Mike It!

A Crash Course In Recording with Microphones

Presented by Fett
Cacapehon Retreat
May, 2024

Wanna Follow The Slides On Your Own Device?

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What's a Fett…?

- Independent producer/engineer, Azalea Studios, Nashville
- Co-founder and owner of Azalea Music Group, Nashville
  - www.AzaleaMusic.com
- Former Technology Editor for *Performing Songwriter* magazine
- Creator & host of Empowering Women In Audio clinics
  - www.EmpoweringWomenInAudio.com
- Coach & mentor
  - www.AzaleaMusic.com/fetts-production-booster-program
- Author
  - *Fett's Mixing Roadmap: A Step-by-step Guide to Mixing In The Studio* (Amazon.com)
- Teacher: online video courses in recording, mixing, mastering, etc.
  - www.AzaleaMusic.com/Programs

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Let’s talk about microphones…

- How much do you know about…
  - Microphone *design*?
  - Microphone *features*?
  - Microphone *behaviors*?
  - Microphone *placement*?
- How each of the above influence the ***sound*** of a recording?

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Microphones are…

- The “Analog Heart” of the music production process. (M. Wagener) Mics have an impact on:
  - Recording & overdubbing
  - Editing
  - Mixing
  - Mastering
  - EVERYTHING!

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All mics have…

- A “body” that houses (and protects) all mic components
- An internal element (capsule) with a diaphragm / membrane that vibrates in response to sound in the air
- A method of converting sound vibrations into electrical signals
- A method of sending electrical signals out of the mic and into a sound-receiving device (such as a “preamp”)
  - Can be wired mic cable, or wireless transmitter
- Possibly additional internal electrical circuitry and external electrical controls (e.g., switches, knobs), depending on features

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Primary mic types (designs)

- Mics can be though of as “speakers in reverse”
  - “Transducers” of sound into electricity
  - You can even use a speaker as a microphone!
- At the core of design is “conversion technology” (also called “transduction technology”)
- Three primary types
  - Dynamic
  - Condenser
  - Ribbon

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Dynamic mics

- Conversion technology is “electromagnetic induction,” using a *moving-coil magnet*
- Primary benefits
  - Can be used to record pretty much anything
  - Extremely rugged and durable
  - Can handle extremely loud sounds without distorting
  - Easy to use
    - No special power source required; just “plug in and go!”
  - Generally lowest overall price for quality, performance and features
- Possible drawbacks
  - Can be less “sensitive” to sonic nuances
  - Can have a bit narrower frequency range

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Condenser mics

- Conversion technology is “electrostatic,” using an *electrically charged backplate*
- Primary benefits
  - Can be used to record pretty much anything
  - Extremely versatile
  - Can handle fairly loud sounds without distorting
  - Generally very high sensitivity to sonic nuances
  - Generally widest frequency range (esp. high frequencies)
- Possible drawbacks
  - Require dedicated power source (internal battery or external “phantom power”)
    - Tube condensers require dedicated “power supply” box
  - Generally widest price range (but has changed considerably)

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Ribbon mics

- Conversion technology is “electromagnetic,” but using a *thin, floating strip of metal (aka, ribbon) suspended between 2 magnetic poles*
  - Actually a variation of dynamic mics
- Primary benefits
  - Extremely high sensitivity to sonic *transients* (“slew rate”)
  - Can naturally add unique sound that’s harder to achieve with other mics
    - Smoothness, silkiness, warmth
- Possible drawbacks
  - Older models are *extremely* fragile; ribbon breaks very easily
    - Can’t handle very loud sounds without distortion or breaking
  - Less versatile; generally more specialized in terms of what they record well
  - Generally have much lower output volume than dynamics or condensers
  - Generally narrowest frequency range
  - Generally less selection to choose from (and correspondingly higher price), but has changed considerably

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Nowadays…

- External appearances can be very deceiving!
  - All types of mics now come in an infinite variety of shapes, sizes and housings
  - Some are even “hybrids” that include features from more than one design type
    - E.g., “phantom-powered ribbons”
- Price is no longer an automatic indication of features – or quality!
  - Some “high end” mics are extremely overpriced and limited
  - Some dirt-cheap mics are mainstays at studios and on stages at every level
  - What matters most is the SOUND and FEATURES that YOU are looking for!
    - Always “try before you buy” if possible

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Primary mic features

- Polar pattern
- Frequency response
- PAD
- Bass rolloff / low cut / HPF

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Primary mic features: Polar Pattern

- Polar pattern (aka, “pickup” pattern)
  - Affects the *sensitivity* of the mic to pick up sounds relative to their position to the diaphragm (front, sides and back)
    - Referred to as a mic’s “*directionality*” of picking up sound
  - Conversely, polar pattern also affects the *rejection* of sounds relative to the position of the diaphragm
    - Has a big impact on how much “bleed” or “leakage” of ambient sounds is picked up
- Most common polar patterns
  - Cardioid
  - Omni
  - Figure 8

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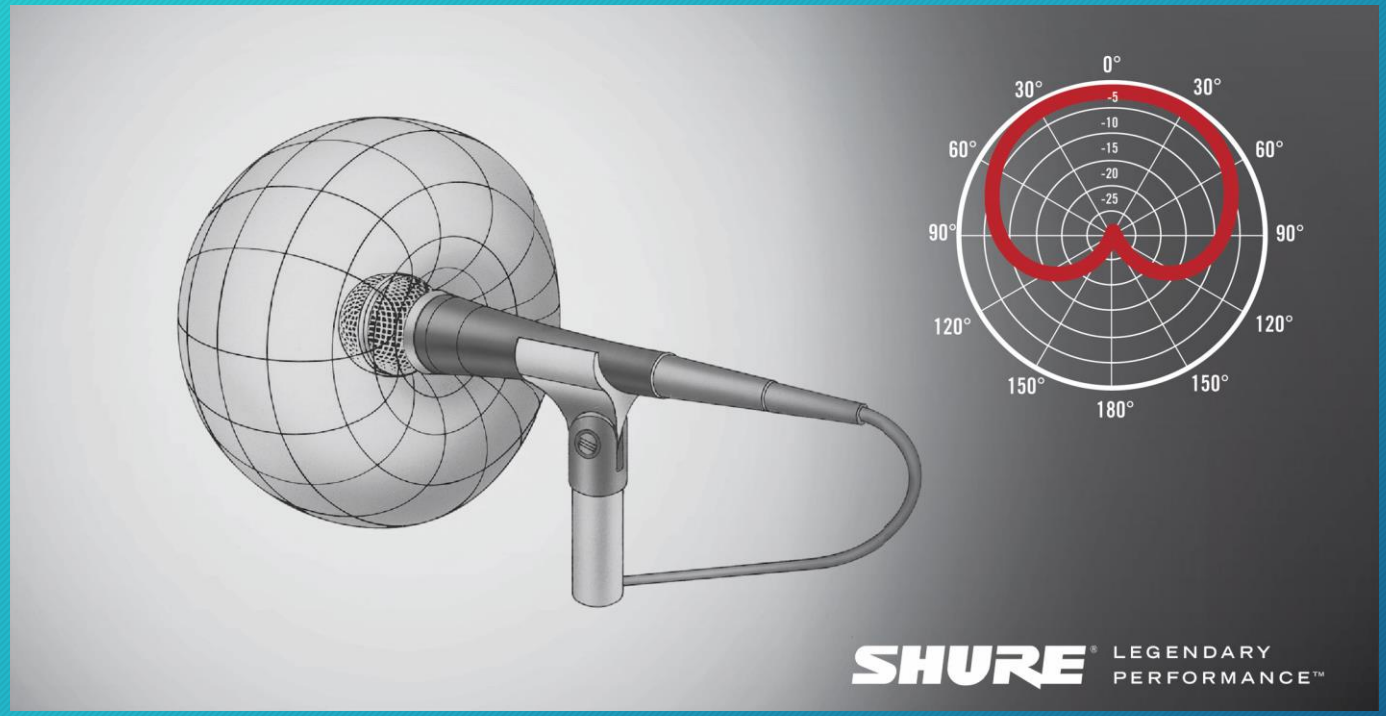
Polar Pattern: Cardioid (Uni-directional)



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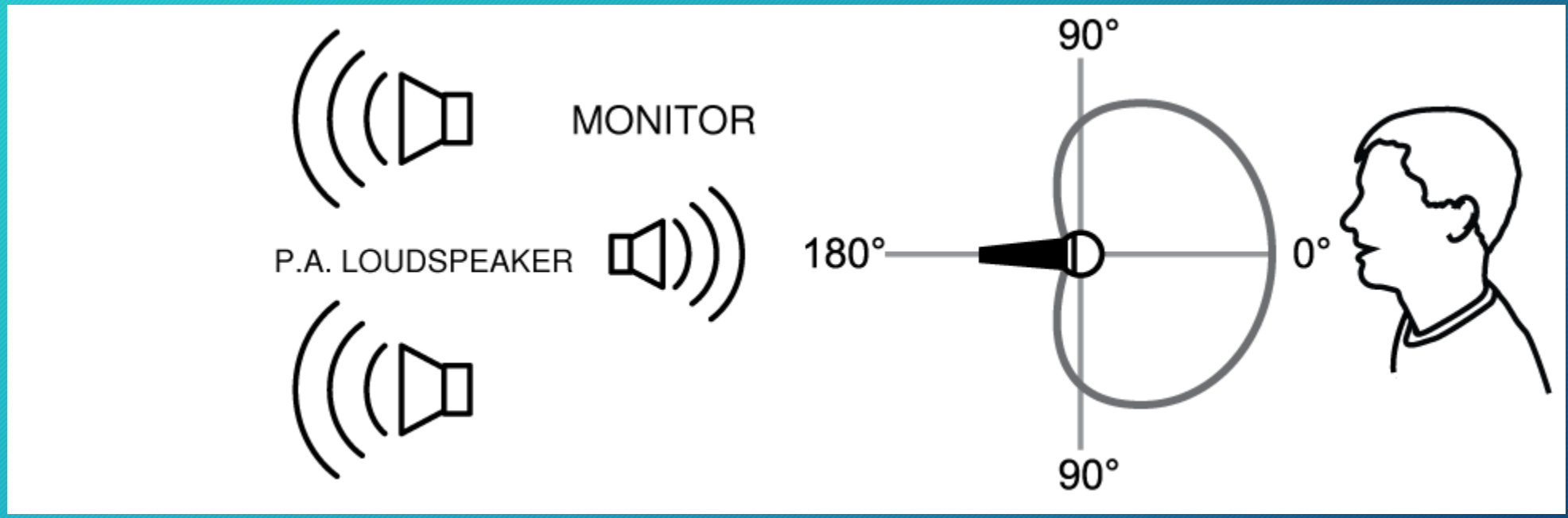
Polar Pattern: Cardioid



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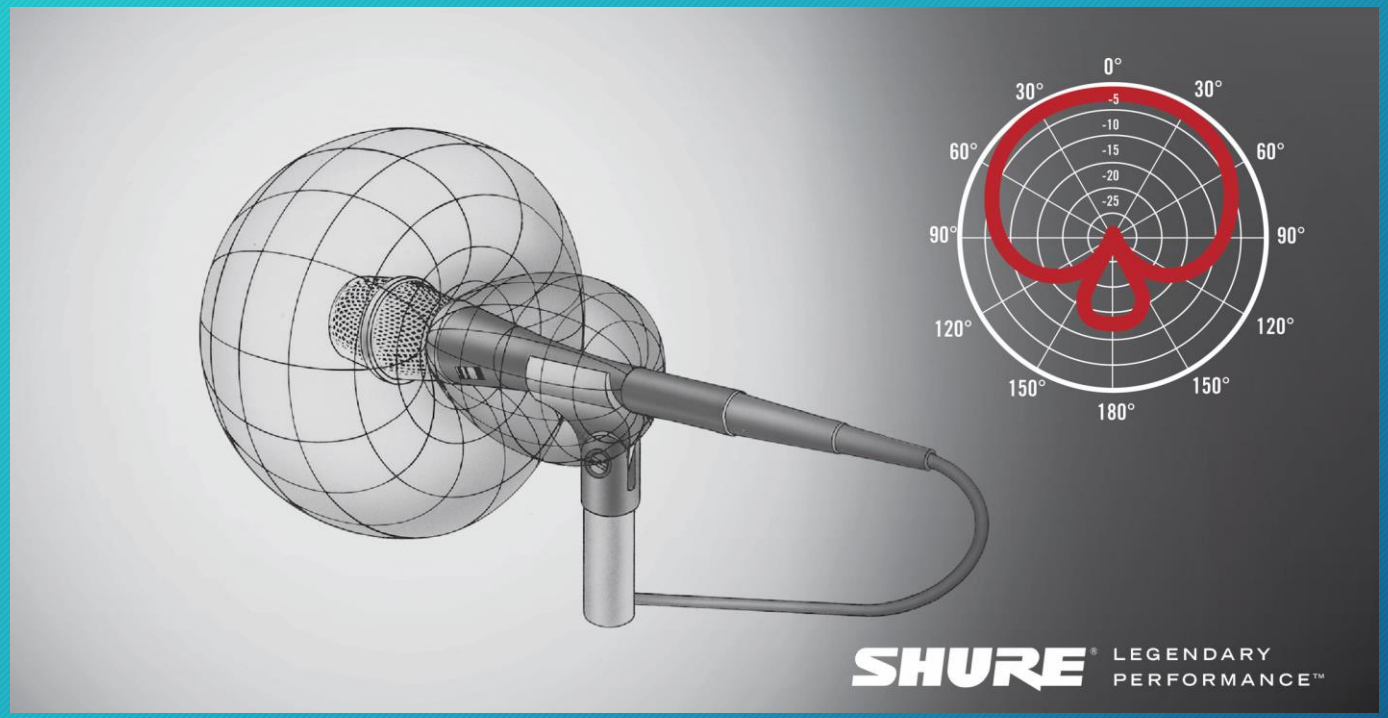
Polar Pattern: Super-Cardioid



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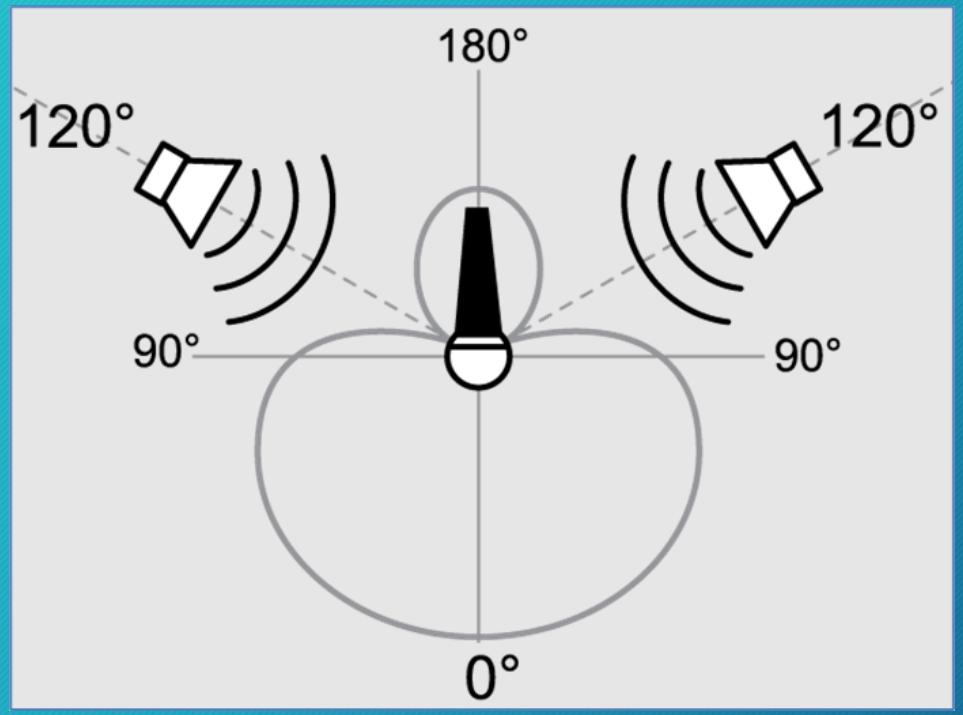
Polar Pattern: Super-Cardioid



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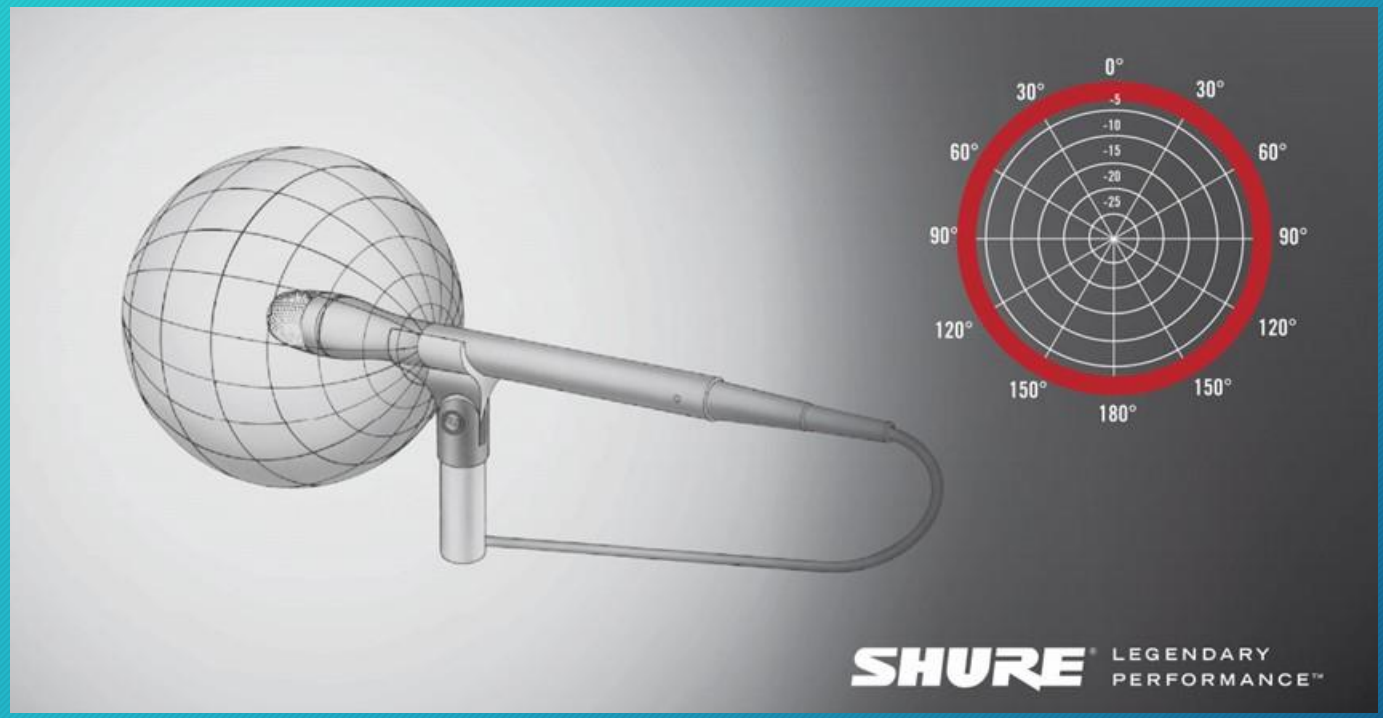
Polar Pattern: Omni (Omni-directional)



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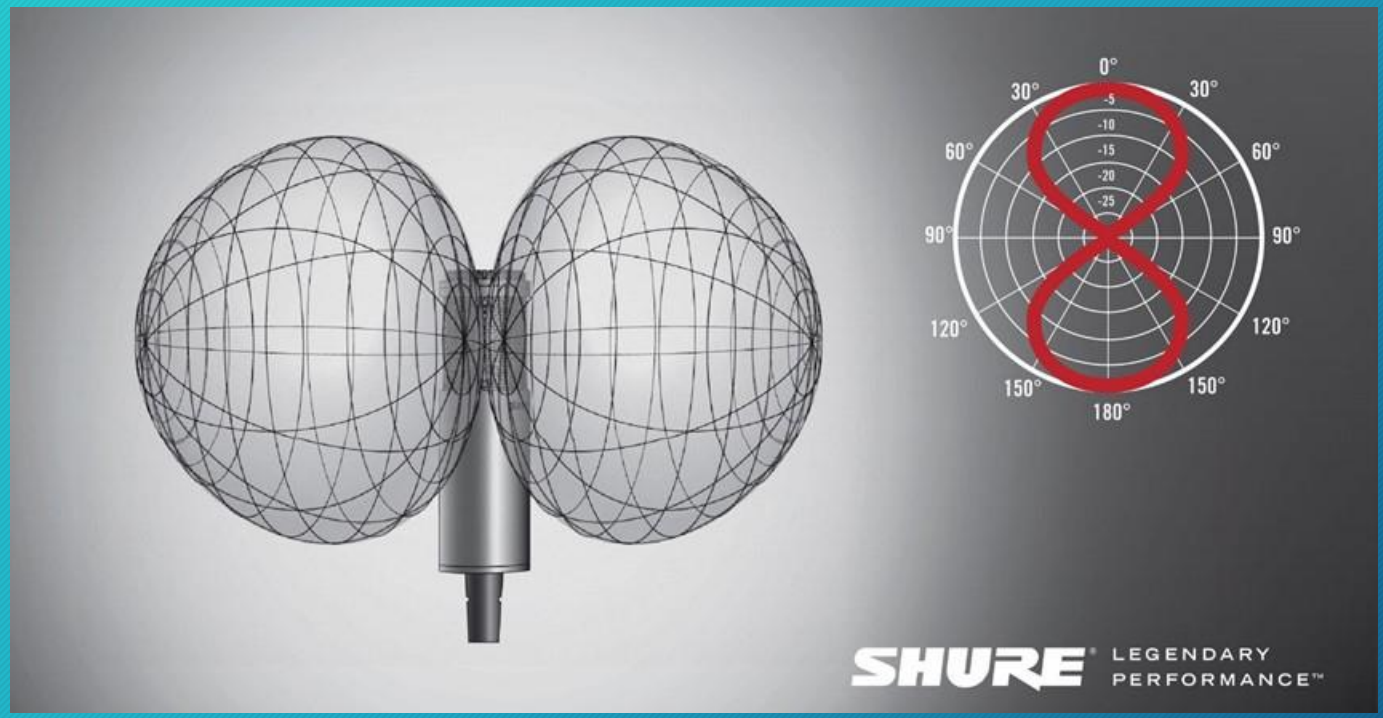
Polar Pattern: Figure 8 (Bi-directional)



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Polar Patterns - Summary

Characteristic	Omni-Directional	Sub-Cardioid	Cardioid	Super-Cardioid	Hyper-Cardioid	Bidirectional
Polar Response Pattern						
Coverage Angle	360°	150°	131°	115°	105°	90°
Angle of Maximum Rejection (null angle)	—	180°	180°	126°	110°	90°

MORE REJECTION

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Polar Patterns - Summary

- The vast majority of mics have only 1 polar pattern (cardioid)
  - Keeps the price down
  - Limits their flexibility
- Many mics have 2, 3, or even a “continuously variable” range of polar patterns
  - Cost more, but
  - Are like having multiple mics in one
  - Or a very flexible, “Swiss Army Knife” tool

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Available Polar Patterns by Mic Design Type

Mic Design Types	Available Polar Patterns		
	Cardioid	Omni	Figure-8
Dynamic	√	√	√
Condenser	√	√	√
Ribbon			√

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Primary mic features: Frequency Response

- Frequency response
  - Specifies the *sensitivity* of the mic to pick up different frequencies on the Audio Spectrum (range of human hearing, generally 20 Hz – 20 kHz)
  - Can be thought of as a mic's "internal EQ"
  - Expressed as a graph in a Frequency Response Curve
    - Will tell you a LOT about how a mic will sound, even before you've heard it
- Why intentionally give a mic a unique "frequency response"?
  - Gives each mic model a unique sound
  - Can vary greatly from one mic model to the next, making each one more likely to be used to record specific situations/setups, instruments, voices, etc.
- A very common characteristic of many mics' frequency response is a "presence peak" in the vocal range
  - Can be very desirable – OR NOT! – depending on what your needs are
  - Varies *drastically* from singer to singer (definitely NOT "one size fits all"!

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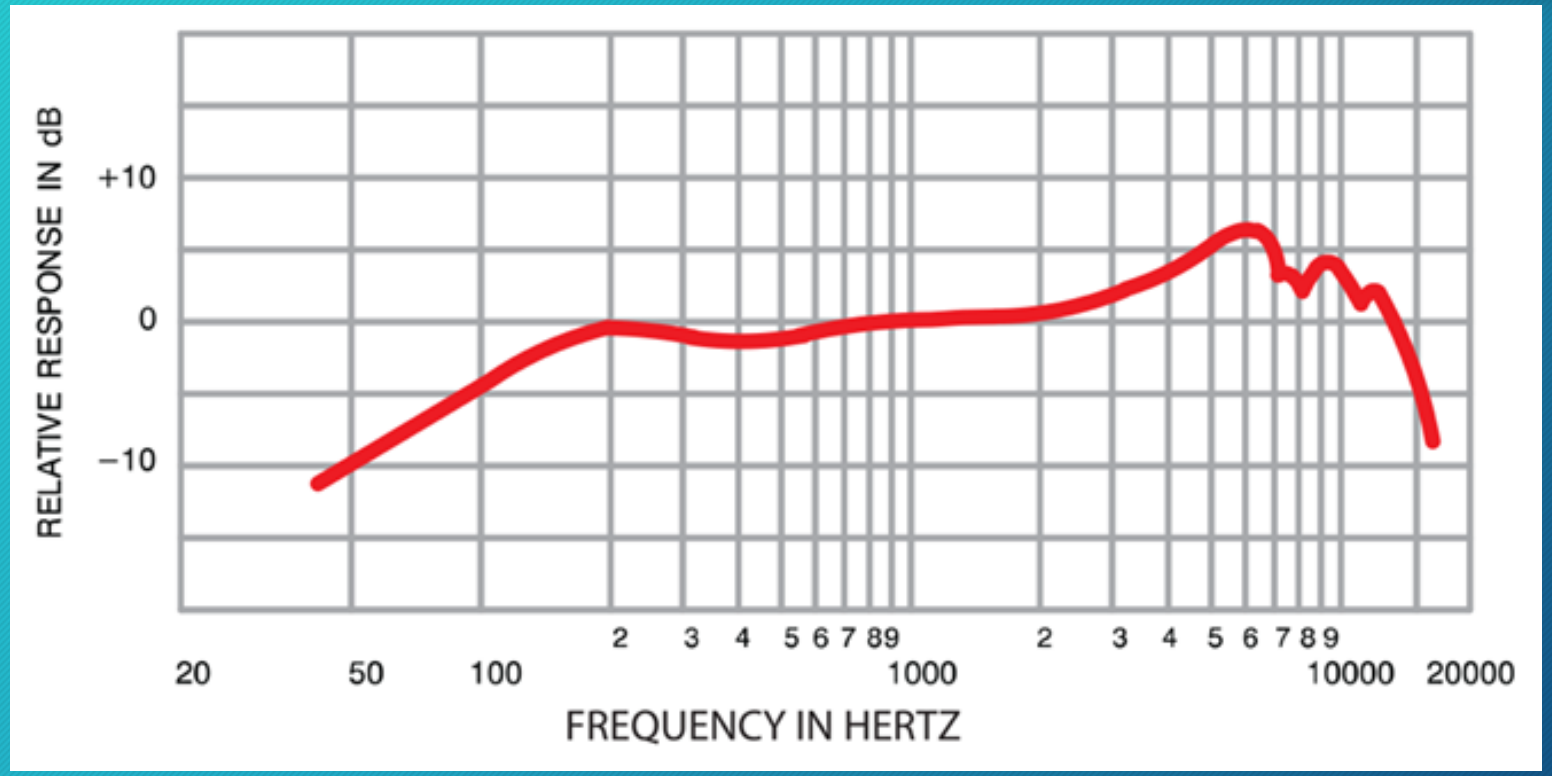
Primary mic features: Frequency Response



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Primary mic features: Frequency Response

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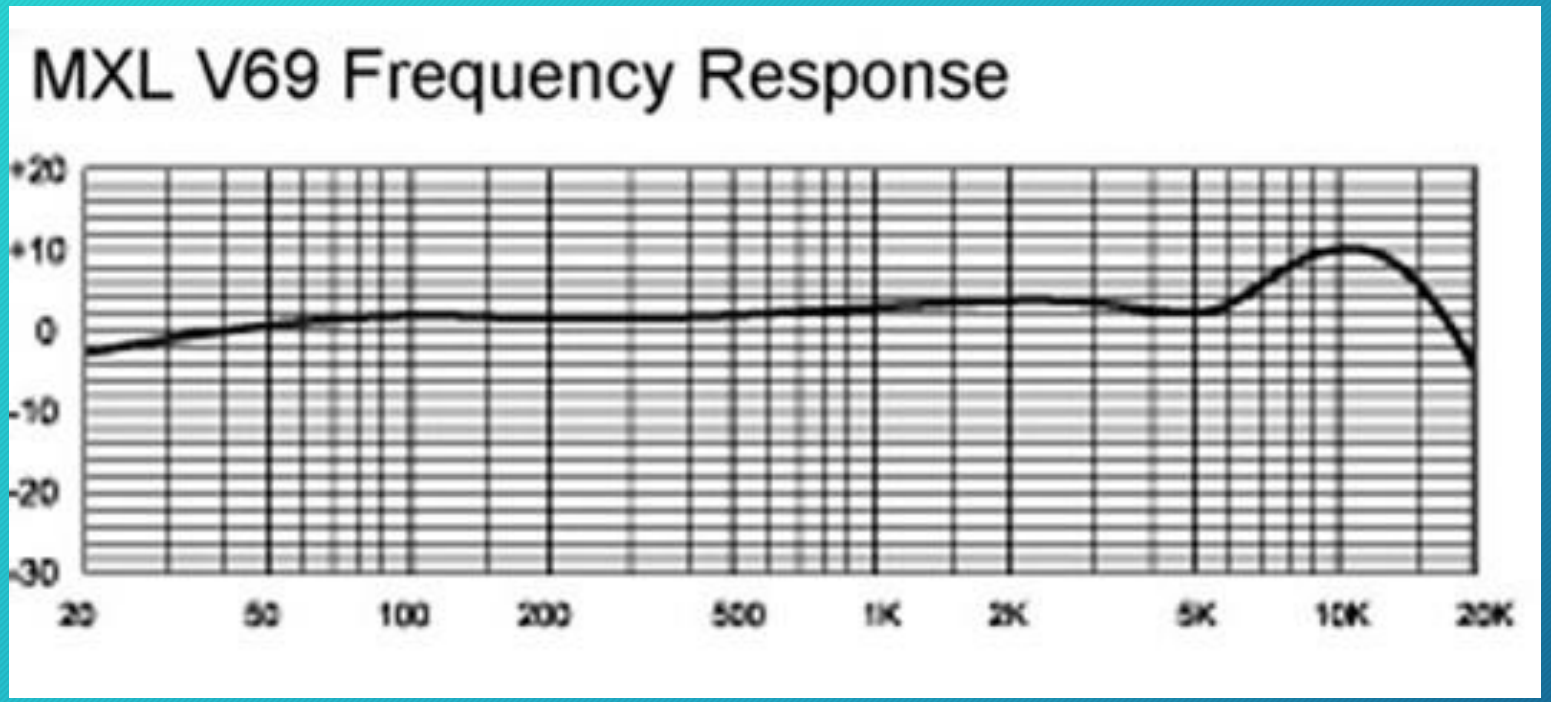
Primary mic features: Frequency Response



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Primary mic features: PAD

- PAD = “Passive Attenuation Device”
  - A way to turn down the *volume* of a mic BEFORE the mic’s circuitry, usually to avoid distortion (“clipping”) from overloading it
  - Usually implemented with a “PAD switch” on the body of mic

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Primary mic features: Bass Rolloff / Low Cut / HPF

- HPF = “High Pass Filter”
  - Lets the high frequencies pass through, effectively cutting (“rolling off”) the lower, bass frequencies
  - Usually set to start around 80 or 100 Hz, with a gradual, downward slope to lowest frequencies
  - Good for quick control of too much “proximity effect,” vocal “plosives” (aka, p-pops), mic stand rumble from foot taps, & other unwanted sounds
    - Many recording spaces, instruments (and some vocals) don’t need / have useful content in the frequencies below the rolloff, so can yield “cleaner” tracks and require less work in the mix
  - Usually implemented with a switch on the body of mic
    - Some mics can also vary the steepness of the slope

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Primary mic behaviors

- Off-axis rejection
- Proximity effect
- Phase cancellation

*** Each can be used on purpose – or avoided – depending on what you want to accomplish while recording.

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Primary mic behaviors: Off-axis Rejection

- Off-axis rejection is the result of polar pattern + the angle of the mic's diaphragm to sound source
- Sounds "off axis" from the microphone are picked up at a lower volume than sounds that are "on axis"
- Expressed in terms of "degrees off axis" in a sphere
  - 0 degrees off axis is directly in front of the diaphragm (i.e., not off axis at all)
  - 180 degrees off axis is directly behind / in back of the diaphragm
- By definition, off-axis rejection occurs *only with directional microphones* (cardioid and figure 8)
  - Omni mics don't exhibit off-axis rejection, since all sounds are picked up equally, regardless of mic positioning relative to the sound source

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Primary mic behaviors: Off-axis Rejection

- Off-axis rejection can be used as a built-in “volume reducer” for less-desired sounds, or separation of sounds
  - Having less or more “room sound” in the studio
  - Isolation of different parts / performers in the same space
  - Reducing monitor bleed / leakage on live stages
- For most mics, off-axis rejection also implies a drop-off in sensitivity to certain (generally higher) *frequencies* as the source is angled less and less directly in front of the diaphragm
  - So, off-axis rejection can also be used as a built-in “frequency control”
    - E.g., angled mic on electric guitar amp cabinet or snare drum

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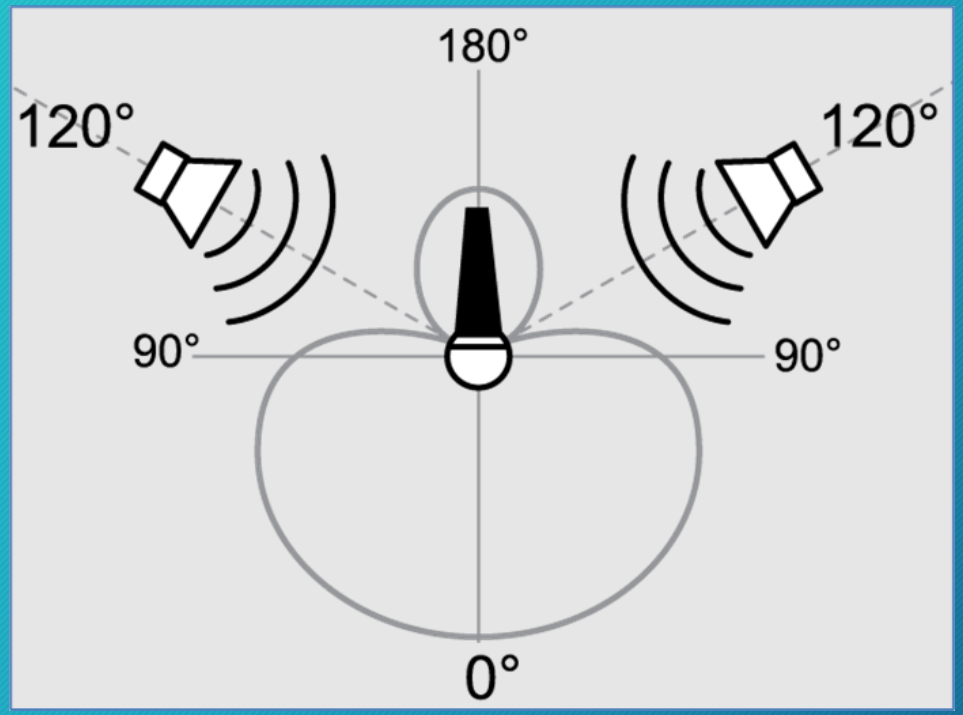
Off-axis rejection with a super-cardioid mic



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Primary mic behaviors: Proximity Effect

- Proximity effect = artificial boosting of low frequencies as the sound source gets closer to the diaphragm of a directional (cardioid or figure-8) mic
  - Omni mics do not exhibit proximity effect, regardless of closeness of the source
- Commonly used to
  - Add intimacy, warmth or “power” to vocals (studio and live)
  - Add “power” or “punch” to electric guitar amps
- Can be a bad thing, too
  - Sometimes needs to be avoided / compensated for
  - Sometimes used in combination with bass rolloff / HPF for optimal balance of low frequencies

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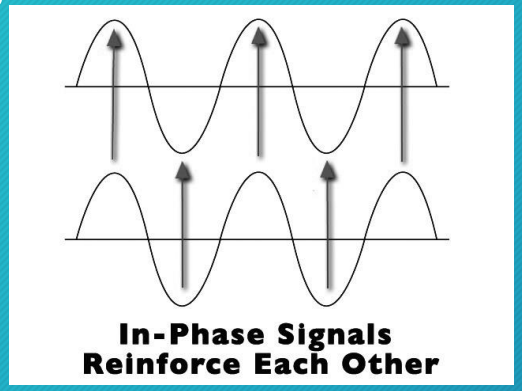
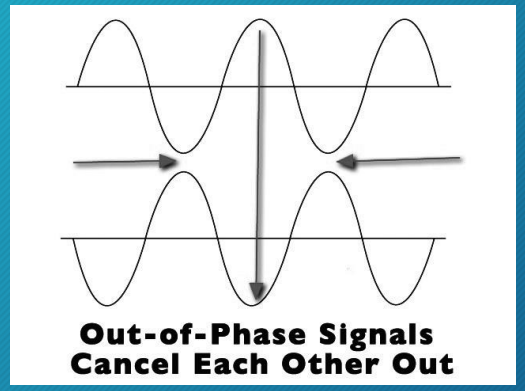
Primary mic behaviors: Phase Cancellation

- Phase cancellation occurs when the exact same sound reaches 2 mics at a specific *difference in time* that makes the 2 sound waves “out of phase” with each other
- The result is that the two sound waves “cancel each other out” to varying degrees.





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Phase Cancellation Results

- The most noticeable symptoms (when the two signals are present together, at the same volume) are typically:
  - A radical, unnatural reduction in overall volume
  - A radical, unnatural change in frequency relationships (tinniness, “bottom drops out”)
  - An uneasy feeling of “vertigo” to the listener (when 2 channels are panned left & right)
- The most extreme cancellation occurs when the two waves/mics are *exactly 180 degrees* out of phase with each other
  - Can result in no volume whatsoever, as if sound is turned off completely

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How to Identify Phase Cancellation

1. Solo the two channels into which the two mics are being recorded
2. To best be able to hear phase cancellation, make sure that both channels are
   - At the same volume (or at least close)
   - Panned to the center (i.e., in mono)
3. Toggle the “polarity” or “phase” on only ONE of the two mic inputs, using either the physical switch on the mic preamp / interface / mixer, or the software button on the DAW channel
   - Usually indicated by the “null” symbol: Ø

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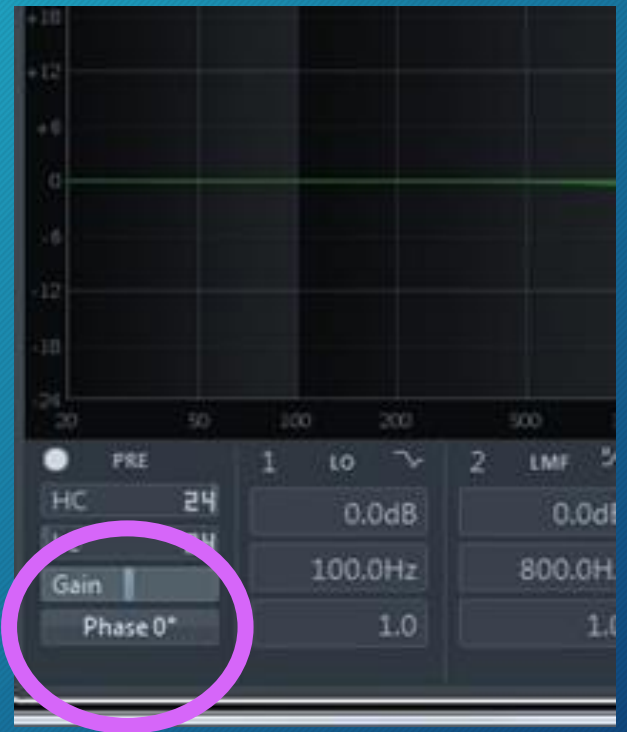
Polarity and Phase Switches/Buttons



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How to Identify Phase Cancellation (cont.)

4. While toggling back and forth, listen for a change in sound
   - If sound becomes “unnatural” (low volume, tinny and thin) when phase/polarity switch is ON, then you don’t have phase cancellation, no action required
   - If sound becomes “natural” when phase/polarity switch is ON, then you have phase cancellation, and should correct it before recording

*** NOTE: Phase cancellation can occur between a DI / pickup and a mic, in the same way that it can occur between 2 mics. Fortunately, the ways to address it are the same in both situations.

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Ways to Avoid / Correct Phase Cancellation

1. Maintain a “3 to 1 rule” when setting up 2 mics, where one mic is at least 3 times further from the source than the other *
   - In many situations, this is not practical or possible (e.g., snare top/bottom, close-miked acoustic guitar)
2. Simply move one of the two mics at the source (a couple inches will usually be enough) and re-check phase cancellation until it’s gone
3. Simply flip the physical “polarity” or “phase” (Ø) switch on only ONE of the two mic inputs on the mic preamp / interface / mixer
4. If not caught during recording, phase cancellation can be addressed with the “phase” or “polarity” (Ø) software button on the DAW channel, after the fact

   *** But ONLY if the 2 mics are recorded onto 2 separate tracks (i.e., not “summed” to 1 track); otherwise, phase cancellation CANNOT be fixed after recording!!!

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Additional mic characteristics to consider

- Diaphragm size: large (1 inch or more) vs. small (< 1 inch)
- Input level (SPL) handling ability
- Noise-related characteristics (where some “cheap” mics falter)
  - Internal isolation
    - Suspension of capsule by itself
    - Separation of body from rest of components
  - Resonance!
  - Circuitry (hiss, hum, signal-to-noise ratio)
    - Including external power supplies for tube mics
  - Handling noise (esp. with handheld stage mics, incl. external coating!)

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Mic recommendations - Vocals

- Large-diaphragm condenser
- Optional: multi-pattern, PAD, rolloff
- Models
  - Audio-Technica AT2020 (no frills, $99)
  - Gauge ECM-87 (no frills, $299)
  - Shure KSM44 (full-featured, $999)

*** More than any other source, no one size fits all for vocals! If at all possible, try out every mic you're considering on YOUR voice before choosing!

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Mic recommendations: Stringed Instruments

- For acoustic guitar, dobro, mandolin, violin, piano, etc.
- Small-diaphragm condenser (consider getting a pair!)
- Optional: changeable capsule / head
- Models
  - sE Electronics sE-7 (w/ PAD, rolloff, $229 for a PAIR!)
  - sE Electronics sE-8 (w/ multi-PAD, multi-rolloff, $549 for a PAIR!)
  - Shure KSM141 (full-featured, $899 for a pair)

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Mic recommendations: Electric Guitar Amps

- Large-diaphragm dynamic PLUS ribbon (2 mics, 2 very different sounds)
- Optional: 3rd, large-diaphragm tube condenser for room mic
- Models
  - Shure SM57 (no frills dynamic, $99)
  - Apex 210 (no frills ribbon, only $155!)
  - AEA Nuvo N22 (high-end, powered ribbon, $1099 vs. $1599 for Royer R-121)
  - (MXL V69 ME (no-frills tube condenser, $250))

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Mic recommendations: Drums and Percussion

- Kick: Large-diaphragm dynamic - Audix D6 ($199)
- Snare (top & bottom): Medium-diaphragm dynamic - Shure SM57 ($99)
- Hi-hat: Small-diaphragm condenser -
  - MXL 603 (no splat!, $180 for pair) OR
  - Shure KSM141 (full-featured, $899 for pair)
- Overheads: same recommendations as hi-hat (pair)
- High and mid toms: Medium-diaphragm dynamic - Audix D2 ($169, or $369 for 3-pack)
- Floor tom: Medium- or large-diaphragm dynamic -
  - Audix D2 ($169, or $369 for 3-pack) OR
  - Electro-voice RE20 ($449)
- Room (mono “crunch”): Large-diaphragm tube condenser - MXL V69 ME ($250) or any spare mic you have laying around 😁
- Percussion: Small-diaphragm condenser (pair) - sE Electronics sE-7 ($229 for pair)
- “Mic pack” bundles are definitely worth considering!

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Mic recommendations: some final thoughts

- You do NOT have to spend a lot of money on mics to get great, high-quality results!
- Knowing your mics and their characteristics, picking the right mic(s) for the job, and positioning them correctly are FAR more important than
  - Price
  - Having a lot of different mics
- The more attention you put into your mic selection and placement, the less work you'll need to do in the mix (and to some degree, mastering)

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Mic recommendations: some final thoughts

- With just a few mics with varied characteristics, you can have a LOT of versatility in your studio
- Most mics you have can be used for MANY different purposes; you don't need a specialized mic for every different source and situation
- It's a great idea to consider buying used if you're on a tight budget
  - There's very little that can "break" with today's microphones; chances are, if they're working at all, they're working just fine

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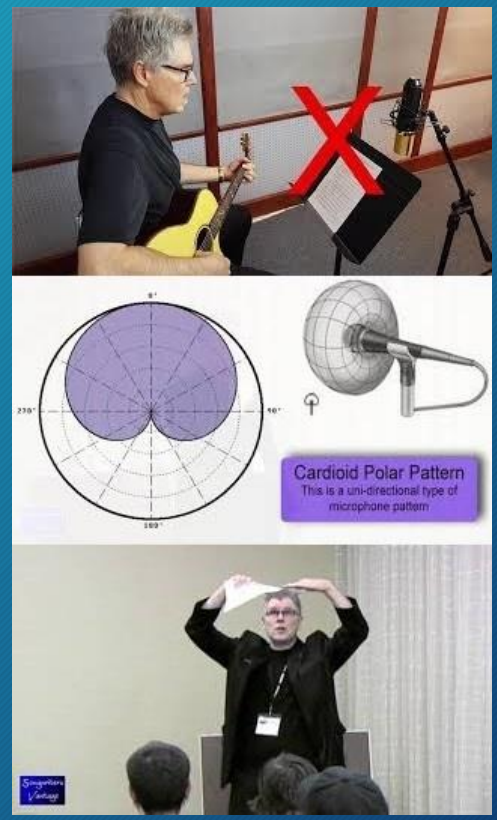

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