determine the quantity of transducers needed by these recommendations:

**WALLS** – One placed every eight linear feet, centered between floor and ceiling. Mount on or within 6 inches of a stud.

**FLOOR and CEILING** – One centered on every 64 square feet. (Use the OMS-2000 speaker for drop ceiling.)

**WINDOWS** – One placed on every major frame of glass within 6' of the corner.

**DOORS** – One placed adjacent to the center hinge on the doorframe.

*Note: "Shielded Screen Rooms" are shielded against R.F. devices transmitting out of the room, but not necessarily against acoustic leakage. During Construction or remodeling of a screen room, the transducers can be mounted on the frame members, and then acoustic insulation and a decorative panel can be installed to the inside wall surface. This will help isolate the noise generated from the room as well as decrease the acoustic leakage out of the room.*

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**MOUNTING**

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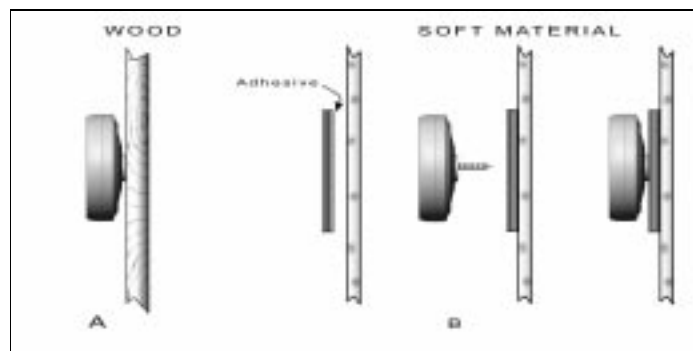
Three basic mounting methods are suggested for transducers: Direct Screw for solid surfaces; Hollow Wall Anchor for drywall (sheetrock), plaster, and other soft or brittle materials; and Plastic Disk for flat, smooth surfaces like glass and plastic.

*Attn: Always mount the transducer before connecting the wiring. The tabs supplied with each transducer easily push on to the lugs. This eliminates twisting the wire.*

**Direct Screw Mounting**

A “Screw Adapter” is provided with a dual head. One end has 10-24 machine screw threads for the transducer, the other has coarse tapered threads to be used in solid materials such as wood.

- If the surface is a solid material such as plywood, studs, or wood beams, the transducer can be mounted directly.
  1. Thread Screw Adapter into the transducer.
  2. Drill a 1/8” pilot hole in the wall.
  3. Screw the transducer clockwise into the pilot hole until it is flush to the surface. **DO NOT TIGHTEN EXCESSIVELY.** (figure 3A)
- If the material is soft such as ceiling tile or drywall, use a piece of plywood and adhesive to attach the transducer to the softer material.
  1. Drill a 1/8<sup>th</sup> pilot hole in the center of a 3-inch square (for drywall) to a 12-inch square (for ceiling tile) piece of 3/8” or 1/2” plywood.
  2. Attach plywood to surface with adhesive or epoxy glue.
  3. Thread the Screw Adapter in the transducer. (figure 3B)
  4. Screw the transducer clockwise into the pilot hole until it is flush to the plywood. **DO NOT TIGHTEN EXCESSIVELY.**

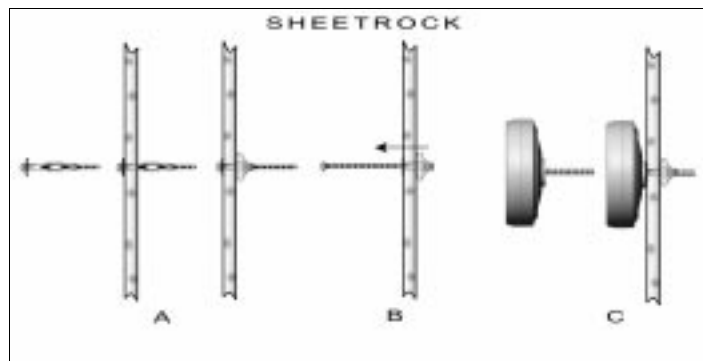


**Figure 3**

**Hollow Wall Anchor Mounting**

For walls with fragile surfaces such as drywall, plaster, or thin paneling, the transducer can be attached with a hollow wall anchor.

1. Use the 10-24-thread size hollow wall anchor included with the transducer. Drill a 7/16" hole and insert the anchor. Thread the screw until the wall anchor is tight. (figure 4A)
2. Remove the screw from the wall anchor. (figure 4B)
3. Screw the 10-24-threaded rod included with the TRN-2000 into the transducer.
4. Turning the transducer clockwise into the wall fastener, tighten the TRN-2000 until it is firm. DO NOT TIGHTEN EXCESSIVELY. (figure 4C)

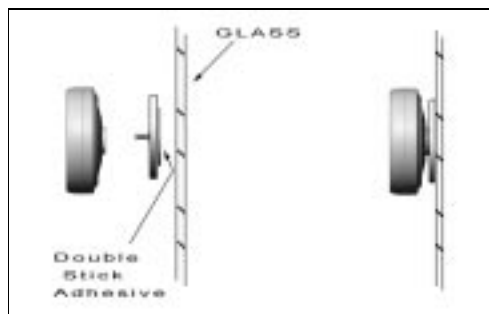


**Figure 4**

**Plastic Disk Mounting**

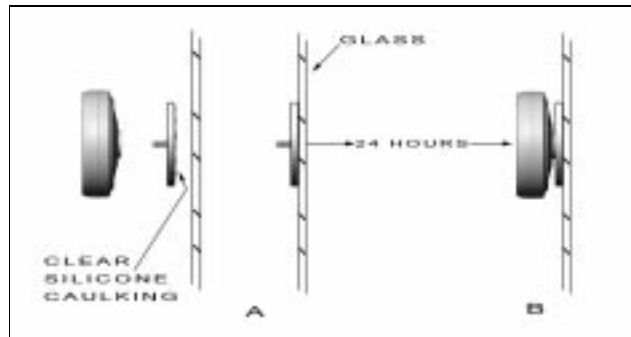
The transducer may be attached to plate glass windows or other smooth surfaces using the plastic-mounting disk. The glass must be firmly mounted to avoid vibration.

- 1a. For temporary mounting, use double-stick tape included with the plastic disk and press the disk firmly to the clean and dry surface. (figure 5)



**Figure 5**

- 1b. For permanent mounting, discard the double-stick tape and use a small amount of clear silicone exterior caulking compound. Place a small thin layer across the disk and press firmly and evenly to minimize air bubbles. This method provides better coupling for high frequency response. Allow the adhesive to set as recommend by the manufacturer (usually 24 hours). (figure 6A)
2. Screw the Transducer clockwise onto the plastic disc until firm. **DO NOT TIGHTEN EXCESSIVELY.** (figure 6B)



**Figure 6**

*Attn: Be sure not to over tighten the transducer, the plastic insert may be damaged.*

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**INTRODUCTION**

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Omni Masking Speakers should be placed above ceiling tile, in storage rooms that are inside the target area and do not have transducers installed on the adjacent walls, or within crawl spaces that do not have protection.

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**QUANTITY REQUIRED**

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Determine the number of speakers needed by these recommendations:

Drop/Tiled Ceiling – One centered on every 81 square feet.

Closets/Crawl Spaces – One suspended half the height of the room; centered on every 81 square feet.

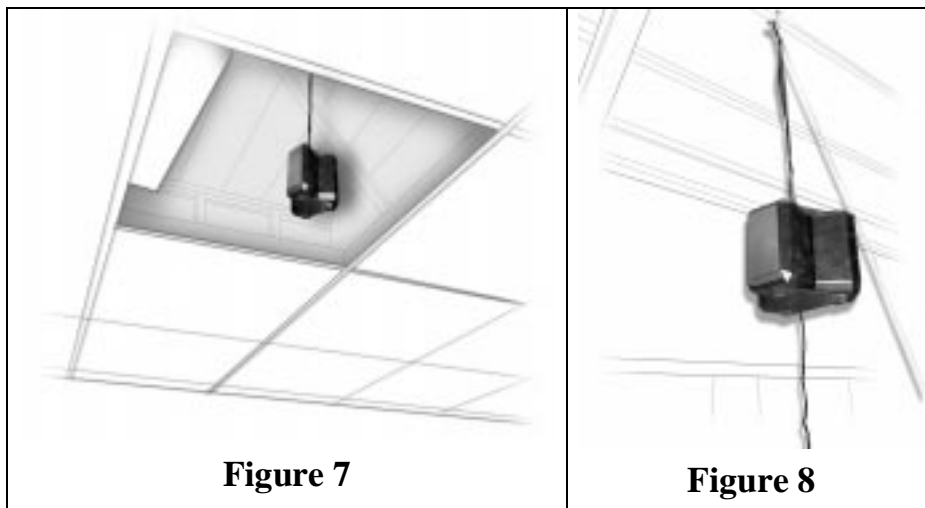
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**MOUNTING**

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Speakers are usually hung by the cable. The environment in which it is placed is the determining factor of its height positioning.

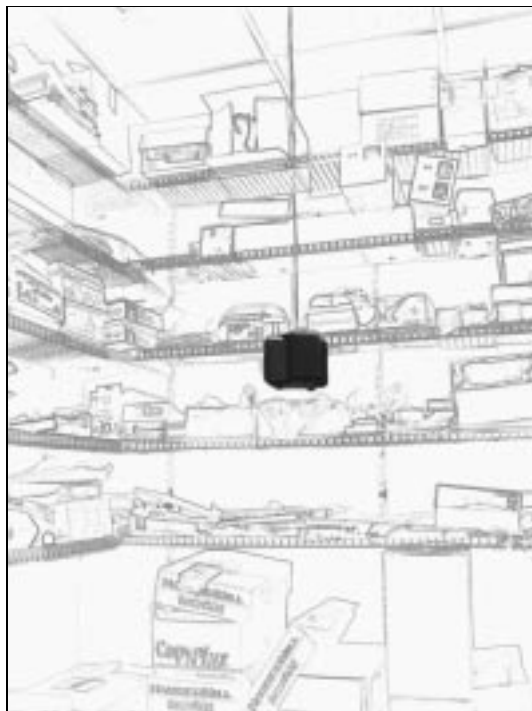
Drop Ceiling – Hang the speaker one to two feet above the ceiling tile. (figure 7 and figure 8)



**Figure 7**

**Figure 8**

Closets/Crawl Spaces – Place the speaker centered in the space halfway between the floor and ceiling. (figure 9)



**Figure 9**

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**INTRODUCTION**

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The ANG-2200 combats the problem of acoustic leakage by injecting noise onto the surface perimeter of a target area. The diversity of the perimeter (walls, windows, floors, ceilings, etc) creates a challenge for controlling levels and the frequency spectrum of the noise. REI addressed this challenge by providing two independent channels with separate frequency control. Two channels allow the user to group similar perimeter surfaces together for level and noise voicing control. In large areas, more than one ANG-2200 should be employed.

When diagramming a room for acoustic protection, the following rules are recommended for good system operation:

- Group solid cement/concrete walls and floors on the same channel at full level when necessary.
- Group windows and OMS-2000 speakers on the same channel when necessary.
- Do not mix speakers in series with transducers. Their impedance are different.
- Use resistive attenuators (figure 10) provided by Research Electronics when transducers are needed at 1/2 Level and 1/3 Level, but there is not the correct number of transducers to divide the level down. Example: 1/3 level is needed but there are only two transducers. Use a 6-ohm resistive attenuator in series with the two transducers to achieve 1/3 Level.



**Figure 10**

*Attn: Damage to your ANG-2200 may occur if improperly wired. Minimum total load is 2 ohms. When a load less than 2 ohms is connected and the level is turned up, the Overload Light will turn on (figure 11).*

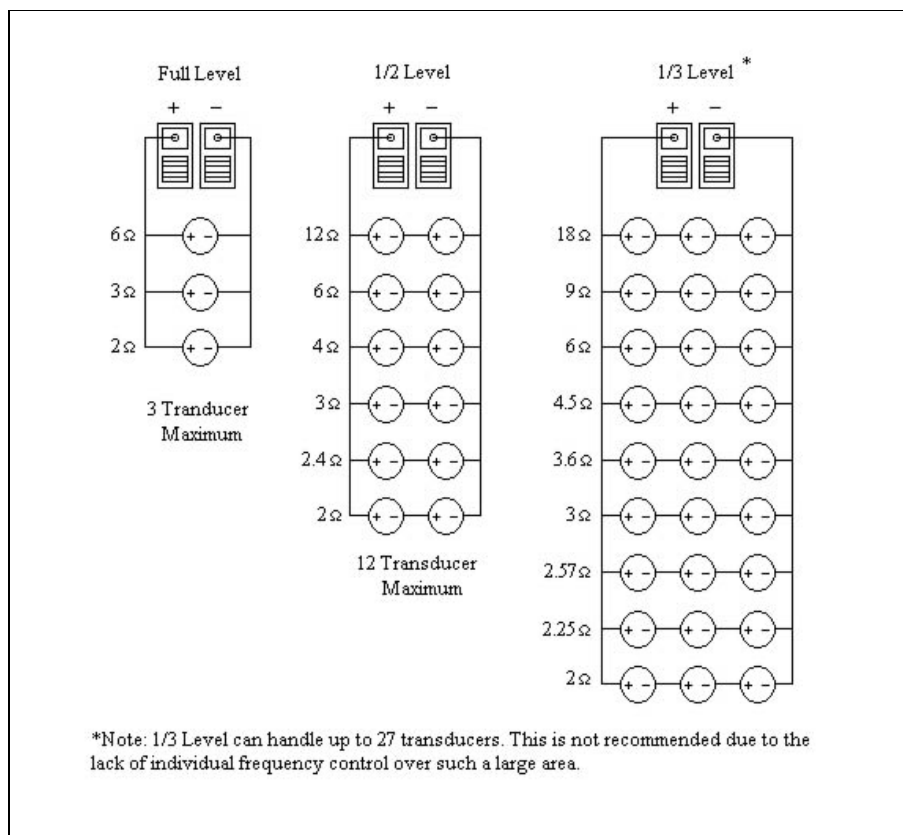


**Figure 11**

CONNECTIONS

**TRANSDUCERS**

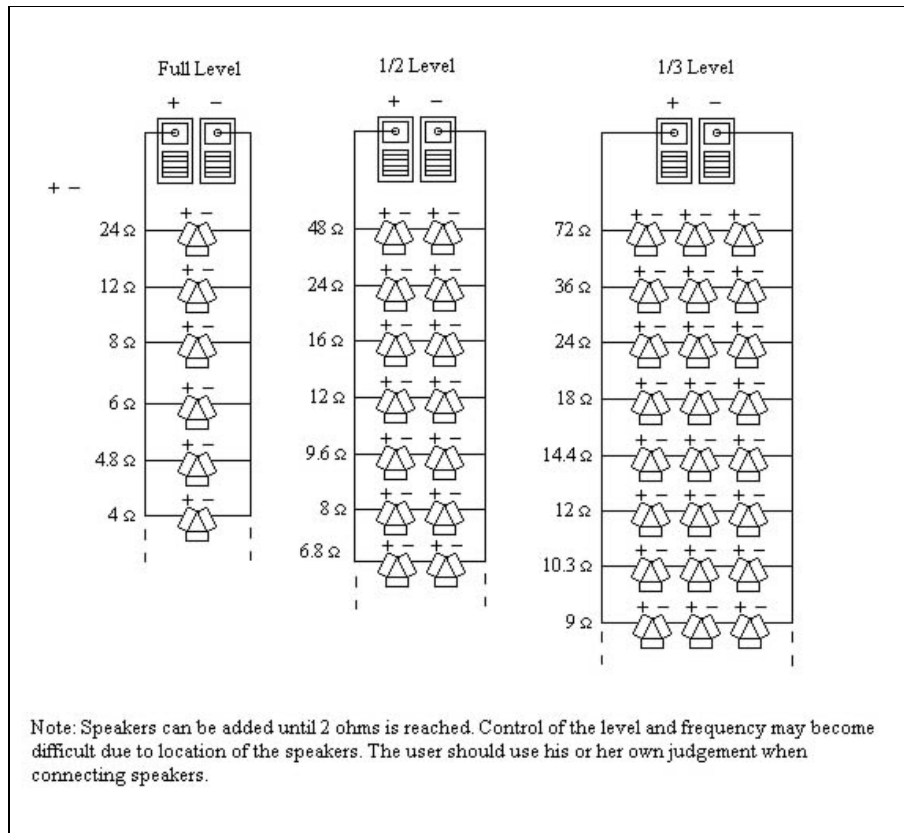
Figure 12 shows the three level combinations for transducers. “Full Level” transducers are recommended for solid or cement walls, floors, and ceilings. “1/2 Levels” are used for typical drywall or less dense surfaces. “1/2 Levels” and “1/3 Levels” are suggested for glass panes dependent on size. Combining levels can be done, but care should be taken to verify the correct output volume out of each transducer.



**Figure 12**

**SPEAKERS**

Figure 13 shows the three level combinations for the OMS-2000 speakers. “Full Level” is recommended for large closets and large crawl spaces. “1/2 Level” is used for small crawl spaces, closets, and ceilings with a large distance between the tile and ceiling. “1/3 Level” is suggested for very small areas and ceilings with very little space between the tile and the top of the ceiling. Similarly to the transducers, care should be taken if the speaker levels are mixed to ensure that proper volume is being achieved to all the speakers.



**Figure 13**

EXAMPLE

Figure 14 is an example diagram of a typical office setting. The target room is protected from adjacent offices, inner building walls, restroom/janitorial walls, outside windows, and drop ceilings. The ANG-2200 is setup so that the wall surfaces are all on the same channel. This allows the equalization of the noise for that particular surface material. The windows and ceiling have been combined on one channel for simplicity. When combining different surfaces on the same channel, walls should be kept separate from windows and ceilings.

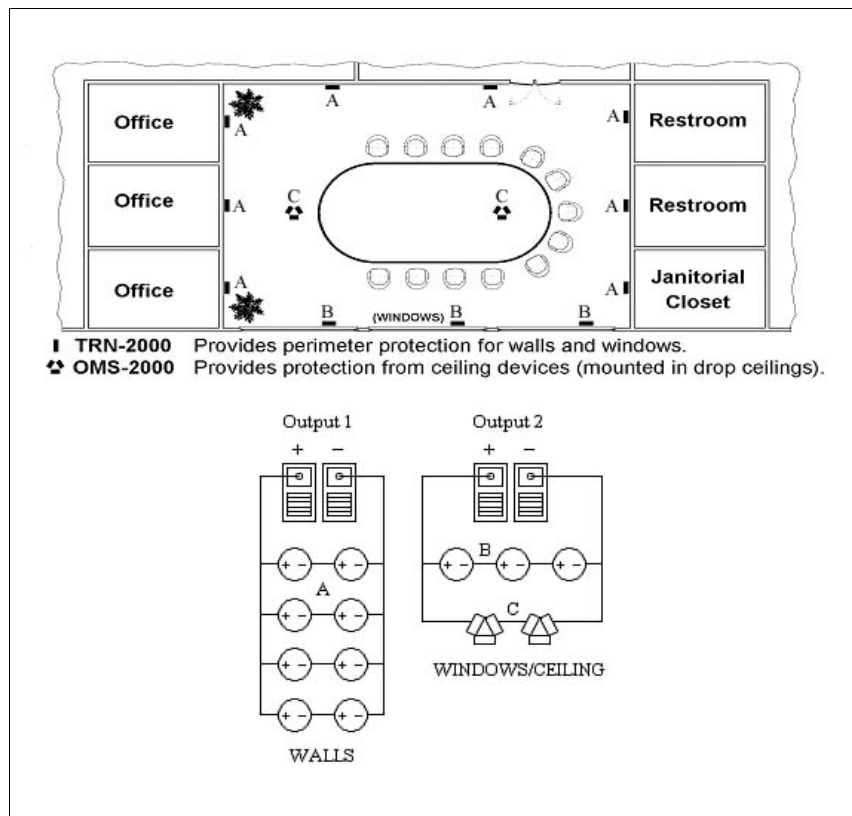


Figure 14

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**WIRING**

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*Attn: Do not turn on the ANG-2200 until you have completed wiring the transducers as recommended in this manual.*

Route the wiring so that it cannot be pinched, cut, tripped over, or damaged in any way. Connect the wires to the transducer using the female “quick connect” tabs furnished. Crimp or solder the wire to the tab.

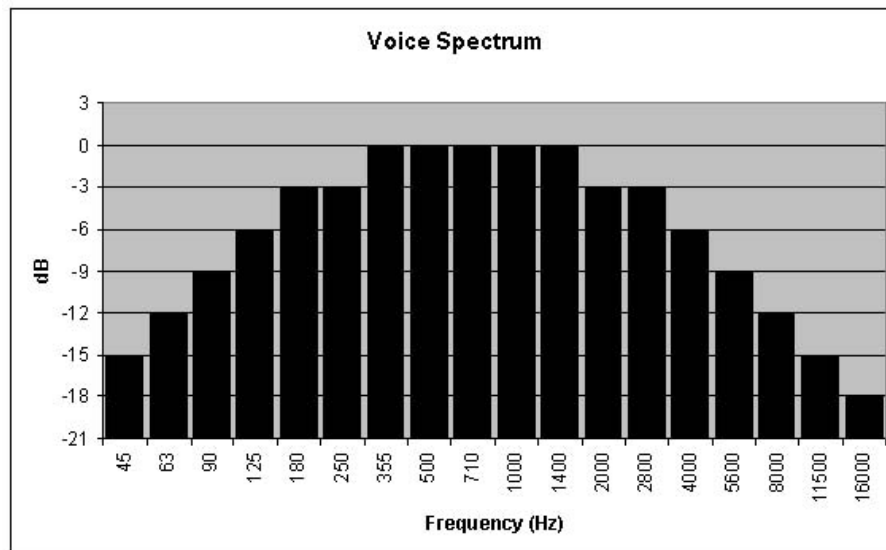
For lengths of less than 60 feet, use 18-gauge “zip cord” wire. Use 14-16 gauge heavy-duty speaker cable (sold at audio stores) for longer runs that have impedance of less than 4 ohms. Use the conductor that is silver or has markings on the insulator as the negative wire.

*Attn: Each generator output is designed to be separate and isolated. Do not cross output wiring or allow any wiring to be connected to the building’s metal or earth ground.*

\* *Rule of Thumb Settings* are based upon lab tests by Research Electronics, Intl. Because each specific site is unique, REI cannot guarantee these levels will be correct for each location.

## SLOPE ADJUSTMENT

Setting the frequency spectrum (Voicing) is done by using the LF and HF Controls. In order to do this properly, one needs an audio spectrum analyzer and a contact microphone. Place the contact mike on the surface that is being masked and look at the output with the Audio Spectrum Analyzer. Adjust the LF and HF controls until the Audio Spectrum Analyzer creates a frequency spectrum similar to figure 15. It should be noted that the distance from the transducer and the type of surface play a major factor in the reading. One should use his or her own judgement as well as his or her own hearing to aid in making the proper adjustment. One note is that certain surfaces transmit high frequency much more efficiently, so the operator may see a graph similar to figure 15 but containing much more high frequency. The high frequency may not always be able to be lowered to match this graph. This is ok and will not be detrimental to the effectiveness of the ANG-2200 system.



**Figure 15**

*\* Rule of Thumb Settings:*

**Table 1**

Surface	LF Slope Control	HF Slope Control
<i>Walls</i>	7 to 8	5
<i>Floors/Ceiling</i>	7	5
<i>Glass/Windows</i>	5 to 6	5 to 6
<i>Speakers</i>	9	5 to 6



**Figure 16**

**OUTPUT ADJUSTMENT**

The actual noise level required to mask speech is dependent on the square footage and composition of the surface, the ambient noise, and the general loudness of the conversation to be protected. Under most situations, the required output level will produce a low to moderate noise level in the target area with which one can talk comfortably. The actual level required under specific situations can be measured with an acoustic contact sound meter and should be adjusted to 20 dB or more over the highest voice level present.

*\* Rule of Thumb Settings:*

**Table 2**

Surface	Normal Level	1/2 Level	1/3 Level
<i>Walls</i>	4 or more	6 or more	N/A
<i>Floors/Ceiling</i>	4 or more	6 or more	N/A
<i>Glass/Windows</i>	N/A	4 or more	4 or more
<i>Speakers</i>	5 or more	5 or more	7 or more

The Red LED (10<sup>th</sup>) indicates excessive level. Avoid operation where the Red LED stays on continuously.



**Figure 17**

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**VERIFICATION**

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One can verify the effectiveness that the ANG-2200 is covering all areas of acoustic leakage by using a contact microphone and amplifier. Acoustic leakage may not be detectable with a dynamic or electret microphone. Research Electronics offer products that fit this need. Check out the web site at <http://www.research-electronics.com>.

When inspecting for acoustic leakage, a “Known Sound Source” such as a cassette or compact disc player should be placed in the center of the target area. Set the volume to a normal level for conversation in that area and leave the ANG-2200 off. Carefully probe any surface from the inside or outside that is connected to the target area, including windows, doors, plumbing, air ducts, etc. The identification of the KSS with the contact microphone will expose the existence of a possible acoustic leak; these locations should be noted. Turn on the ANG-2200 and listen again for the KSS to verify effective masking. The KSS should not be heard through the generated noise. Adjust levels as needed.

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**ACOUSTIC NOISE GENERATOR (ANG-2200)**

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Size: 1.6 x 5.5 x 8 in. (4.1 x 14.0 x 20.3 cm.)

Weight: 1.2 lb. (.5 Kg)

Output Max: 10 V p-p @ 6 ohms

Min. Load: 2 ohms

Frequency: 125 Hz – 4 kHz

Power: 12Vdc, 1A

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**TRANSDUCER (TRN-2000)**

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Size: 3 x 1.25 in. (7.6 x 3.1 cm)

Weight: 1-lb. (454 g)

Impedance: 6 ohms

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**OMNI SPEAKER (OMS-2000)**

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Size: 5 x 5.75 in. (12.7 x 14.6 cm)

Weight: 2-lb. (907 g)

Impedance: 24 ohms

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**PRECAUTIONS**

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- Do not connect more than three transducers in parallel or loads that present impedance less than 2 ohms to the output.
- Avoid areas with high moisture.
- Do not drop.
- Provide adequate ventilation around the cabinet.
- Avoid extreme temperature exposure below –22F (-30C) or above 122F (50C)
- There are no serviceable parts inside. Contact your dealer or Research Electronics, Inc. for repairs. Opening the unit will void the warranty.