A Brief Guide to Microphone Selection and Use for Places of Worship
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A Word about Audio-Technica

For over 40 years Audio-Technica has been dedicated to advancing the art and technology of electro-acoustic design and manufacturing.

From a beginning in state-of-the-art phono cartridges, A-T has expanded over the years into high-performance headphones, microphones, speakers and electronic products for home and professional use. In each new area the goal has been to create innovative, problem-solving products.

The results of these engineering and production efforts can be seen in the effective use of A-T products in a broad spectrum of applications.

Audio-Technica microphones, for example, are found in daily use in major broadcast and recording studios, and relied upon by top touring musicians. A-T mics are chosen for important installations and major events, such as the U.S. Senate and House of Representatives, the Commonwealth Games, World Cup Soccer and the Olympics.

Whether in the home, on stage, or in schools and universities, boardrooms, council chambers or places of worship, Audio-Technica products are providing superior performance and exceptional value worldwide.
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Introduction

The ideal sound system in a place of worship should make speech and music clearly and comfortably audible, yet never draw attention to itself or its operation. Meeting these objectives can be a challenge, given the diverse requirements such systems are often asked to fulfill and the added frustration of dealing with difficult acoustic conditions. For although many worship spaces are visually impressive and excellent for music, their reverberation times may be long enough to “muddy” the sound, seriously reducing speech intelligibility. And reverberant environments tend to accentuate interference from distracting noises such as coughs, baby cries, rustling of pages and dropped hymn books*

Regardless of acoustic constraints, careful selection and application of both loudspeakers and microphones can go a long way toward achieving maximum clarity and overcoming auditory distractions with natural, easy-to-listen-to sound. Assistance in the art and science of loudspeaker selection and placement is available in many books and other resources. This guide is dedicated to helping you develop an ideal system through thoughtful selection and application of microphones and system accessories.

*The examples in this booklet are drawn largely from the worship situations most commonly encountered in the United States. We hope and trust that those of other religions and traditions will see the applicability of the described audio solutions to their particular situations and needs.
The Basic Sound System

The sound system begins at the microphones where acoustic sound is converted into an electrical signal. Our example below has four microphones – one for the podium, one for the piano and two for the choir (Fig. 1). The microphones are connected to an audio mixer where their input signals are amplified, adjusted and combined to produce a single output signal. (Note that if an auxiliary phantom power source for the mics is required, it must be placed between the microphones and the mixer.)

From the mixer, the output signal is sent to a power amplifier. The amplifier strengthens the signal further, making it powerful enough to drive loudspeakers which convert the microphone signals back into acoustic sound.

Figure 1
Example of a Multi-microphone Sound System
Some Microphone Basics

Why Condenser Microphones

One way microphones are classified is by how they convert sound energy to an electrical signal. The most common types are “dynamic” and “condenser.” In a place of worship, condenser microphones offer a number of advantages over dynamics. First, condenser microphones can be made much smaller (and less conspicuous) than dynamics without compromising performance. They also have higher sensitivity for excellent pickup, even at the distances required by hanging choir mics. They have lower handling noise than dynamics, and their extended frequency response provides a crisper, more accurate reproduction of sound. Finally, condenser mics have superior “transient response” for accurately reproducing sudden sonic impulses such as those produced by voice, piano and percussion.

Condenser microphones require a power source for their internal electronics. Some models can receive power from an internal battery. Others may be “phantom” or “remote” powered. Phantom power supplies, built into some mixers and also available as Audio-Technica accessories, deliver low DC voltage to the microphone over the same 2-conductor shielded cable used to carry the microphone’s output signal. Phantom power has no effect on the sound of the system.

Why Unidirectional Microphones

Another way to identify microphones is by their directional properties, that is, how much sound they pick up from various directions.

“Omnidirectional” microphones pick up sound almost equally well from all directions (Fig. 2). While they must be used close to the sound source wherever feedback is a possibility, “omnis” offer reduced sensitivity to handling noise and breath blasts, making them ideal for many clip-on mic applications.
In a place of worship, however, most applications are better served by unidirectional types of microphones described as “cardioid” (Fig. 3). These microphones pick up sound best within a 120° conical area at their front called the “acceptance angle.” Outside the acceptance angle, microphone sensitivity is reduced. A sound source located at a 90° angle to the side of the microphone will seem to be twice the distance away as the same source located directly in front. And, when the same source is directly to the rear of the microphone (at the angle of minimum sensitivity, or “null”), it will seem to be about 10 times as far away.
By pointing the microphone directly at the desired sound source, with the null of the microphone facing any unwanted sound (such as a sound reinforcement loudspeaker), problems with feedback and echo will be reduced. The result is improved intelligibility of speech at a greater “working distance.”

Hypercardioid models extend the working distance farther, with their 100° acceptance angle providing greater rejection of sound from the sides. Even more side cancellation is offered by A-T MicroLine® models. Their narrow 90° acceptance angle and higher output make them a good choice for more distant pickup of sound. They also improve clarity in reverberant or otherwise noisy environments. Figure 4 summarizes the performance of different pickup patterns.

**Figure 4**

*Basic Polar Patterns*

<table>
<thead>
<tr>
<th></th>
<th>Omni-directional</th>
<th>Cardioid</th>
<th>Hypercardioid</th>
<th>Line</th>
<th>Bidirectional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptance Angle (3 dB down)</td>
<td>—</td>
<td>120°</td>
<td>100°</td>
<td>90°</td>
<td>90°</td>
</tr>
<tr>
<td>Null (angle of minimum sensitivity)</td>
<td>none</td>
<td>180°</td>
<td>110°</td>
<td>120°</td>
<td>90°</td>
</tr>
</tbody>
</table>
Specific Applications

Now that you understand some basic concepts about microphone designs and features, let's discuss how to select and use them in specific circumstances common to places of worship. As it is simply not possible to anticipate all the variables that can affect any one microphone application, actual results will vary. See your Audio-Technica sound specialist for more detailed information and complete technical specifications on all Audio-Technica products. Also, additional easy-to-understand general information about how various types of microphones operate, and how to select and use them, is available in the Audio-Technica booklet, *A Brief Guide to Microphones*, available from your A-T dealer.

Pulpit/Lectern

Audio-Technica offers a selection of gooseneck-style condenser microphones that are ideal for pulpit or lectern miking (Fig. 5). Each offers exceptional feedback rejection and very natural sound quality. Their low-reflectance black finish and slim profile make them nearly invisible to the congregation.

While sharing similar sonic characteristics, the different models provide choices in mounting method (Fig. 6), mic height and directionality. Adapter-mount models attach to the threads on all standard microphone stands, shock mounts and mounting flanges. Some can be powered by either an internal AA penlight battery or phantom power. Quick-mount models plug directly into a surface-mount XLR-type (professional 3-pin) connector mounted on the pulpit, or a special shock mount designed for this purpose. Quick-mount models receive their power from a phantom power supply.
Where cables cannot be run unobtrusively, or a pulpit or lectern must be moved often, the adapter-mount models can be used with an A-T UniPak™ wireless system transmitter to create a “wireless” lectern.

Figure 5

Figure 6

Adapter Mount

Quick Mount
Choir

Audio-Technica pioneered miniature hanging microphones, which offer the long reach and smooth, wide-range response required for professional-quality choir miking. Their small size and light weight allow them to hang inconspicuously above the choir by their own cable, without unsightly guylines. A supplied wire hanger adapter allows the microphone to be aimed with precision. Models come with either an in-line power module or a ceiling plate power module that easily flush-mounts in the ceiling or wall.* The entire assembly, including microphone housing, hanger and miniature cable, is available in black or white, allowing it to blend visually with dark or light settings.

A cardioid microphone’s 120° acceptance angle provides well-balanced overhead pickup. The microphone should be located forward of the front-most source, above the rear-most source and “aimed” between them (Fig. 7). Increasing the height of the mic above the sources will tend to equalize sound levels between them, but may also increase background/reverberant sound pickup. Whenever possible, the distance from the mic to the rear-most pickup should be no more than twice the distance to the front source, to maintain front-to-rear balance (Fig. 7). Width of pickup is approximately three times the distance to the closest performer. If additional mics are needed for wide sources, they should not be closer together laterally than three times their distance to the front source (Fig. 8).

*The power modules contain internal electronics needed by the microphones in order to operate, yet because of their miniature design, are too small to hold. These power modules should not be confused with the phantom power supplies mentioned earlier.

Figure 7

垂直定位

Figure 8

水平定位
Clip-on

For clip-on (or “lavalier”) microphone applications, most users prefer the convenience and full freedom of movement offered by an Audio-Technica UniPak™ professional wireless system. A miniature microphone connects by a short cable to a small transmitter worn on the belt or elsewhere, and a special receiver picks up the signal and feeds it to the mixer. A separate receiver/transmitter pair is needed for each microphone used. UniPak systems offer a choice of omnidirectional or cardioid microphones. While omnis work well for most clip-on applications, the cardioid may be chosen to lower the risk of feedback or to reduce the pickup of reverberation. The excellent sound quality of A-T wireless systems allows wired and wireless versions of the same microphones to be used simultaneously with no audible difference in response.

Attach the clip-on microphone about 6" below the user’s chin (Fig. 9). The furnished clip allows easy attachment to most clothing. However, an available “tie-tac” mount may be better suited for some situations. In either case, anticipate movements that may cause the microphone to rub against or be covered by clothing, and position the microphone to avoid it. A belt clip is included with many clip-on microphones, which reduces cable noise and prevents pulling on a wired microphone when the user is moving.

Figure 9
Handheld Vocal

Audio-Technica offers a wide variety of wired and wireless handheld microphones to fit your specific needs. Used close-up as intended, the best handheld microphones provide the depth and clarity of studio-quality response, with low sensitivity to handling noise. For wireless applications, our handheld transmitters deliver total freedom of movement without the noise and “dropouts” sometimes associated with wireless systems. The exceptional audio performance and the mobility offered by their advanced RF circuitry make them ideal for both music and speech, and for interview-style applications. Our wireless mic systems may be used in combination with “hard-wired” microphones with no change in natural sound quality.

Sing or speak across rather than directly into any handheld microphone to reduce, if not eliminate, popping caused by sudden breath blasts (Fig. 10). While the microphone should be positioned in front and slightly to one side of the mouth, the user must stay within the acceptance angle* of the microphone to avoid unwanted changes in volume. Note that some of the best microphones may be the most susceptible to breath popping because of their flatter, more extended low-frequency response. Use of proper technique, and perhaps an accessory windscreen, will solve most popping problems.

Figure 10

*See Figure 4, page 6.
Table or Altar

Boundary or plate microphones, with their low-profile design – less than $\frac{3}{4}$" (19 mm) high – provide very inconspicuous sound pickup at a table or altar. Unidirectional boundary mics pick up sound clearly over a horizontal angle of about 120° and a vertical angle of about 60° above the mounting surface (Fig. 11). Omnidirectional models pick up sound from all directions around the table or altar.

The microphone should be centered on the mounting surface and positioned with the front of the microphone facing the sound source. The sound source should not be below the surface of the mounting plane. Where feedback is a problem, a flexible gooseneck-style microphone may be installed, as on a pulpit, to place it very close to the subject.

Figure 11
**Group or Area**

Certain situations, such as dramas or children’s programs, necessitate picking up sound from an area rather than from a specific person in one spot. One solution is to use suspended microphones, miking the area as you would a choir.

However, for temporary situations, or where architecture makes hanging microphones impractical, a miniature cardioid gooseneck microphone mounted on a floor stand provides excellent sensitivity and “zone” coverage while its slim design makes it visually unobtrusive. Generally, one such microphone will work well to pick up duets, trios and quartets.

Boundary microphones also offer inconspicuous miking possibilities, particularly for dramas where they may be placed on hard, flat-surface props or set on the floor when feedback is not a factor. Note that if stage-monitor speakers are used, or if high volume levels must be achieved, individual close miking is normally required.
Grand Piano

The piano is one of the most demanding instruments to record or reinforce accurately. The microphone selected should have a very flat, extended frequency response and excellent transient response.

Ideal microphone placement for piano depends greatly on acoustics and the potential for either feedback or the pickup of unwanted nearby sounds ("leakage"). While a grand piano is designed to be heard from a few feet or more away, isolating the piano sound requires getting close. Place a mono or stereo microphone about two feet above the strings (Fig. 12a). For greater isolation, lower the microphone within six to eight inches of the strings.

If the lid is lowered to the short stick, place the microphone just outside the piano, near the curve. Move it toward the keyboard for a brighter sound, away from it for more emphasis on the low end.

For close-up stereo miking, use two microphones inside the piano with the lid raised. Center one mic over the low strings and the other over the high strings (Fig. 12b). Or the microphones may be centered about midway between the low and high strings (Fig. 12c). In either case, both mics should be six to eight inches above the strings.

As another alternative, one boundary (plate) microphone – or two for stereo – may be mounted inside the piano. They may be permanently attached to the underside of the lid, or placed on temporary "bridges" of duct tape affixed to the metal ribs over the strings (Fig. 12d). Taping down the mic cables to prevent buzzing against parts of the piano may be helpful. With either boundary-mic approach, the choice of microphones and the considerable mechanical and sonic differences between pianos usually require some experimentation with mic placement to achieve the desired acoustic character and balance. These boundary-mic techniques are often a good choice when the piano lid must be closed; they also offer good control over leakage of other sound sources into the piano mic when recording.
Figure 12c

Figure 12d
Upright Piano

Because the upright piano is a large instrument, two microphones spaced about six to eighteen inches behind the sound board are recommended. They should be far enough apart so that one picks up sound from the high strings, while the other picks up the low notes (Fig. 13). In stereo recording, the two microphone outputs should be “panned” slightly left and right at the console.

If greater isolation of the piano sound is needed, try removing the lower front cover (below the keyboard) and positioning a single microphone facing slightly upward, away from the pedals, and somewhat nearer the high strings.

Figure 13
**Acoustic Guitar**

For close-up perspective and minimum feedback, A-T offers a miniature cardioid condenser microphone that mounts directly on the guitar with an adjustable clamp adapter. The microphone’s frequency response is specially tailored for this location, resulting in excellent control and well-balanced sound. Another approach is to use a wide-response cardioid condenser microphone on a stand or short boom, with the microphone pointing at the bridge of the guitar. If ultra-close miking is needed, avoid placing the mic too close to, or directly facing, the sound hole to avoid a “tubby” sound.

*Figure 14*

![Miniature Clip-on Microphone](image1)

![Stand-mounted Microphone](image2)
**Baptistry or Baptismal Font**

An enclosed baptistry offers special sound problems due to its acoustics, confined space, and the need to keep the microphone away from water. A miniature hanging microphone suspended above and forward of the baptistry is inconspicuous, out of reach and safe from excess humidity. While a cardioid pickup pattern should provide excellent results, an optional hypercardioid or MicroLine® element will offer greater working distance and reduced sensitivity to reverberation and other unwanted sounds. An alternate approach is to use a miniature gooseneck microphone, either wall-mounted just outside the baptistry or placed on a portable microphone stand in front. A miniature hanging microphone will also work well suspended above an open baptismal font.

*Figure 15*
“SmartMixing”

During a service or other sound reinforcement event, microphones not in use should be turned down to avoid pickup of undesired ambient noise and to decrease the possibility of feedback. In order to accomplish this, systems with traditional mixing boards require an operator who controls the mic levels manually. But some systems must function without an operator either some or all of the time. The Audio-Technica SmartMixer® solves this problem by automatically turning up only those microphones that are in use and turning them down between uses. The SmartMixer keeps the last microphone channel used turned on until another channel is activated. This continuous pickup of at least some ambient sound avoids disturbing “holes” or total silences that would otherwise occur.

The SmartMixer may be used as the only mixer in a system, or as a “small event” mixer to control selected inputs when an operator cannot be present. A single SmartMixer controls and provides 12V DC phantom power to four microphones. Additional units can be linked together to expand the number of available inputs. Setup is extremely simple and takes only minutes. Security covers are included to limit access to the controls if desired.

Figure 16
SmartMixer®
Some Useful Accessories

Windscreens reduce problems of “popping” from close vocal use. They also help control the wind noise often encountered in outdoor applications and from heating/air conditioning air movements. The windscreen simply slips over the head of the microphone to completely cover all acoustic openings.

Microphone shock mounts help reduce mechanical noise transferred to a microphone through its mounting hardware. This includes the sound of physical contact with the pulpit, lectern or microphone stand, or even a foot tapping on a wooden stage.

Durable microphone cables from A-T combine the protective properties of conductive vinyl and a rugged braided shield to ensure maximum rejection of AC hum and RF interference. Their supple, “low memory” material lets them lie flat without unsightly kinks and bends that can create a tripping hazard.

Wireless Microphones

Providing total freedom of movement, Audio-Technica professional wireless microphone systems set high standards for wireless microphone performance in the most difficult environments. Choose a self-contained handheld microphone/transmitter or one of our versatile UniPak™ systems offered with headworn, lavalier, boundary, gooseneck and instrument microphones. For extensive information on selecting and using wireless microphones, visit www.audio-technica.com.
A Final Word

We hope this guide serves as a help to you in developing an ideal sound system for your place of worship. Additional tips on how to use A-T microphones are included in individual instruction sheets. If you have any questions about microphones in general, or A-T microphones in particular, please feel free to contact us, or visit our website at www.audio-technica.com.