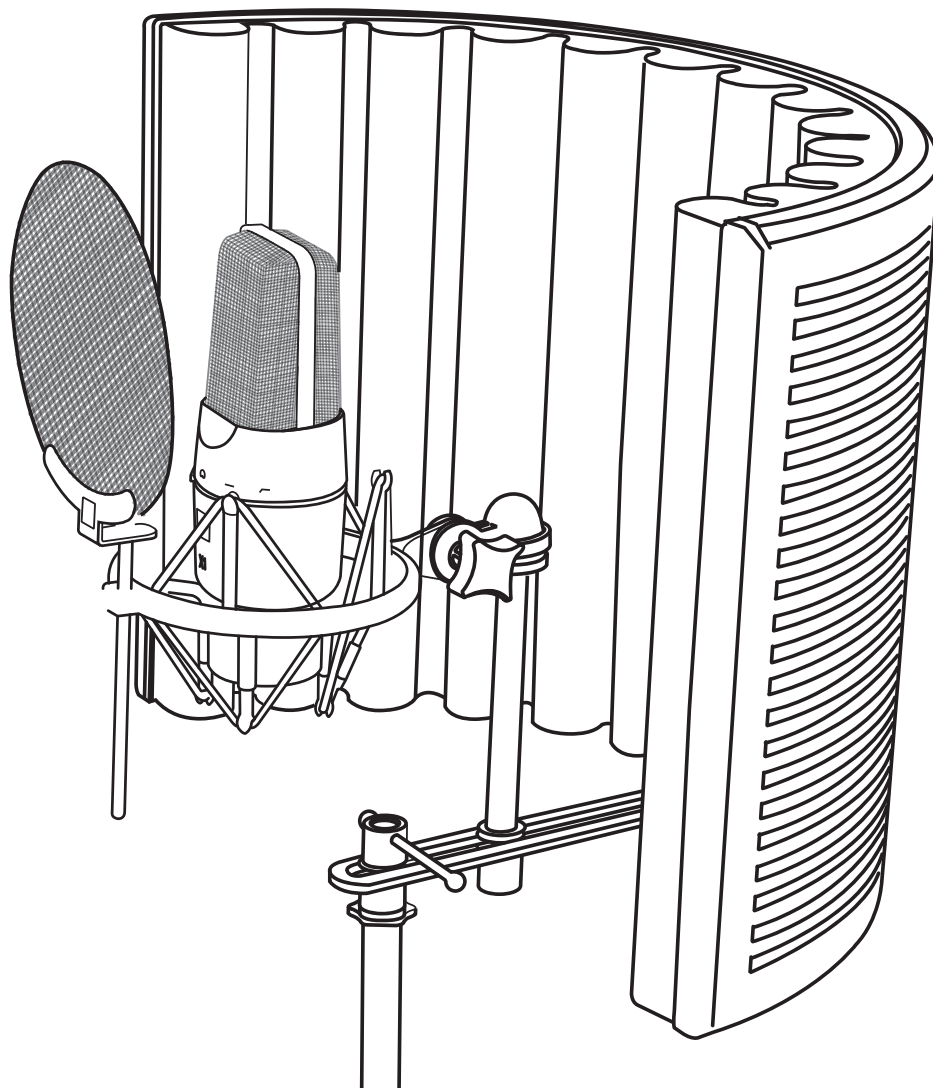




Mic Techniques and Applications



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Microphone basics

Like the human ear, the microphone is designed to capture sound. But whilst there is a single optimal design for the human ear, the same isn't true of the microphone; not least because it doesn't have the human brain's ability to process and filter the sound being captured. For example, the human hearing system can pick out a single voice in a group of voices and, to a large extent, can ignore room acoustics. On the other hand, a microphone simply picks up what it hears and passes it on. Furthermore, a microphone may be called upon to collect sound in environments that would be hazardous to the human ear - such as inside a kick drum, looking down the bell of a trumpet or touching the speaker grille of a 200 Watt guitar stack.

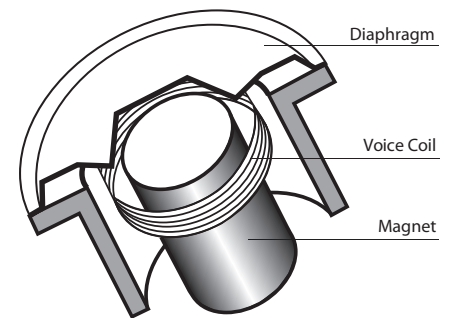
The solution is to build different types of microphone which are optimised for different tasks, though in reality, most well-designed microphones can cover a reasonably wide range of applications. There are three types of mechanism commonly used in microphone design: the Dynamic or "moving coil" Transducer, the Condenser Transducer and the Ribbon Transducer, all of which have specific characteristics and strengths.



Dynamic Microphones

Dynamic microphones (mics) comprise a voice coil attached to a lightweight diaphragm which is suspended in a magnetic field. When sound causes the diaphragm to vibrate, the coil moves within the magnetic field, and consequently a small alternating electrical voltage is generated which is proportional to the sound being picked up. Dynamic mics require no external power (phantom power, for example), they are robust, and as well as being used extensively in live sound for vocal and instrument use, they suit the sound of certain instruments such as electric guitar and bass, close-mic'ed drums and some brass instruments. They produce a punchy sound that cuts through busy mixes, but they are less effective at capturing high frequency (transient) detail. Most have a response that rolls-off at around 16kHz and they are not particularly sensitive, which means that they need a lot of preamplifier gain when used with quieter or more distant sound sources. The vast majority of dynamic microphones have a fixed Cardioid or Hypercardioid pickup pattern, which means that they pick up sound predominantly from in front of them.

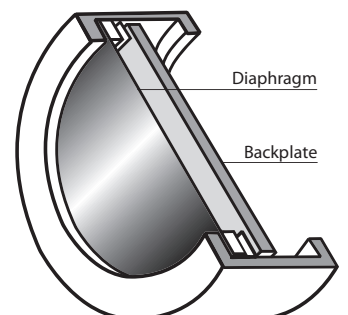
Dynamic Microphone



Condenser Microphones

Condenser microphones use a much lighter diaphragm, usually made from extremely thin Mylar with a coating of pure gold, and require no voice coil. Their much lower diaphragm mass means that they are much more responsive to high frequency sounds. A polarising voltage is applied between the diaphragm and a fixed backplate, such that the voltage is modulated when air vibrations force the diaphragm to move. The electrical output from the capsule requires a preamplifier with an extremely high input impedance, so FET or tube amplifiers are usually built into the microphone body.

Condenser Microphone



Many models cover the full 20Hz to 20kHz range which is deemed adequate to satisfy the human hearing system, and they are more sensitive than dynamic models – meaning that they need less amplification. All amplifiers introduce some noise, so the less amplification is needed, the quieter the end result is likely to be. Condenser microphones have on board impedance-matching and amplification circuitry that requires power, and they also require a polarising voltage for the capsule, so most (other than tube mics) run from 48 Volt "phantom power" which is supplied by the preamp along a standard balanced XLR cable. With very few exceptions, tube microphones come with their own power supplies.

Some companies use capsules based on the Back-Electret principle, where a material carrying a permanent electrical charge is

fixed to the back-plate in order to avoid the need for a separate polarising voltage. An internal preamplifier is again necessary, so either phantom power or battery power is still required. These microphones can work extremely well though the 'permanent' charge may eventually leak away, resulting in reduced sensitivity over a period of a decade or two. This may sound like a long time, but some of the traditional condenser microphones still used in studios can be up to 50 years old or more.

Large-diaphragm cardioid capsules (usually around one inch and above) tend to be favoured for vocal recording as they can be tuned to add character to the sound, while small-diaphragm models (usually around half an inch) are often preferred when greater accuracy is required. The psychological perception that bigger diaphragms must somehow produce a "bigger" sound is simply not true and excellent, full-sounding vocal recordings can be made using small diaphragm models. Technically speaking, small-diaphragm models tend to have a better off-axis response than large-diaphragm models; the larger the diaphragm, the greater the time arrival difference between sounds arriving at opposite edges of the diaphragm when originating off-axis. This time difference leads to high-frequency cancellation, which is why the off-axis sound of a large diaphragm microphone can sound dull when compared with the on-axis sound.

Patterns

It is possible to build condenser mics with any of the three main pickup patterns (Cardioid/Unidirectional, Figure-of-Eight or Omnidirectional). Dynamic mics are mainly Cardioid or Hypercardioid, while Ribbon mics have a natural Figure-of-Eight response.



Perhaps the simplest type of microphone is the Figure-of-Eight, in which the diaphragm is open to the air on both sides. It picks up sound equally well at the front and rear, but is insensitive to sounds approaching from the sides. By contrast, an Omnidirectional microphone comprises a diaphragm placed over the mouth of an acoustic chamber and picks up sounds from all directions. An Omnidirectional mic can sometimes be referred to as a Pressure-Gradient mic, as it essentially senses air pressure changes in its vicinity (though the acoustic chamber does have a small vent to equalise the air pressure inside, otherwise the diaphragm would bulge as the outside air pressure changed). While Cardioid and Figure-of-Eight mics also operate on the pressure gradient principle, they sense the difference in air pressure between the front and rear of the microphone. Note that both Cardioid and Figure-of-Eight-pattern microphones exhibit what is known as the "proximity effect", where low frequencies are boosted if the mic is used very close to the sound source; typically 100mm or closer.

The Cardioid pattern is really a modification of the Figure-of-Eight principle, where the addition of acoustic porting reduces the sensitivity of the capsule at the rear and sides. This porting can affect the natural tonality of the microphone to some extent, which is why Omni-pattern mics generally have a more natural and open sound than cardioid models. However, a well-designed Cardioid microphone can still sound extremely good and has the obvious spill-rejection benefits associated with uni-directionality.

By building a condenser mic using two back-to-back cardioid capsules (usually large-diameter), the outputs from the two capsules can be mixed electronically to generate any desired pickup pattern from cardioid, via figure-of-eight, right through to omni; and all points in between. However, there is an argument for choosing a single-diaphragm, dedicated Omni microphone for critical Omni-mic'ing applications as their simpler construction usually gives a more even, natural sound. With dual large-diaphragm capsules, the high frequency response of the microphone often fluctuates very slightly with angle, being most accurate when the sound source is directly in front of them. In many cases, this small compromise is offset by the microphone's versatility.



Ribbon Mics

Ribbon microphones are based on one of the first microphone principles ever devised, where a thin ribbon of conductive metal (usually aluminium) is suspended in a magnetic field. This construction produces a natural figure-of-eight pickup pattern. When the ribbon moves in response to sound, a very small electric current is generated which is fed out via an impedance-matching transformer to produce an electrical signal. Traditional ribbon microphones are fairly insensitive (little signal is produced for a given sound level) and their high frequency response rolls off significantly above 10kHz or thereabouts. The reason they remain popular is that they have a musically pleasing sound, especially for use on strings, electric guitar amplifiers and drum overheads. Modern advances in ribbon design have made these microphones more robust than before, and the sE RNR1 has a much extended high frequency response - but they still need to be handled with reasonable care as a fall could break the ribbon. It is important to check what manufacturer backup is available for ribbon microphones, though you'll find sE is very generous in this respect.

Active ribbon models can be made so that they're more sensitive and can have their high frequency response extended somewhat, but they still retain the smoothness of tone and musicality that made them popular in the first place. The introduction of the sE RNR1 means that ribbon microphones may now be used in some applications where previously a capacitor model would have been the only logical choice.

The Importance of Patterns



Unidirectional or cardioid mics are useful in limiting the level of unwanted off-axis sound, such as room reverberation or spill from other instruments being picked up by the microphone. In the studio this helps create better separation when several musicians are playing together, each with their own microphone. However, it should be borne in mind that off-axis sounds will be reduced in level but not eliminated entirely, and a characteristic of a typical cardioid pattern mic is that high frequencies fall off more rapidly than low ones as you move away from the frontal axis. In practice this means that off-axis spill can sound dull and coloured.



The figure-of-eight pattern microphone is used for some specialist applications such as stereophonic mic'ing but the fact that they are almost totally 'deaf' to sounds arriving 90 degrees off-axis can be exploited in maintaining good separation simply by ensuring the 'deaf' axis aims directly at the unwanted sound. Often you won't need to pick up sound from the rear of the mic (which is just as sensitive as the front) so this can be screened to some extent using acoustic gobos or an sE Reflexion Filter™.



Omnidirectional microphones have an inherently more natural sound than cardioids, as their simple construction eliminates the need for complex rear porting to shape their directional response. Off-axis sounds are reproduced reasonably faithfully and with small diaphragm models the sound quality is virtually consistent regardless of the direction from which the sound approaches. Other advantages include a higher immunity to handling noise than cardioid mics, extended low end response, lack of proximity effect, and often a greater ability for handling high sound levels.

In situations where separation is a prime requirement, cardioid microphones are usually the instinctive choice but as omnis don't colour the off-axis sound in the way cardioids do, any off-axis spill will be captured faithfully. In practice, a recording made using omni mics can be easier to mix; spill levels may be a few dBs higher than when using cardioid microphones but the quality of the spill isn't compromised so it integrates with the wanted sound better. Note that if you place an omni mic at between half and two thirds the distance from the source than you would for a cardioid mic, the amount of spill will be similar so the use of omnis doesn't necessarily signify poor separation.

What the Terms Mean.

- Sensitivity:** This is a means of stating how much signal output a mic produces for a given level of sound input, usually specified at 1 Pa or Pascal of sound pressure at 1kHz.
- Max SPL:** The maximum sound pressure a mic can accommodate before the output becomes significantly distorted. A typical figure would be around 130dB, but for high sound level applications some models can handle up to 145dB or more and this may be further extended if the mic has a pad switch.
- Pad Switch:** Used to reduce the output from a microphone, usually by 10 or 20dB when used in high sound level environments. This prevents the internal electronics and any subsequently connected preamplifier from being overloaded.
- Noise:** All electronic circuitry produces random noise and in the case of microphones this is often specified as an equivalent input noise or EIN. Typical EIN noise figures for capacitor microphones are between 12 and 20dB where the higher the number, the noisier the mic. Extremely low noise models may produce as little as 5dB of self noise.
- Signal-to-noise ratio:** This is another way of expressing noise performance by expressing it as the ratio between the noise and the nominal operating level of the microphone. This figure is expressed in dBs and anything higher than 75dB is reasonably good with larger values indicating lower noise.
- Low Cut Filter:** If a mic doesn't need to pick up very low frequency sounds from bass instruments, it can be advantageous to switch in a filter to reduce the effect of vibration, rumble, vocal popping and so on. Many mics have a low cut filter, often at around 80Hz with a 12 or 18dB/octave slope.
- Pop Shield:** Close mic'ed vocals can suffer popping when the singer pronounces B and P sounds as these tend to expel a blast of air that can slam into the diaphragm causing a high level, low frequency thump at the output. These can sometimes be called "plosives". While a low cut filter will help reduce popping, a more effective solution is to use a perforated nylon or metal mesh in front of the mic to disperse the air blasts before they reach the microphone. These are normally placed 50 to 75mm from the microphone, directly in front of the singer's mouth.
- Shock Mounts:** Microphones are sensitive to vibrations picked up by their casework and even a well-designed flexible capsule suspension system can't eliminate it entirely. Where stand-borne vibrations might be a problem, a shock mount cradle that holds the mic via a series of elastic belts makes a significant improvement.
- Tube Mics:** Typical condenser microphones use Field Effect Transistors or FETs as amplifiers as these have the very high input impedance necessary to match the capsule. Before FETs, tubes or valves were used, and though these require additional power supplies and are more costly to build, they are still popular because of the warm, solid tonality imparted by the valve circuitry. This is partly due to the progressive distortion characteristics of valves, which add pleasing harmonics to the sound and add some natural compression. Tube microphones have an external power supply and so don't require phantom power. While vintage tube microphones often use exotic tubes that are difficult to find and very expensive to replace, modern versions use more commonly available tubes so getting spares presents no problem.
- Phantom Power:** Condenser microphones and other active microphones are often designed to run from a standard 48 Volt phantom power source. This is supplied by the mixer or mic preamp and is passed along the conductors of a standard balanced XLR mic cable. The term 'phantom power' came about because no additional cabling is needed. When considering the purchase of a condenser microphone, check that your mixer or mic preamp can supply phantom power.

Care of Microphones

Studio microphones need to be protected from dust, mechanical shock and excess humidity. The best strategy is to put them back in their cases when not in use and to store these in a domestic environment or other low humidity area such as a typical home. If the microphone must be left out on its stand, a plastic bag placed over it when not in use will protect it from dust. Ribbon mics are particularly vulnerable to mechanical damage so avoid deliberately blowing into them or dropping them.

The outer case of most microphones can be cleaned quite effectively using a damp (not wet) cloth with a drop of household detergent (washing up liquid) added to the water if necessary. Avoid the use of alcohol or spirit cleaners and don't spray household polish near the capsule basket. With reasonable care, a good microphone can give trouble-free operation for many years or even several decades.

Mic Techniques



Vocals

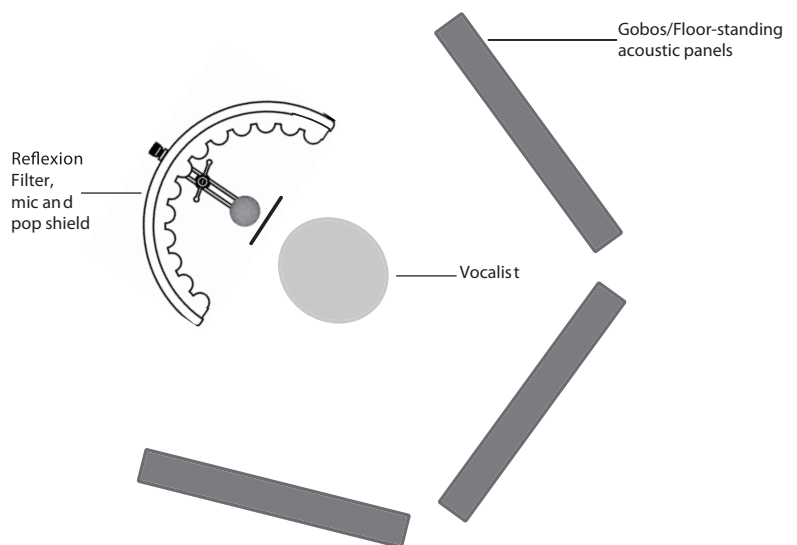
Vocal recording is often considered difficult but it is actually pretty straightforward as long as the acoustic environment is taken into consideration. For most studio work, a relatively dead environment is ideal as it allows artificial reverb to be added while mixing. Small vocal booths may give the illusion of sounding dead, but unless very well designed, may actually sound quite boxy due to a lack of low frequency absorption. A better approach may be to place the singer in a larger room and then apply localised acoustic treatment. A combination that works well is to place acoustic absorbing gobos behind and to the sides of the singer and an sE Reflexion Filter™ behind the microphone. In low rooms, an absorber placed above the singer's head also brings about significant benefits and in smaller rooms, avoid placing the singer or microphone close to either the walls or the exact centre of the room.

A metal mesh pop screen will usually produce less in the way of tonal artifacts than a fabric screen and few singers can manage a pop-free performance without one. Place this around 50 to 75mm from the microphone with the singer's mouth typically 150 to 250mm from the microphone. The microphone height can be adjusted so that the singer sings slightly above or below the axis of the microphone if this produces a more suitable tonality. The microphones own low cut filter may be engaged if necessary to further reduce popping and low frequency spill, although always check that this doesn't compromise the natural sound of the voice.

The choice of microphone is entirely a function of what suits a particular singer, and the most expensive model won't necessarily sound the best. While large diaphragm, cardioid capacitor microphones are the most common choice for studio vocals, different models sound either bright, or warm so it is necessary to match the characteristics of the microphone to the strengths and weaknesses of the singer. You may also find that a small diaphragm model sounds more natural in some cases, and if you're after a more rounded, vintage sound, try a ribbon model. The extended high end response of the sE RNR1 ribbon microphone makes it suitable for both vintage and contemporary sounding vocals.

Vocal mic'ing

Top-down view of a vocal mic setup. Positioned off-centre in the room, and at an angle to minimise direct reflections from walls.





Acoustic Guitar

Acoustic guitars, both steel and nylon strung, can be fairly quiet instruments if picked rather than strummed, so a fairly sensitive microphone with low self noise is desirable. Condenser microphones are often used as they are easily able to capture the high frequency detail of these instruments and for the most natural sound, a model with a nominally flat frequency response may be desirable. However, a microphone with a specific character can be chosen if it suits a particular instrument so the end always justifies the means. At the outset, it must be emphasised that the microphone will pick up both the direct sound from the instrument itself and sound reflections from the environment in which it is played, so some acoustic screening may be needed to control the amount of reflected sound reaching the microphone.

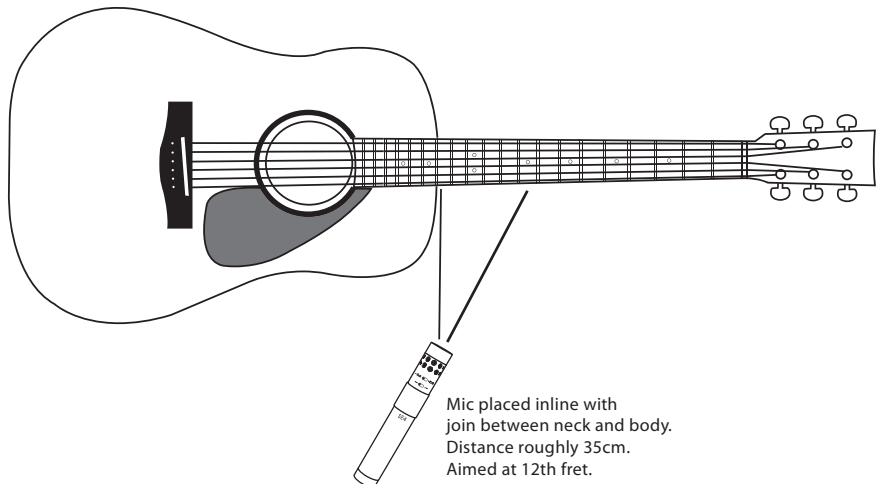
Most acoustic instruments, the guitar included, sound best if played in a sympathetic room where the reflected sound supports the natural tonality of the instrument. Covering the floor beneath the layer with hardboard or other reflective material if the room is normally carpeted can create a localised live environment. It may also help to play close to a reflective plaster or wood panel wall.

The key to a good guitar sound is to find the best position for whichever microphone you choose to use. Great results can be achieved using large diaphragm models, small diaphragm models, cardioids and omnis. Omnis can give a very sweet sound but you may need to screen off the rear and sides of the mic if spill from other parts of the room becomes a problem. If you are fortunate enough to own an sE RNR1 ribbon microphone, you will find that this also sounds extremely good used on acoustic guitars, when ribbon microphones from other manufacturers may sound too dull in this application.

The easiest way to find the best mic position is to monitor the mic output via good quality headphones and then move the mic around the guitar as the player runs through the piece. Many engineers start out aiming at where the neck joins the body from a distance of around 350mm but you can also get results by setting up the mic 150mm or so in front of the guitar and then aiming it at the guitar bridge either from above or below the guitar. Again a mic distance of around 350mm is a good starting point but you'll need to experiment to find the 'sweet spot' as every combination of player, room and instrument is different. In cases where the player moves excessively, consider using a guitar body mounting arrangement for the microphone such as the sE GM10 system which comprises an effective clamp and adjustable arm with a small high quality condenser microphone attached.

Recording the guitar using a single mic avoids any mono-compatibility phase issues that might occur with spaced stereo mics, but a guitar part can be given more width and definition by mic'ing up the body as just described and then aiming another mic part way up the neck. The outputs from the two mics can then be panned apart slightly in the mix. Unless the guitar is physically small and bass-light, avoid pointing a microphone directly at the sound hole as this tends to capture a very boxy, resonant sound.

Mono guitar mic'ing starting point





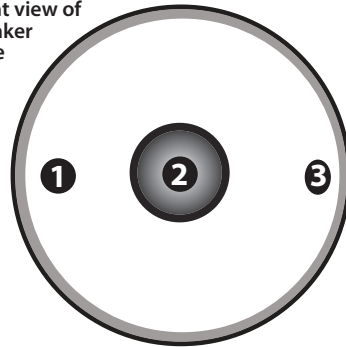
Electric Guitar

There are probably as many ways to mic up the electric guitar amplifier

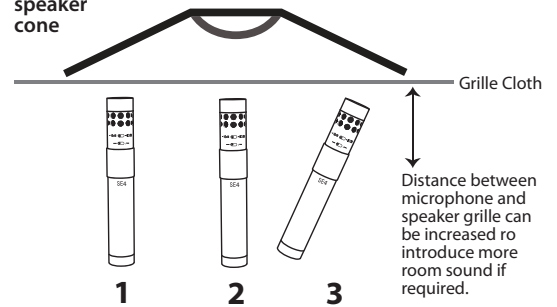
as there are engineers but some standard approaches have evolved. Because of the restricted frequency response of guitar speaker systems, which don't employ tweeters, dynamic microphones have a more than adequate frequency range and can tolerate the high SPLs that occur close to the grille cloth. A general purpose cardioid or omni mic will usually give quite adequate results and now that ribbon mics are becoming more affordable, these are once again becoming popular for recording the electric guitar. Some engineers also prefer the sound of condenser microphones, usually large diaphragm models, so there's no hard and fast rule as to which type of microphone to try.

Suggestions for guitar amplifier microphone positions

Front view of speaker cone



Top view of speaker cone



Cardioid mics don't pick up sound from the rear as omnis and ribbon (figure-of-eight) mics do, but if they're placed very close to the speaker grille, spill from other sources is unlikely to constitute a serious problem. When using a single mic, a position close to the grille cloth is the normal starting point but it is important to try different positions across the face of the speaker as you get a different tone when mic'ing the centre as you do when mic'ing close to the edge.

At the SPLs guitar amps generate, microphone sensitivity and noise are unlikely to cause problems — the most important thing 'spec-wise' is to choose a mic that can handle a high SPL without clipping. Try all the mics you can as the most obvious choices may not always produce the best results.

While the single mic approach can produce great results, it is not uncommon to see engineers putting up both ribbon and dynamic mics close to the speaker grille, and where the room has a sympathetic ambience, a condenser mic a couple of metres back. The outputs from the various mics can then be combined and mixed to give the desired sound. If the guitar is played in the control room with the amp in the live room, it is also possible to mic the guitar strings directly using a capacitor mic and then mix a little of that in with the mic'ed amp sound to add definition.



Drums and Percussion

Depending on the kit, how well it is tuned and how well it is played, drums can either be a joy to work with or the source of much frustration. A good sound starts with a good sounding kit, and though that sounds obvious, there are many examples of engineers trying to fix the sound of a bad sounding kit using EQ and compression.

A good-sounding kit will have the correct heads fitted for the type of music and will be well maintained to avoid squeaks and rattles. Good tuning and correct damping is paramount. Drums often sound best in a slightly live environment, but in the smaller studio you may be better off trying to exclude wall and ceiling reflections and then add ambience when you mix using a suitable reverb device or plug-in. Top-league studios have large drum rooms with high ceilings, so in the smaller studio, getting rid of ceiling reflections that might otherwise leak into the overheads is a priority. You could stick acoustic foam to the ceiling but a less permanent solution is to use sE Instrument Reflexion Filters™ on the drum overheads. Acoustic foam panels may be hung on the walls to control excessive small room liveness but don't be tempted to use carpet as that will only make the room sound more boxy. The close drum mics are less of a problem as they pick up relatively little room sound.

Kick drums are easier to mic in the context of rock and pop music if they either have the front head removed, or are fitted with a front head into which a hole has been cut to allow some flexibility in positioning the kick mic inside the drum shell. A wooden or plastic bass drum beater gives a harder, more defined sound than softer beaters and it is usual to damp the kick drum using a folded blanket placed inside the shell so as to prevent the batter head from ringing too long.

The snare drum may be damped using duct-tape or materials such as Moon Gel but damping is not normally applied to the lower snare head as this prevents the snares from vibrating properly. The same approach can be taken with the toms, which may either be double or single headed.

Drum Mic'ing Options

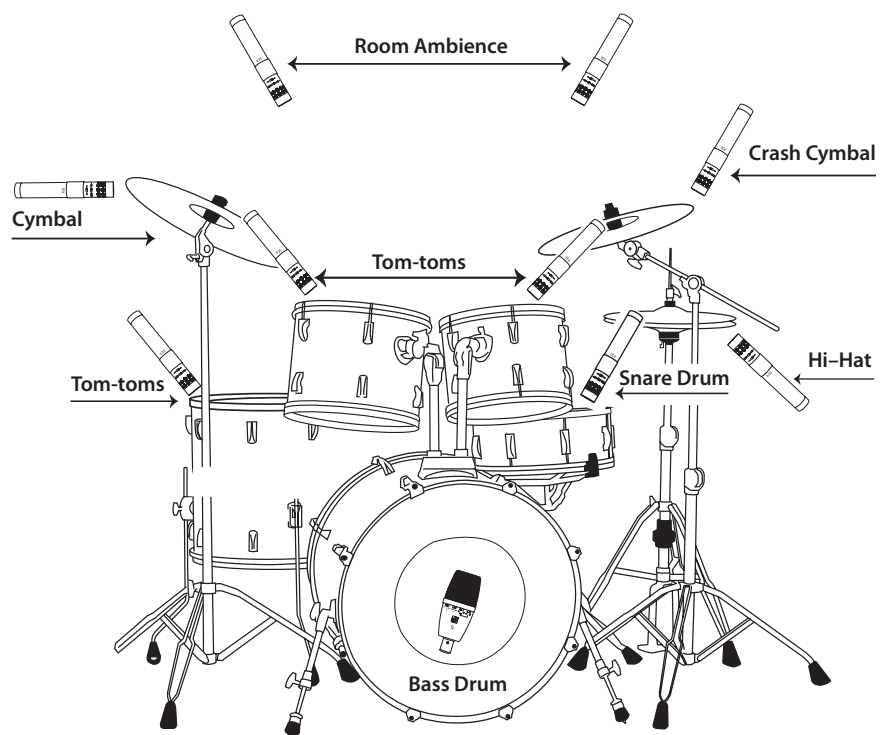
For some styles of music, such as jazz, the entire kit can be recorded using just one or two microphones set up between one and 1.5 metres from the ground and placed a couple of metres in front of the kit. These will capture the live sound (and stereo imaging if a spaced pair is used) of the kit as it sounds in the room, but for this to work well the room has to augment the sound of the kit rather than simply muddy it. While condenser mics are the usual choice for room mics, a high quality ribbon mic (or stereo pair) such as the sE RNR1 placed a couple of metres in front of the kit can sound wonderful in a good room.

Even with this purist approach, the snare and kick drums often benefit from having their own close mics that can be mixed in to give them more definition. With such a setup, the two front mics may be moved to above the kit so as to better capture the sound from the cymbals and toms, though in good sounding rooms, the use of both room mics and overheads often yields the best results. Some engineers are very careful to ensure the two mics are the same distance from the snare drum so as to avoid "comb filtering" effects should the track be played back in mono. Snare mics are often simple dynamic models whereas the kick mic could be a large diaphragm condenser mic or a specialist dynamic model with an extended bass response. As long as you choose a model with a high SPL handling capability, you won't damage anything while experimenting.

A typical snare mic position would be 50mm above the rim and aimed towards the centre of the drum head, while the kick mic is often placed just inside the drum shell aimed somewhere between the beater and the drum shell. Every kit is different so some experimentation is invariable necessary to get the best result. A more sophisticated approach would be to set up a second large diaphragm condenser mic a metre or so in front of the kick drum, and then balance that with the mic inside the shell.

Overheads may be set up as a coincident pair or spaced at around two metres from the floor. A coincident pair would normally be based on two cardioid condenser mics with their capsules close together and their axis pointed to either side of the drum kit but where spaced mics are used, any of the main pickup patterns can be used. Many professional engineers also like the sound of ribbon mics as overheads as they give a smoother, more rounded sound to the cymbals. Whatever mic type or pattern is used, in low rooms, some form of acoustic absorber between the mic and ceiling is desirable.

Drum mic'ing





Tom mics are set up similarly to the snare mic, and may be either dynamic or capacitor models. Both snare and tom mics should be positioned so they point away from adjacent drums (and hi-hats) where possible so as to minimise spill.

In pop music recording, drums are invariably mic'ed individually as well as by means of overheads and perhaps more distant room mics. Typically the overheads and room mics establish the essential character of the sound, then the close mics are brought in to add focus and to fine-tune the balance. Separate hi-hat mics can be used where the overheads aren't giving them enough prominence and are generally condenser models. Positioning the hi-hat mic 200 mm or so from the side of the hi-hat cymbals, either just above or just below the cymbals, ensures it doesn't get hit by a blast of air every time the hi-hats are closed.

Other percussion such as congas, djembes and so on may be mic'ed from overhead in either mono or stereo using capacitor microphones. The further the mic is raised above the drum, the more room ambience will be captured along with the direct sound. As with the drum kit, a naturally live environment often produces the most pleasing sound.

General Mic'ing Hints

If you come across an instrument that you haven't recorded before, you can learn a lot by walking around it during a performance and listening. Even where most of the sound seems to come from, mainly one part of the instrument, you'll usually find that other parts also contribute to the overall sound so avoid placing the mic too close, and if in doubt, try a position close to the player's head; if it sounds good to the performer then it should sound good to the microphone! Most acoustic instruments respond well to a mic distance of 300 to 600mm though physically large instruments may require a correspondingly larger mic distance. You also have to take into account the effect of room reflections when working at greater distances and also any spill implications when recording multiple instruments at the same time. The standard technique of moving the mic around while listening to the result on headphones is probably still the best approach and if the sound isn't right, try changing the mic or mic position before reaching for EQ.

Mic Applications Notes for specific model types

Many manufactures list the sound sources that they believe their microphones handle best, but in our experience every situation is different and very often the least likely choice of microphone produces the best sounding result. For that reason we've put together a few guidelines to help you decide which microphone is most likely to be right for each job, but where time allows, we urge you to experiment.

Small Diameter Cardioid Condenser Models

sE1a, sE4, RN17

Small diameter condenser microphones are generally associated with good transient handling and general tonal accuracy, making them suitable for use with a wide variety of sound sources - ranging from acoustic stringed instruments, such as guitars, to percussion and drum overhead mic'ing. Because of their largely uncoloured sound, they can produce high quality recordings from virtually any source, though you may choose to use an alternative type of microphone when a specific tonal character is required. For example, while a small diaphragm microphone can give you a very accurate recording of bowed strings, many engineers prefer to use a ribbon microphone as it helps disguise the hard edge produced by such instruments when heard at close range. Similarly, a small diaphragm microphone used in conjunction with a pop shield will often produce a first class vocal recording though some voices are better suited to a large diaphragm model with a tonal quality that flatters their voice.

Cardioid and hypercardioid versions are chosen when it is necessary to optimise the separation between instruments playing at the same time, or where the effect of the room acoustic must be minimised. However, the off-axis response of all cardioid pattern microphones tends to fall away at high frequencies more rapidly than at low frequencies, so sounds picked up from the sides or from behind, though attenuated, may sound dull compared to sound being picked up on the main axis of the microphone. Note that all cardioid and hypercardioid pattern mics exhibit a proximity bass boost effect when used very close to the sound source. For stereo use, cardioid pattern microphones may be used as a spaced pair or as a coincident pair with their capsules angled at between 70 and 110 degrees depending on the width of the sound source.



Small Diameter Omni Condenser Models

sE4, RN17 (both require optional Omni capsules)

The highly accurate off-axis response of a dedicated small diaphragm omni capacitor microphone capsule makes it extremely flexible and natural-sounding. The fact that an omni capsule picks up sound from all directions makes it less suitable for use in situations where spill or room acoustics need to be minimised, though they do have the benefit that any spill they do pick up from other instruments is likely to sound more natural and so may be less problematic when you come to mix. When close-mic'ing acoustic instruments with omni pattern microphones, an sE Reflexion Filter™ placed directly behind the mic will help exclude spill and room reflections. Because of its versatility, you can use a small diaphragm omni mic on virtually any electric or acoustic instrument (or voice) where an accurate interpretation of the sound source and the surrounding acoustic environment is required.

Note that omni mics do not exhibit a proximity bass boost when used close up and also have a naturally more extended low frequency response than cardioid microphones making them more suitable for the recording of bass instruments in situations where the microphone can't be placed very close to the source. For stereo use, omni microphones are normally used as a spaced pair.

Large Diameter Cardioid Condenser Microphones

sE X1, G3500, Gemini 5, Gemini II, Gemini III, sE2200a, sE2200a II C (Cardioid only), sE2200a II Multi Pattern, sE2200a T (Tube), sE4400a, sE T2, Z3300a, Z5600a II

sE large diaphragm condenser microphones for use in the studio are side-entry types, where the 'hot' or active side of the capsule is denoted by the sE logo. Most large diaphragm models are designed with a specific tonal character to enable them to flatter the sound source being recorded. All sE large capsule models have their own tonal colour and in the case of vocal recording, you should try to pick a model that enhances the good elements of the voice while suppressing those less attractive traits. For example, if you are working with a singer who has a hard or thin voice, then a microphone with a smooth high end and a slightly exaggerated low end may achieve a better result. Conversely, a singer with a softer voice may gain greater clarity through using a microphone with a subtle presence peak.

Though large diameter cardioid capacitor microphones are often perceived as being primarily vocal microphones, their tonal 'flavouring' can be used to advantage when recording acoustic guitar, acoustic piano, brass and bowed strings. They are also popularly used in pairs as drum overheads or drum room mics.

Large Diameter Multi-pattern Capacitor Microphones

Gemini III, sE2200a II Multi Pattern, sE4400a, Z3300a, Z5600a II, T2

By combining the outputs two back-to-back cardioid capsules in different proportions, all the possible pickup patterns from omni, through wide and narrow shades of cardioid to figure-of-eight can be created. While the off-axis response of these patterns may not be quite so precise as those of dedicated single pattern capsules, the multi-pattern microphone is an incredibly versatile tool for use in the recording studio where most of the wanted sound is generally arranged to be on the axis of the microphone. The figure-of-eight pattern is particularly valuable in situations where spill is to be avoided, as this pattern is unique in being almost totally insensitive to sound arriving from 90 degrees off axis. This enables the engineer to aim the dead side of the mic towards the source of spill. Note that like the cardioid pattern, the figure-of-eight pattern exhibits a pronounced proximity effect where the bass response rises significantly when the microphone is used close to the sound source.



Addendum for Tube models

The use of tube circuitry adds a subtle musicality that tends to sweeten the highs and add density to lows, thanks in part to the natural non-linearities inherent in tube amplifiers. Technically this is a form of distortion that also modifies the dynamic range in a similar way to a very gentle compressor, but it is an effect that the human hearing system finds pleasant providing it isn't excessive. sE tube microphones are designed to exploit the natural characteristics of audio tubes, not to add artificial distortion. All our tube microphones come with their own power supplies and so require no phantom power but are not affected if phantom power is applied.

Ribbon Microphones

Ribbon microphones have a natural figure-of-eight polar response, so where a more controlled directivity is required, we recommend using an sE Reflexion Filter™ behind the microphone. Their unique character enhances the interesting mid-range resonances in an instrument while smoothing out the highs, making them ideal for sweetening bowed strings or as drum overheads where you need to prevent the cymbals from becoming too splashy. They are also used by many leading engineers for recording guitar amplifiers as they retain the bite and character of the sound, while filtering out some of the less desirable high-end harmonics. Passive ribbon models have a naturally low output and so should be used in conjunction with a good quality, low noise preamplifier.

Though other manufacturers may provide suggested lists of instruments for use with their ribbon models, we would recommend you try our ribbon models on as many sources you can (other than perhaps close-mic'ed drums), as they often reveal a surprising and musically valid alternative to the more obvious microphone choices. Use a pop shield if using them to record vocals and shield the rear of the mic using a Reflexion Filter or other suitable acoustic absorber.