A Brief Guide to Microphones

audio-technica®

A Word about Audio-Technica

For over 30 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. House of Representatives, the Super Bowl, 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.

A Brief Guide to Microphones

If microphones seem a mystery, a few minutes reading this guide may help clear up some misconceptions and assist you in understanding the differences between various microphone types and the advantages of important microphone features.

The fact is, microphones are really rather simple devices. And if you know the meaning of just nine key terms, you are well on your way to becoming a microphone expert. With this basic knowledge under your belt, it will be easier to select the right model for almost any application. The nine basic terms are:

1. **Dynamic**
2. **Condenser**
3. **Omnidirectional**
4. **Directional**
5. **Proximity Effect**
6. **Feedback**
7. **Impedance**
8. **Sensitivity**
9. **Acoustic Phase Interference**

Although there are many kinds of microphones for many uses, we intend to concentrate on those models most suited for high-quality recording, broadcasting and sound reinforcement. We'll skip over the most common microphone of them all (the one in your telephone) and the many specialized types used for CB radio, industry and other similar areas.

What a Microphone Does

Like phono cartridges, headphones and loudspeakers, the microphone is a transducer – in other words, an energy converter. It senses acoustic energy (sound) and translates it into equivalent electrical energy. Amplified and sent to a loudspeaker or headphone, the sound picked up by the microphone transducer should emerge from the speaker transducer with no significant changes.

How It Does It

While there are many ways to convert sound into electrical energy, we'll concentrate on the two most popular methods: dynamic *and* condenser*. These are the types of microphones most often found in recording studios, broadcast and motion picture production, home stereo and video recording, and on stages for live sound reinforcement.*

And Why It's Important

The microphone is, by its nature, at the very beginning of most sound systems and recording applications. If the mic can't capture the sound clearly and accurately, and with low noise, even the best electronics and speakers following it won't produce the optimum sound. So it's important to invest in good microphones, to maximize sound-system performance potential.

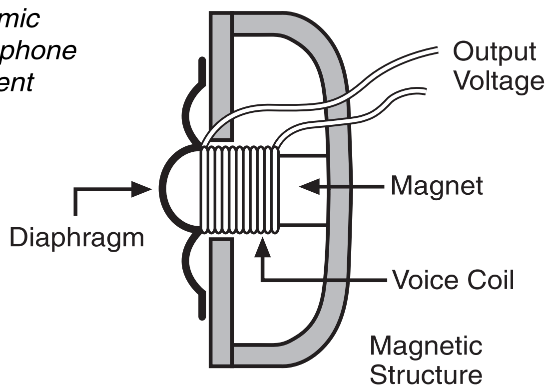
Basic Term #1

Dynamic

Comparison of microphone types to loudspeakers may help you to more readily understand their operation. Dynamic microphones can be considered as similar to conventional loudspeakers in most respects. Both have a diaphragm (or cone) with a voice coil (a long coil of wire) attached near the apex. Both have a magnetic system with the coil in its gap. The difference is in how they are used.

With a speaker, current from the amplifier flows through the coil. The magnetic field created by current flowing through the voice coil interacts with the magnetic field of the speaker's magnet, forcing coil and attached cone to move back and forth, producing sound output.

Figure 1
Dynamic Microphone Element



A dynamic microphone operates "in reverse." The diaphragm is moved by changing sound pressure. This moves the coil, which causes current to flow as lines of flux from the magnet are cut. So, instead of putting electrical energy *into* the coil (as in a speaker) you get energy *out* of it. In fact, many intercom systems use small speakers with lightweight cones as both speaker *and* microphone, by simply switching the same transducer from one end of the amplifier to the other! A speaker doesn't make a great microphone, but it's good enough for that application.

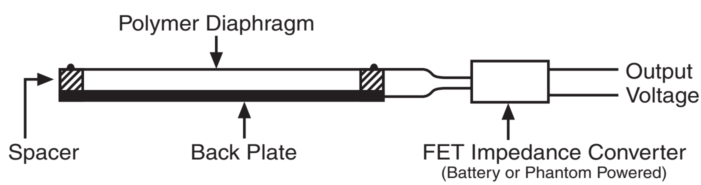
Dynamic microphones are renowned for their ruggedness and reliability. They need no batteries or external power supplies. They are capable of smooth, extended response, or are available with "tailored" response for special applications. Output level is high enough to work directly into most microphone inputs with an excellent signal-to-noise ratio. They need little or no regular maintenance, and with reasonable care will maintain their performance for many years.

Basic Term #2

Condenser

Condenser (or capacitor) microphones use a lightweight membrane and a fixed plate that act as opposite sides of a capacitor. Sound pressure against this thin polymer film causes it to move. This movement changes the capacitance of the circuit, creating a changing electrical output. (In many respects a condenser microphone functions in the same manner as an electrostatic tweeter, although on a much smaller scale and "in reverse.")

Figure 2
Electret Condenser Element



Condenser microphones are preferred for their very uniform frequency response, and ability to respond with clarity to transient sounds. The low mass of the diaphragm permits extended high-frequency response, while the nature of the design also ensures outstanding low-frequency pickup. The resulting sound is natural, clean and clear, with excellent transparency and detail.

Two basic types of condenser microphones are currently available. One uses an external power supply to provide the polarizing voltage needed for the capacitive circuit. These externally-polarized microphones are intended primarily for professional studio use or other extremely critical applications.

A more recent development is the electret condenser microphone (Fig. 2). In these models, the polarizing voltage is impressed on either the diaphragm or the back plate during manufacture, and this charge remains for the life of the microphone.

The best electret condenser microphones are capable of very high-quality performance, and are used extensively in broadcast, recording and sound reinforcement.

Due in part to their low-mass diaphragms, condenser microphones are inherently lower in handling or mechanical noise than dynamic microphones. For all of its electret condenser designs, Audio-Technica has elected to apply the polarizing voltage, or fixed-charge, to the back plate rather than the diaphragm. By doing this, a thinner material may be used for the diaphragm, providing a considerable performance advantage over electret microphones of conventional design. Many Audio-Technica microphone diaphragms, for example, are only 2 *microns* thick (less than 1/10,000th of an inch)!

Condenser microphones have two other design advantages that make them the ideal (or the only) choice for many applications: they weigh much less than dynamic elements, and they can be much smaller. These characteristics make them the logical choice for line – or “shotgun” – microphones, lavaliers and miniature microphones of all types.

Attempts at miniaturizing dynamic microphones result in greatly reduced low-frequency response, overall loss in acoustic sensitivity, and higher mechanical or handling noise.

Phantom Power

While the electret condenser microphone doesn't need a power supply to provide polarizing voltage, an FET impedance matching circuit inside the microphone does require some power. This may be supplied by a small low-voltage internal battery or by an external "phantom" supply.

Phantom powering is a technique which delivers a DC voltage to the microphone through the same shielded two-conductor cable that carries the audio. The phantom power may be supplied either by the mic mixer or from an external supply that is "inserted" into the line between the microphone and mixer input. For phantom power to function, the line between the power supply and the microphone must be balanced to ground, and uninterrupted by such devices as filters or transformers which might pass the audio signal but block DC (more about balanced lines later). Phantom power also requires a continuous ground connection (Pin 1 in the XLR-type connector) from the power supply to the microphone. The supply delivers positive DC voltage equally to both signal-conducting leads, and uses the shield as a return path, or negative. Balanced-output dynamic microphones are not affected by phantom power, since there is no connection between the shield and either signal lead and, therefore, no circuit for the DC voltage.

Phantom power supplies are available in various output voltages ranging from as low as 9 volts up to 48 volts. They may be designed to operate from AC line voltages or from internal batteries.

Externally polarized or "discrete" condenser microphones seldom have internal battery power. Instead, a phantom power source is used to provide both the polarizing voltage for the element and to power the impedance converter.

Other Types of Microphones

There are a number of ways to translate sound into electrical energy. Carbon granules are used as elements in telephones and communications microphones. And some low-cost microphones use crystal or ceramic elements that are generally OK for speech, but are not seriously considered for music or critical sound reproduction.

One other type sometimes found in recording studios is the ribbon microphone. It is a form of dynamic mic, with a thin metallic ribbon (which serves as both voice coil and diaphragm) suspended between the poles of a magnetic circuit. While it is capable of excellent performance, the ribbon element must be protected against high acoustic pressures or wind, since it is relatively fragile. For this reason, ribbon microphones are rarely seen in sound reinforcement applications or non-studio recording.

Ribbon microphones are often designed to respond to sound from both the front and back, and are sometimes used when a bidirectional pickup pattern is required – which brings us to the next major microphone classification.

What's the Pattern?

In addition to classifying microphones by their generating elements, they can also be identified by their directional properties, that is, how well they pick up sound from various directions. Most microphones can be placed in one of two main groups: omnidirectional *and* directional. *Omnidirectional microphones are the simplest to design, build and understand. They also serve as a reference against which each of the others may be compared.*

The basic directional types include cardioid, subcardioid, hypercardioid and bidirectional. Also included under the general heading of directional microphones is the line – or "shotgun" – microphone, a more complex design that can provide considerably higher directionality than the four basic directional types.

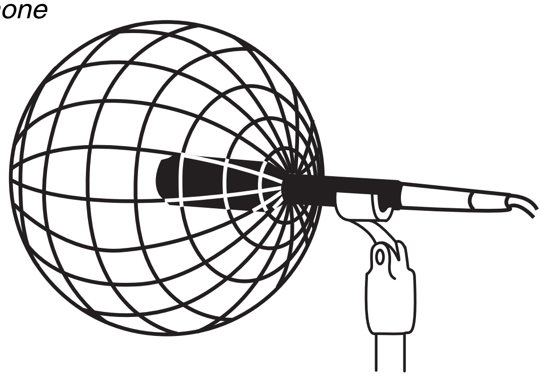
Let's examine the differences among the various types.

Basic Term #3

Omnidirectional

Omnidirectional microphones pick up sound from just about every direction equally. They'll work about as well pointed away from the subject as pointed toward it, if the distances are equal. However, even the best omni models tend to become directional at higher frequencies, so sound arriving from the back may seem a bit "duller" than sound from the front, although apparently equally "loud."

Figure 3
Omnidirectional Microphone

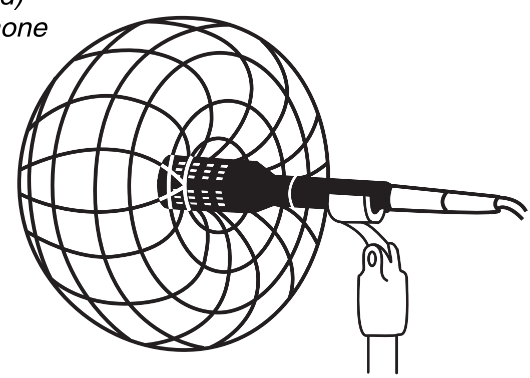


The physical size of the omnidirectional microphone has a direct bearing on how well the microphone maintains its omnidirectional characteristics at very high frequencies. The body of the microphone simply blocks the shorter high-frequency wavelengths that arrive from the rear. The smaller the microphone body diameter, therefore, the closer the microphone can come to being truly omnidirectional.

Directional

Directional microphones are specially designed to respond best to sound from the front (and rear in the case of bidirectionals), while tending to reject sound that arrives from other directions. This effect also varies with frequency, and only the better microphones are able to provide uniform rejection over a wide range of frequencies. This directional ability is usually the result of external openings and internal passages in the microphone that allow sound to reach both sides of the diaphragm in a carefully controlled way. Sound arriving from the front of the microphone will aid diaphragm motion, while sound arriving from the side or rear will cancel diaphragm motion.

Figure 4
Directional (Cardioid) Microphone



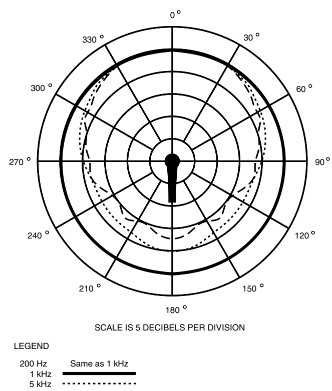
Polar Patterns

To help you visualize how a directional microphone works, you will find polar patterns in our literature and spec sheets. These round plots show the relative sensitivity of the microphone (in dB) as it rotates in front of a fixed sound source. You can also think of them as a horizontal "slice" through the pickup patterns illustrated in Figures 3 and 4.

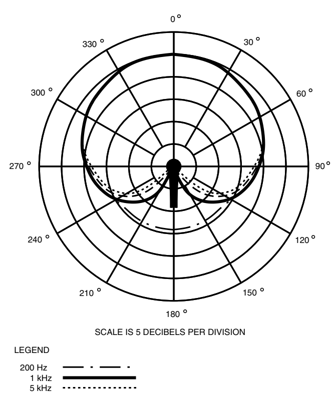
Plots of the microphone polar response are usually shown at various frequencies. The most common directional microphones exhibit a heart-shaped polar pattern, and, as a result, are called "cardioid" microphones.

Figure 5
Polar Patterns

Typical Omnidirectional Pattern



Typical Directional (Cardioid) Pattern



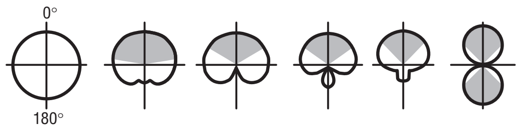
Polar patterns should not be taken literally as a "floor plan" of a microphone's response. For instance, in the cardioid pattern illustrated, response is down about 6 dB at 90° off-axis. It may not look like much in the pattern, but if two persons were speaking equidistant from the microphone, one directly on-axis and the other at 90°, the person off-axis would sound as if he were twice as far from the microphone as the person at the front. To get equal volume, he would have to move to half the distance from the mic.

A word of caution: these polar patterns are run in an anechoic chamber, which simulates an ideal acoustic environment – one with no walls, ceiling or floor. In the real world, walls and other surfaces will reflect sound quite readily, so that off-axis sound can bounce off a nearby surface and right into the front of the microphone. As a result, you'll rarely enjoy all of the directional capability built into the microphone. Even if cardioid microphones were completely "dead" at the back (which they never are), sounds from the rear, also reflected from nearby surfaces, would still arrive partially from the sides or front. So cardioid microphones can help reduce unwanted sound, but rarely can they eliminate it entirely. Even so, a cardioid microphone can reduce noise from off-axis directions by about 67%.

The directional microphone illustrated in Fig. 5 is about 20 dB less sensitive at 180° degrees off-axis, compared to on-axis. This means that by rotating the cardioid microphone 180°, so that it faces directly away from the sound source, the sound will "look" to the microphone as if it had moved TEN TIMES farther away!

The maximum angle within which the microphone may be expected to offer uniform sensitivity is called its *acceptance angle.* As can be seen in Fig. 6, each of the directional patterns offers a different acceptance angle. This will often vary with frequency. One of the characteristics of a high-quality microphone is a polar pattern which changes very little when plotted at different frequencies.

Figure 6
Basic Polar Patterns



	Omni-directional	Sub-cardioid	Cardioid	Hyper-cardioid	Line	Bidirectional
Acceptance Angle (3 dB down)	—	170°	120°	100°	90°	90°
Null (angle of minimum sensitivity)	none	160°	180°	110°	120°	90°
Distance Factor (DF)	1.0	1.2	1.7	2.0	2.5	1.7

Distance Factor

A directional microphone's ability to reject much of the sound that arrives from off-axis provides a greater working distance or "distance factor" than an omni. As Fig. 6 shows, the distance factor (DF) for a cardioid is 1.7 while the omni is 1.0. This means that if an omni is used in a uniformly noisy environment to pick up a desired sound that is 10" away, a cardioid used at 17" from the sound source should provide the same results in terms of the ratio of desired signal to ambient noise. Among other microphone types, the subcardioid should do equally will at 12", the hypercardioid at 20" and the bidirectional at 17".

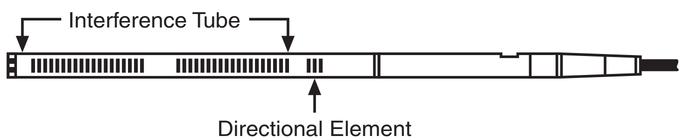
If the unwanted noise is arriving from one direction only, however, and the microphone can be positioned to place the null of the pattern toward the noise, the directional microphones will offer much greater working distances.

Line Microphones

When miking must be done from even greater distances, line or "shotgun" microphones are often the best choice. Line microphones are excellent for use in video and film, in order to pick up sound when the microphone must be located outside the frame, that is, out of the viewing angle of the camera.

The line microphone uses an interference tube in front of the element to ensure much greater cancellation of sound arriving from the sides. Audio-Technica line microphones combine a directional ("gradient") element with the interference tube to increase cancellation at the rear as well.

Figure 7
Line + Gradient Microphone



As a general design rule, the interference tube of a line microphone must be lengthened to narrow the acceptance angle and increase the working distance. While shorter line microphones may not provide as great a working distance as their longer counterparts, their wider acceptance angle is preferred for some applications, because aiming does not need to be so precise. (Some A-T shotgun mics employ an exclusive design* that provides the same performance from an interference tube one-third shorter than conventional designs.)

*U.S. Patent No. 4,789,044

How Do They Sound?

From a distance of two feet or so, in an absolutely "dead" room, a good omni and a good cardioid may sound very similar. But put the pair side-by-side in a "live" room (a large church or auditorium, for instance) and you'll hear an immediate difference. The omni will pick up all of the reverberation and echoes – the sound will be very "live." The cardioid will also pick up some reverberation, but a great deal less, so its sound will not change as much compared to the "dead" room sound. (This is the "Distance Factor" in action.)

If you are in a very noisy environment, and can point the microphone away from the noise, a comparison will show a better ratio of wanted to unwanted sound with the cardioid than with the omni.

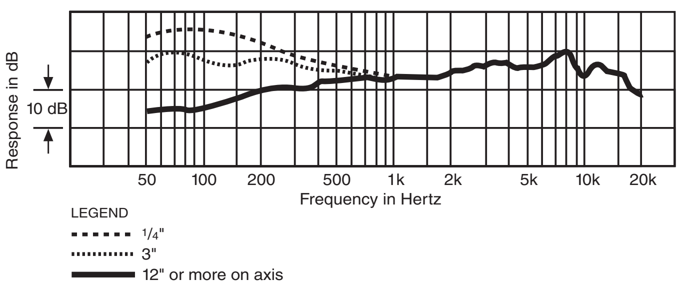
Now, let's repeat the comparison, but this time with the microphones very close to the source (a singer, perhaps). As you get within about two inches, you'll notice a rising bass response in most cardioid microphones. This is known as <u>proximity</u> <u>effect</u>*, a characteristic that is not shared with the omni microphone used for comparison.*

Basic Term #5

Proximity Effect

Proximity effect can either be a blessing or a curse, depending on how it is used. A singer can get a deep, earthy sound by singing very close, then change to a more penetrating sound by singing louder while moving the microphone away. This kind of creative use takes some practice, but is very effective. On the other hand, singing at the same volume (with no special effects desired) and moving the microphone in and out will create problems of tonal balance, apart from changes in overall mic level. Some performers also like to work very close at all times to "beef up" an ordinarily "light" voice.

Figure 8
Influence of Proximity Effect
on Directional Microphone Response



Proximity effect can be used effectively to cut feedback in a sound reinforcement situation. If the performer works very close to the mic, and doesn't need the extra bass, an equalizer can be used to turn down that channel's bass response. This makes the microphone less sensitive to feedback at low frequencies, since it is now less sensitive to any low-frequency signal arriving from more than a foot away. (This equalization technique also will help reduce the effect of any handling noise.)

Basic Term #6

Feedback

Feedback is simply a condition in a sound-reinforcement application when the sound picked up by the microphone is amplified, radiated by a speaker, then picked up again, only to be re-amplified. Eventually the system starts to ring, and keeps howling until the volume is reduced. Feedback occurs when the sound from the loudspeaker arrives at the microphone as loud or louder than the sound arriving directly from the original sound source (talker, singer, etc.).

The right microphone will reduce the problem. A microphone without peaks in its response is best, as feedback will occur most easily at the frequencies where peaks exist. While a good omni might work well in some situations, a cardioid is almost always preferred where a high potential for feedback exists. When the loudspeaker sound comes primarily from a single direction (rather than mainly reflected from all the walls, ceiling, etc.), the null of a cardioid (or other directional pattern) microphone can be aimed to minimize pickup of the speaker's sound.

Distance is also a factor. Moving the microphone (or speaker) to lengthen the acoustic path to the loudspeaker can often reduce feedback. Bringing the microphone closer to the desired sound source will also help. And in general, the microphone should always be located *behind* the speakers.

Which Pattern is "Best"?

Whether you should select a directional or omnidirectional microphone can depend on the application (recording vs. sound-reinforcement), the acoustic conditions, the working distance required and the kind of sound you wish to achieve. Directional microphones can suppress unwanted noise, reduce the effects of reverberation and increase gain-before-feedback. But in good acoustic surroundings, omnidirectional microphones, properly placed, can preserve the "sound" of the recording location, and are often preferred for their flatness of response and freedom from proximity effect.

Omnidirectional microphones are normally better at resisting wind noise and mechanical or handling noise than directional microphones. Omnis are also less susceptible to "popping" caused by certain explosive consonants in speech, such as "p," "b" and "t." Serious recordists will undoubtedly want to have both types of microphones available to be ready for every recording problem.

Basic Term #7

Impedance

One important characteristic of a microphone is its output impedance. This is a measurement of the AC resistance looking back into the microphone. Generally, microphones can be divided into low (50-1,000 ohms), medium (5,000-15,000 ohms) and high (20,000+ ohms) impedance. Most Audio-Technica microphones are rated low-impedance. They'll work directly into mixer inputs of 150 ohms on up to approximately 4,000 ohms, so they should be ideal for most of the tape recorders and mixers currently available. Of course, some users may want to use a low-impedance Audio-Technica microphone into a high-impedance (50,000 ohms) input, which is why we offer the CP8201 microphone line matching transformer. It should be located as close to the electronic input as possible, so most of the microphone cable is low-impedance and balanced to ground. Here's why.

There is a limit to how much cable should be used between a high-impedance microphone and its input. Any more than about 20 feet will result in loss of highs, and loss of output level. But by using low-impedance microphones and cable, microphone cables can be almost any practical length, with no serious losses of any kind.

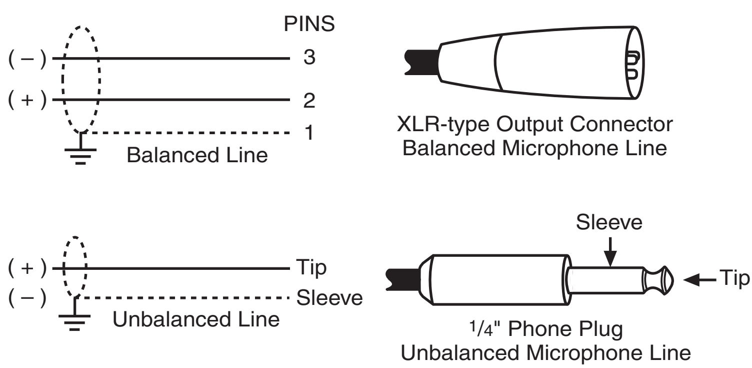
Balanced and Phased

Most Audio-Technica microphones offer *balanced output.* A balanced output offers real advantages to the serious recordist. Balanced lines are much less susceptible to RFI (Radio Frequency Interference) and the pickup of other electrical noise and hum. In a balanced line, the shield of the cable is connected to ground, and the audio signal appears across the two inner wires which are *not* connected to ground. Because signal currents are flowing in opposite directions at any given moment in the pair of signal wires, noise which is common to both is effectively cancelled out ("common mode rejection"). This cancellation can't occur when only one signal wire plus the shield is used. Of course, it is possible to wire a low-impedance microphone directly to an unbalanced low-impedance input, but the noise-cancelling benefit will be lost. This should not be a problem with short cable runs, but if longer cables are used, a balanced input is preferred.

Microphone phasing is most important when two (or more) microphones are to be used close together, then mixed into a single channel, or when recording in stereo. If they are wired out-of-phase to each other, signal levels and tonal balance will be adversely affected, and can change abruptly with small movements of the sound source or the microphones. In stereo there may be poor imaging, imprecise location of instruments and reduction of bass. The term "out-of-phase" is used to describe a microphone that is wired with its polarity reversed with respect to another. While "out-of-phase" is not a technically correct expression when speaking of polarity reversal, it is in such common usage that we include it here to help you understand the idioms of audio.

Audio-Technica wires its microphones to conform to the most popular industry convention: Positive acoustic pressure on the diaphragm generates a positive voltage on Pin 2 of the 3-pin output connector or on the tip of a 1/4" plug. Of course, consistent phasing (polarity) must be preserved in *all* of the cables between the microphone(s) and the electronics.

Figure 9
Wiring of Typical Microphone Connectors



Basic Term #8

Sensitivity

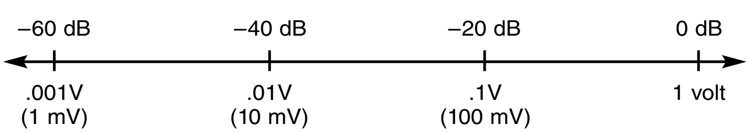
Sensitivity ratings for microphones may not be exactly comparable, since different manufacturers may use different rating systems. Typically, the microphone output (in a sound field of specified intensity) is stated in dB (decibels) compared to a reference level. Most reference levels are well above the output level of the microphone, so the resulting number (in dB) will be negative. Thus a microphone with a sensitivity rating of –55 dB will provide more signal to the input terminals than one rated at –60 dB. (See Fig. 10.)

Audio-Technica typically rates a microphone's sensitivity in terms of its *open circuit output voltage.* Stated in dB-relative-to-1-volt, or in actual millivolts (mV), this is the output the microphone will deliver with a stated sound pressure level (SPL) input. A-T uses a reference sound pressure of 1 Pa (Pascal), which equals 94 dB SPL, or 10 dynes/cm^2. (A reference of 0.1 Pa equals 74 dB SPL, or 1 dyne/cm^2.) In most modern audio equipment, microphone input impedances are substantially greater than the output impedance of the microphone, and thus may be regarded as an open circuit. That makes the open circuit voltage measurement a useful tool in comparing microphone sensitivities.

Although knowing how to read/compare microphone sensitivity (output) is important, the actual sensitivity rating usually is not a major consideration in mic selection. In fact, mic output is one factor considered in the design of a microphone for a particular application. For example, A-T shotgun mics have higher-than-“normal” output levels because they need to maintain useable output voltage with distant subjects.

It should be noted, however, that when someone says, “The microphone is distorting,” most often it is the *electronics input* (mixer/amplifier/recorder) which is overloading and

Figure 10
“dB re 1V”



distorting. (This is more likely to occur with A-T's high-output condenser mics and Hi-ENERGY® neodymium-magnet dynamic mics.) If high-level sound is creating distortion, before blaming the microphone, try inserting an attenuator between the microphone and its input. The Audio-Technica AT8202, designed for use with balanced Lo-Z microphones, offers a selector switch to drop the level 10, 20 or 30 dB, and will usually solve the problem. (Some mixers have a switchable "input pad" to help prevent input overload.)

Basic Term #9

Acoustic Phase Interference

Multiple Microphones

Acoustic phase interference occurs when the same sound arrives at two or more adjacent microphones at different times. This happens, for example, when two microphones are placed on a lectern as in Fig. 11. Because they are spaced apart, sound from the subject will almost certainly arrive at the two microphones at different times. The curves in Fig. 12 show the effects of the destructive wave interferences this causes when the microphone outputs are mixed together. These response degradations can result in not only poor audio quality, but often feedback problems as well.

Figure 11
Unequal Microphone Distances

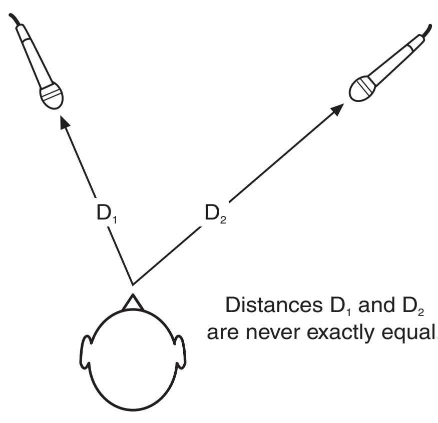
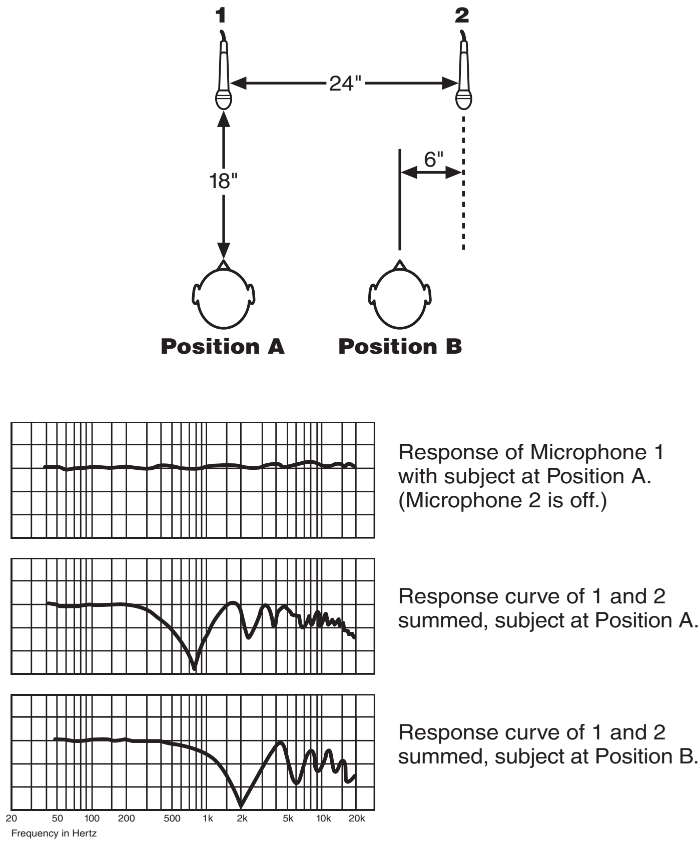


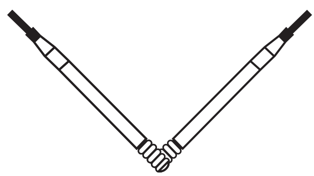
Figure 12
Multiple Microphone Response Curves



An obvious solution to this lectern-mic problem would be to use only one microphone. This not only improves the sound quality, but cuts the lectern microphone budget by approximately 50%! (Sometimes a second microphone may be desired as part of a backup or "redundancy" system, such as for press conferences. The two microphones should then be located directly in front of the subject, as close together as practical, and only one should be on or "open" at a time.)

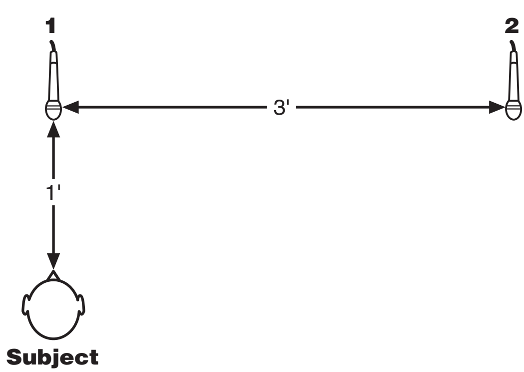
Fig. 13 shows another approach to podium miking with two microphones. Here the two mics are placed with their capsules as close together as possible, and angled in a “crossfire.” This provides a wider overall acceptance angle, allows stereo miking with excellent mono compatibility, and largely avoids the phase-interference problem.

Figure 13
Multi-mic Podium Setup



Whenever two spaced microphones must be used, the “3:1 Ratio Rule” is a good guide for placement. Fig. 14 illustrates this rule of thumb. In the illustration, Microphone 1 is one foot from the sound source. The *next closest* microphone in the system, Microphone 2, should be located three feet or more from Microphone 1. If the distance between the sound source and Microphone 1 changes to two feet, then the minimum distance between the two microphones should be at least six feet, maintaining the 3:1 ratio.

Figure 14
The 3:1 Ratio Rule

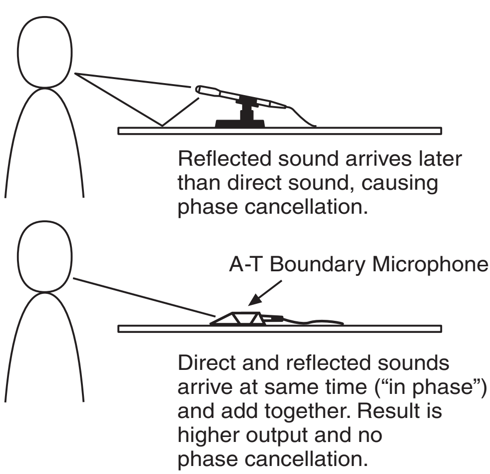


Single Microphone Placement

Acoustic phase interference may also occur when only a single microphone is in use. This happens when sound is reflected off a nearby surface and arrives at the microphone slightly after the direct sound. Adding the two signals together may give problems similar to those encountered in improper multi-microphone setups. (The phase interference will be most noticeable when the reflected sound arrives at a sound pressure level that is within 9 dB of the direct sound.)

There are several ways to eliminate this problem. First, try putting the microphone closer to the sound source. Second, move the microphone farther from the reflective surface. Third, use a microphone specially configured to be placed extremely close to the reflective plane (Fig. 15). When using a low-profile directional Audio-Technica boundary or "plate" microphone, for example, the microphone capsule is so close to the surface that the direct sound and the reflected sound arrive simultaneously and add together rather than cancel. This technique can prove very helpful on the apron of a stage, on a table or desk for conference use, or on the altar of a church.

Figure 15
Effects of Reflections



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.

Audio-Technica offers two *phantom power supplies* for use with most condenser microphones requiring phantom power: the CP8506 four-channel 48V phantom supply that powers up to four microphones, and the AT8801 single-channel 48V phantom supply.

We have already mentioned the CP8201 *line matching transformer*, which permits use of low-impedance microphones with unbalanced high-impedance inputs, and the AT8202 *in-line attenuator*, which prevents distortion caused by the overloading of sensitive input stages.

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.

A large selection of microphone *stand clamps* for use with most A-T microphones is also available.

SmartMixer®

The Audio-Technica SmartMixer® is a four-channel automatic microphone mixer. By automatically turning up only those microphones that are in use and turning them down between uses, it decreases excessive ambient noise and greatly reduces the possibility of feedback in multi-mic applications. 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. A single SmartMixer controls and provides phantom power to four microphones. Setup is extremely simple and additional units can easily be linked together to expand the number of available inputs.

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.

A Final Word

This guide is necessarily brief and just barely touches on the topic of microphone usage. 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 call or write us for the answers. Our technical support staff will be happy to assist you.

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