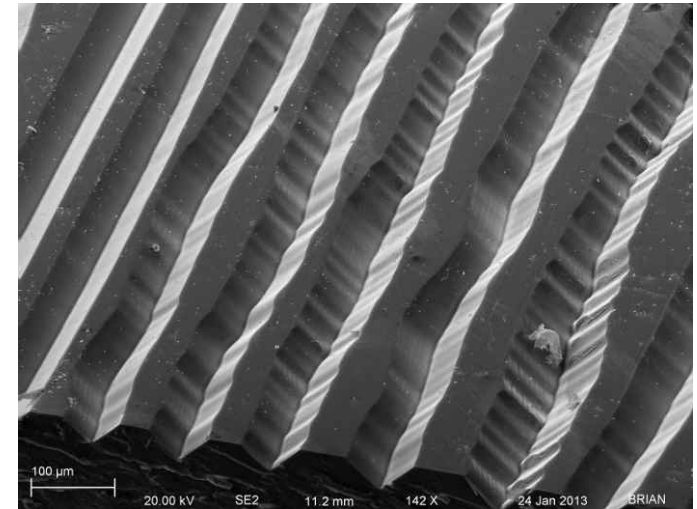
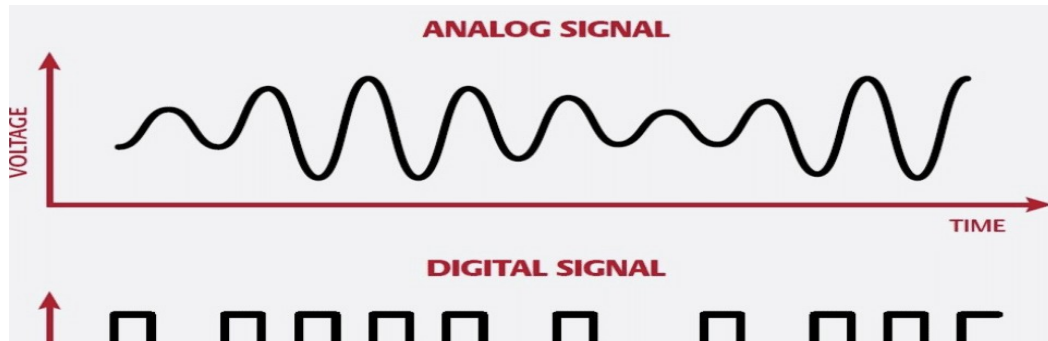


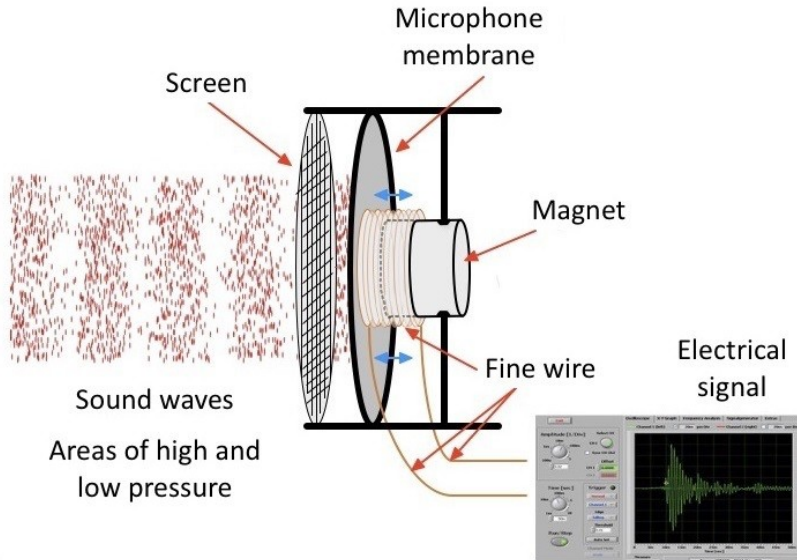
What is a recording?

What is a recording?

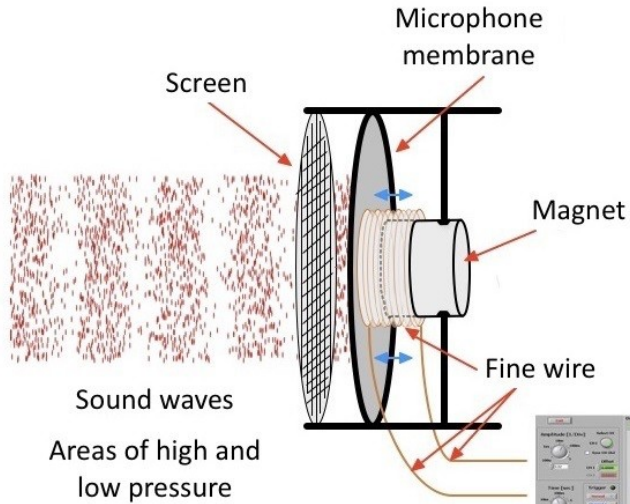
- A time-based piece of information that can be repeatedly “played back” on speakers



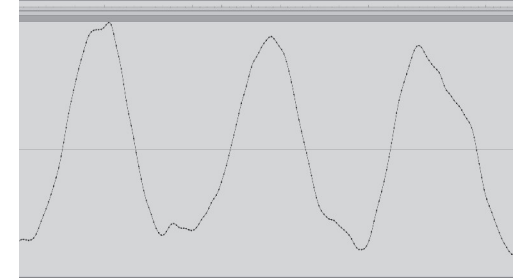
Analog Recording



Digital Recording

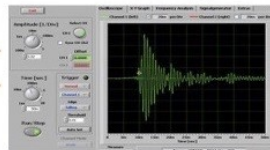


{Encode
analog
digi}



{Decode
digi
analog}

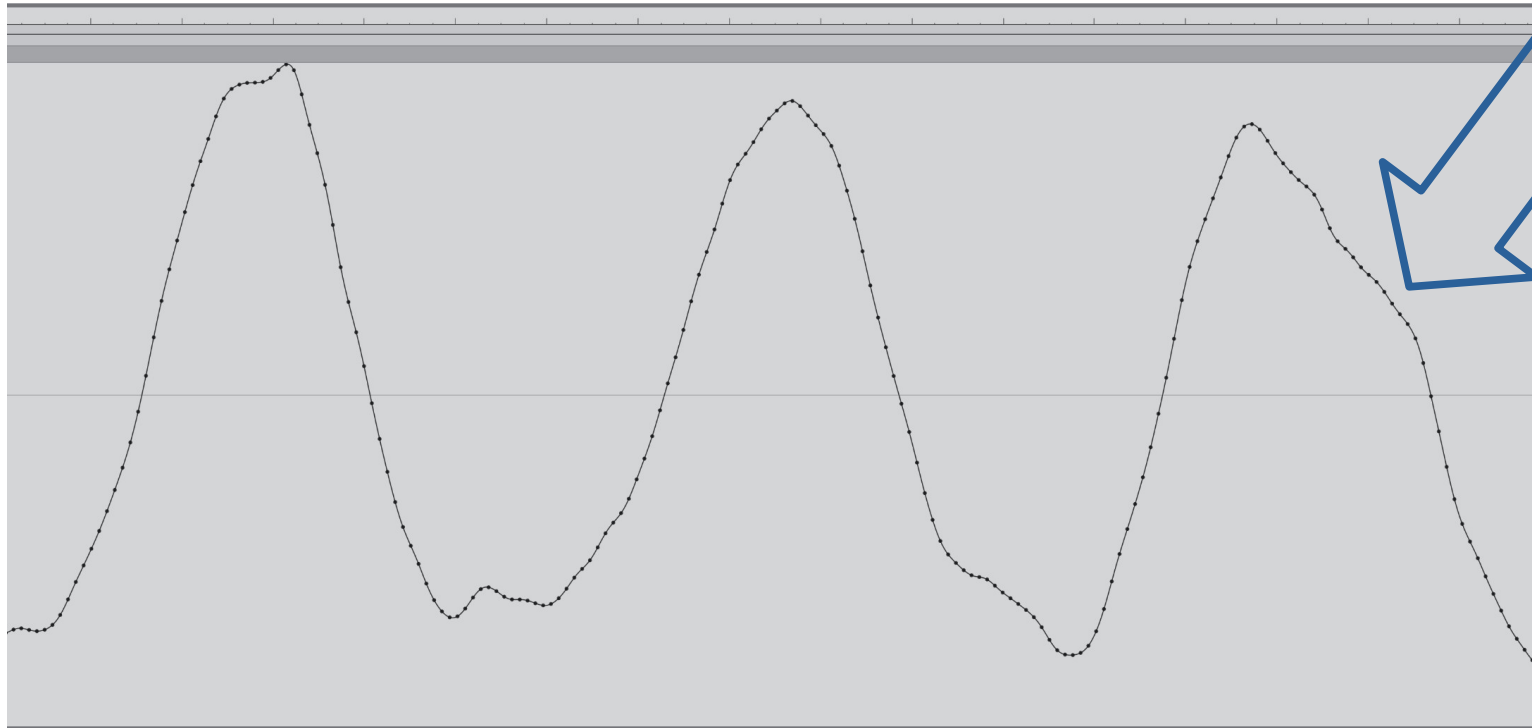
Electrical
signal



Digital Recording

- Computers work in 0s and 1s (binary)

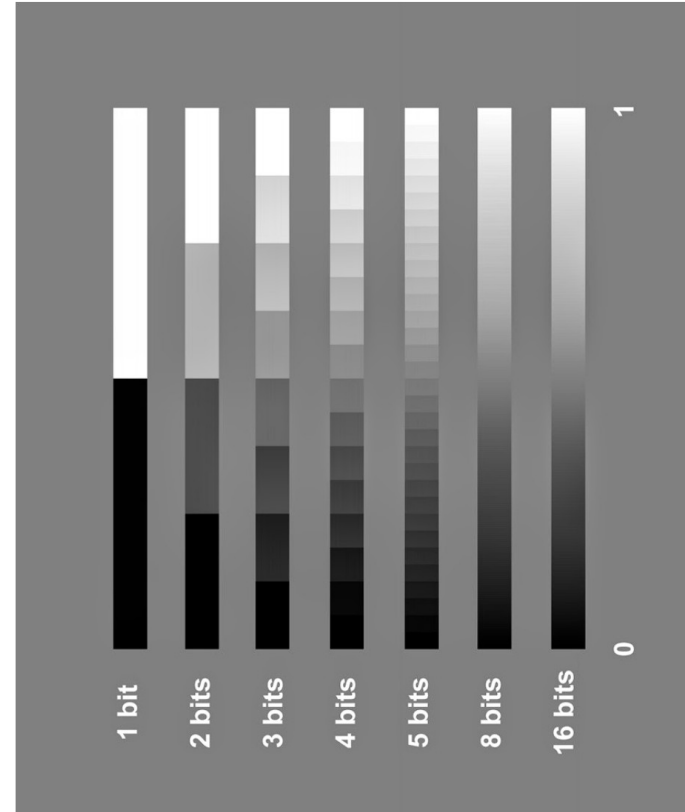
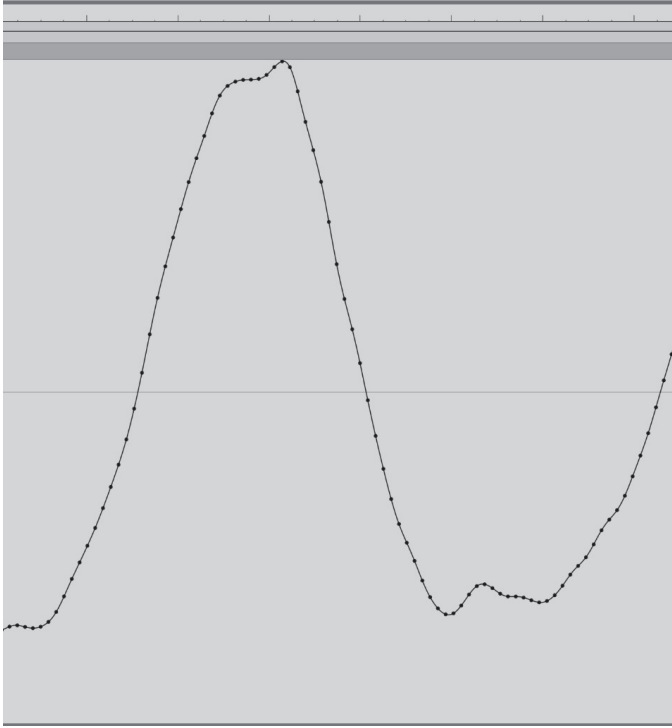
Each dot is a digital sample.
Samples/sec =
“sample rate”



Total range
of
“intensities”
samples
can have is
“bit depth”

Bit Depth

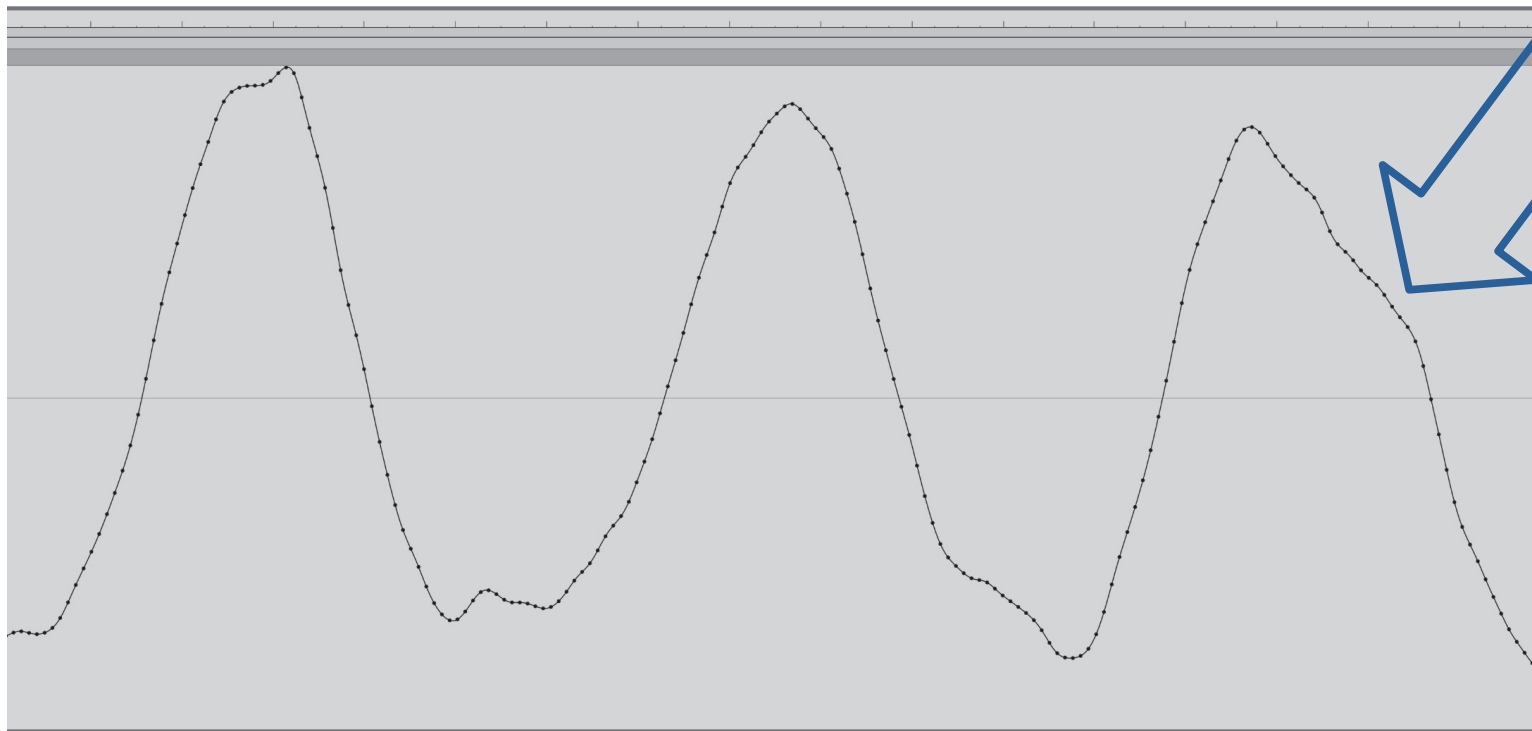
<http://www.the-working-man.org/2014/12/bit-depth-color-precision-in-raster.html>



Digital Recording

- Computers work in 0s and 1s (binary)

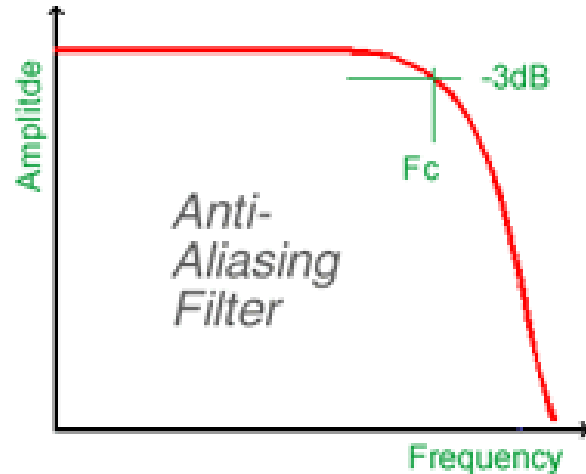
Each dot is a digital sample.
Samples/sec =
“sample rate”



Total range
of
“intensities”
samples
can have is
“bit depth”

Notes on Sample Rate

- “Nyquist frequency” = half the sample rate, can exactly reproduce all frequencies below
- Aliasing happens when a frequency higher than the Nyquist is sampled
- 48 khz works an aliasing filter less hard than 44.1



Example of aliasing in video (blades)

Digital Recording Basics

- I advise recording at 48khz (khz = 1000s of samples/sec)
 - Cmd/cntrl + comma often opens settings to set the session sample rate, should be in audio settings
- Most digital recording is automatically at 24 bit
- CD format (“full res” audio minimum, imo) is 16 bit 44.1 khz
- 48 khz offers a little more high detail and rides an aliasing filter less hard
- I export final masters at 24 bit 48 khz

Recording Studios

- In a lot of ways, many capabilities of “professional recording studios” are based around an analog audio signal chain
- Many of these capabilities are consolidated into modern audio interfaces



Audio Interfaces often contain

- Microphone preamplifiers
- Line inputs with gain
- Analog to digital converters + clock (replaces tape machine)
- Clock and DSP
- Digital to analog converters for output
- Headphone amplifier
- I **highly** recommend one with AT LEAST two mic inputs
 - ADAT in is also very useful

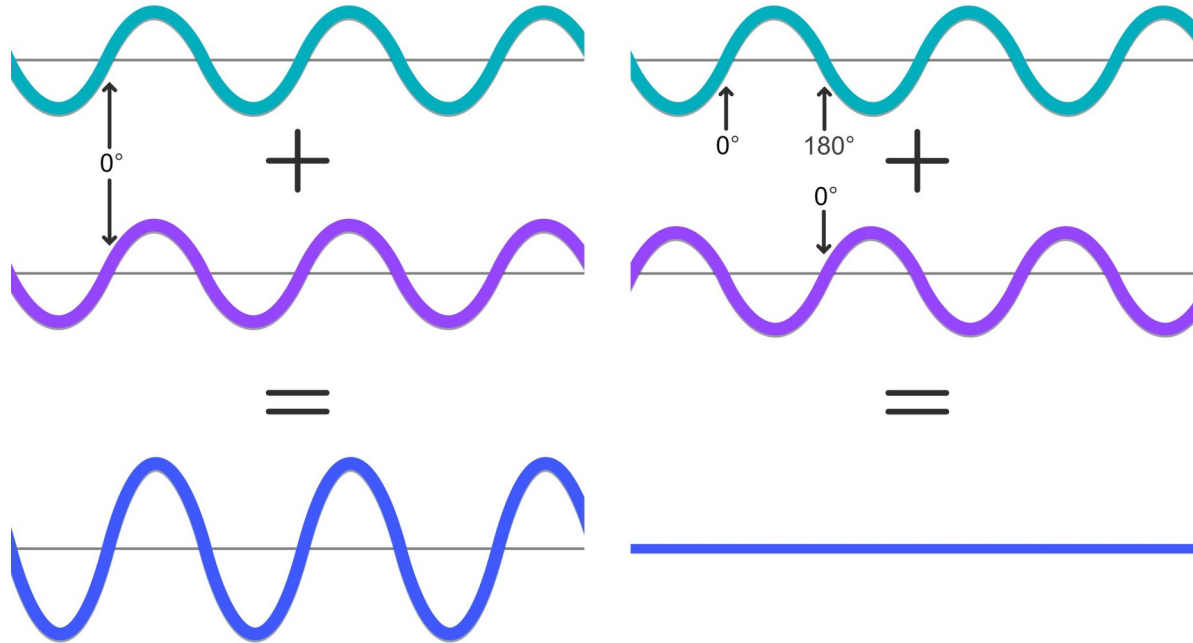




Bleed

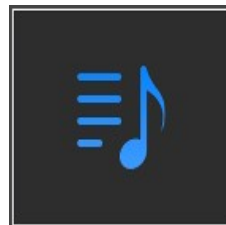
- Bleed is signal that is picked up by multiple mics
- Bleed is energy in space
- Bleed forces your hand w.r.t. editing and mixing
 - E.g., if there is acoustic guitar in the vocals, you are limited in how much louder you can make the vocals relative to the guitar
 - You also can't, e.g., edit out the guitar or vocals for that section
 - Guitar and vocals are “married” to some degree
 - E.g., if there is too much snare in the kick mic, the kick can only be so bright
- Bleed has both a level and a ‘color’
- There will always be a phase relationship between two mics that can “hear” the other’s input

Phase



Home Recording vs Studio

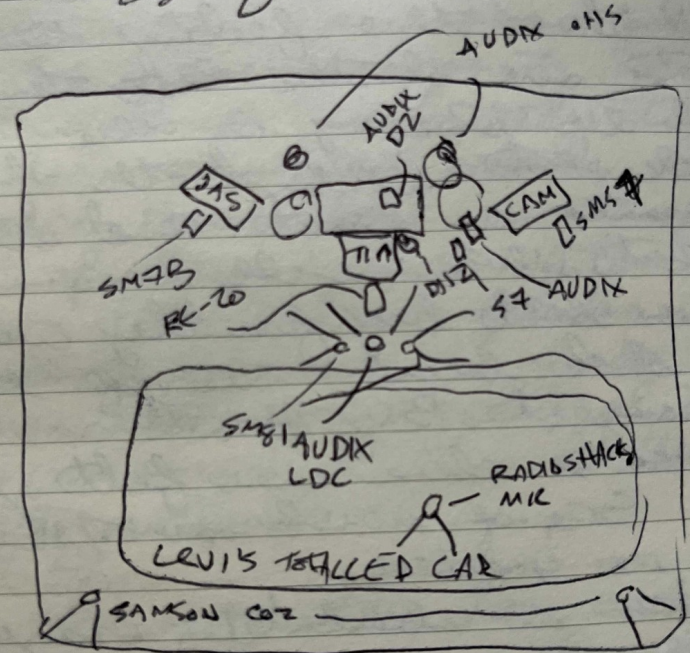
	Home	Studio
Cost	Free	Expensive
Outside noise	Lots	None
Room treatment	None	Lots
Monitoring	Poor	Excellent
Separation without line of sight	Lots	None to lots
Separation with line of sight	Not much	None to lots
Time	Limitless	Limited
Comfort	Good vibes	Recording studio







and set up that night. We tuned the kit to A and were very particular about where everything was. As follows:



We tracked everything on Sunday in a few hours, and then went inside to listen. Jason, Jacob, and I removed Dave, and









Review

- Audio interfaces support many of the capabilities of legacy recording studios
- Studios have nice rooms and often separation, but this can be recreated at home
- Digital recordings contain “samples” of audio at a fixed rate and bit depth
 - Best practice is record at 48khz

Recording into a DAW

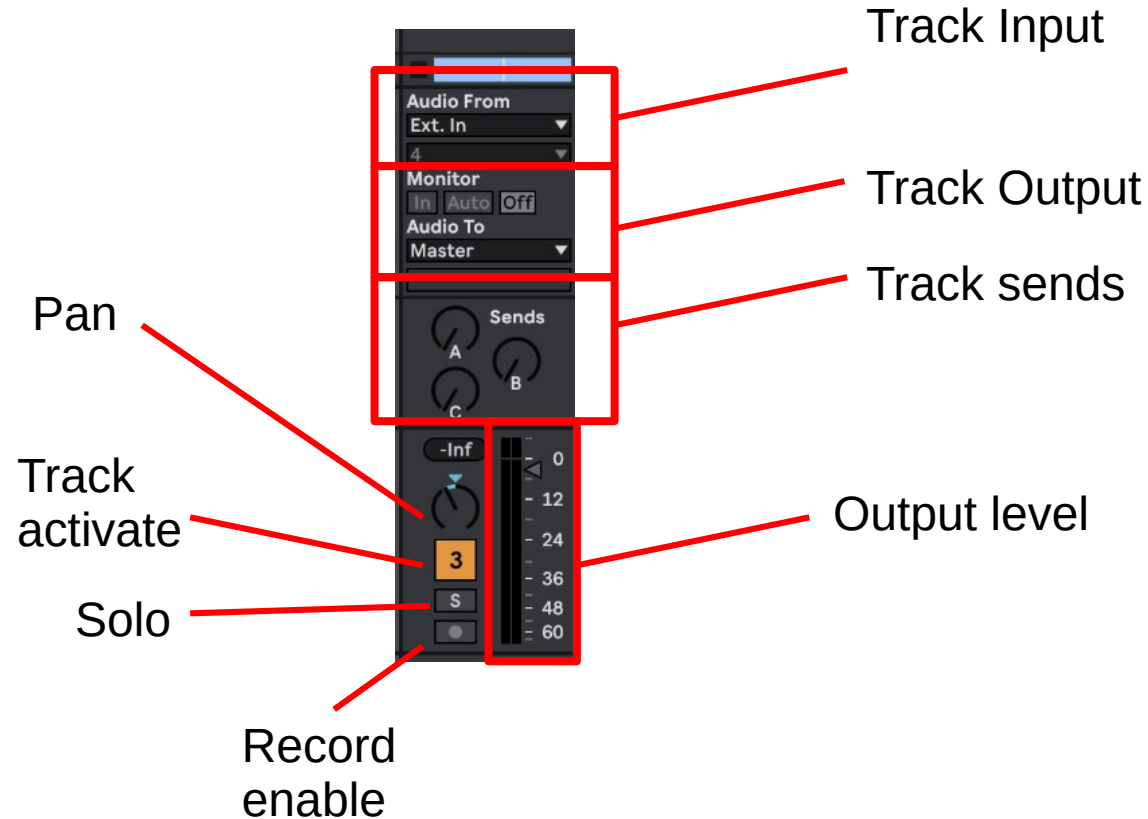
- Digital Audio Workstations (DAW) often offer multitrack recording and audio editing capabilities

DAW	Price	Notes
Audacity	Free and open-source	Cool for analysis, less capable for multitrack
Reaper	Free* (\$60 with unlimited free trial)	Great all-around “free”/cheap DAW Can host on a flash drive
Logic	\$200 lifetime	Apple only. GarageBand is free Logic “lite” on Mac
Ableton Live	Like \$300/version	
Pro Tools	Expensive	Industry Standard

DAW Terminology

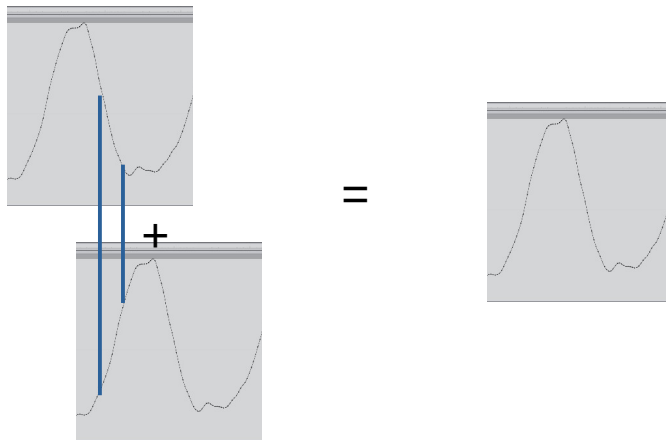


DAW Terminology cont.

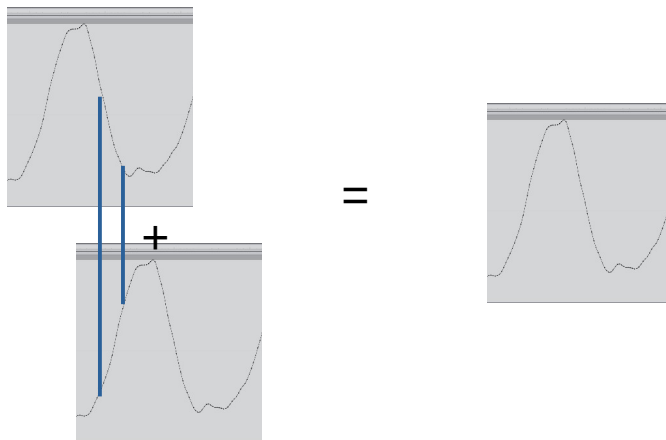


A little on the 2-bus

Left channel



Right channel

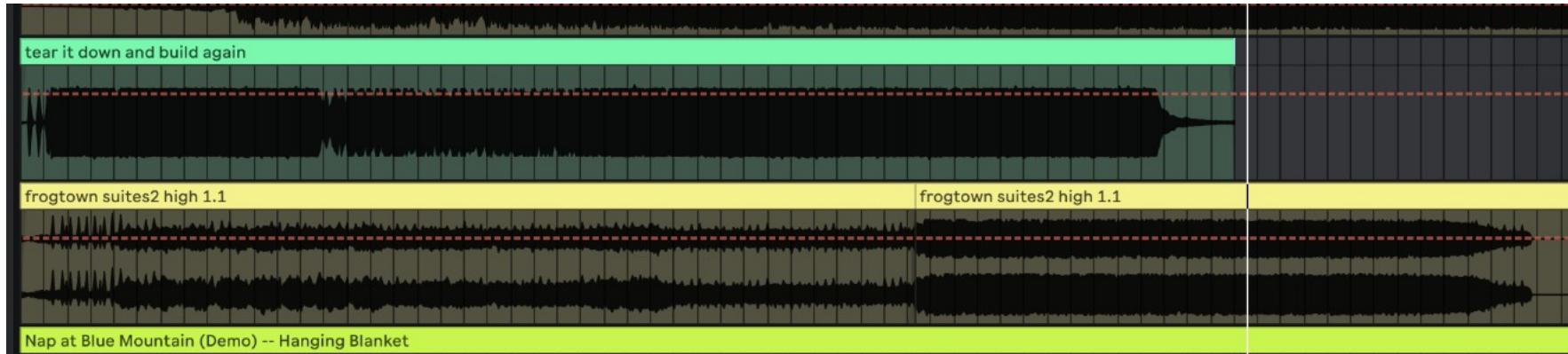


“Mono” and “Stereo”

- **Monophonic** means one output/track
- **Stereophonic** means 2 outputs/track for a single source
 - Generally advisable to always record stereo inputs as dual mono tracks. i.e., avoid creating stereo tracks in DAW, you’ll have more control and a stereo track is a pair of hard-panned mono tracks
 - Mixes of songs will almost always be stereo files as well as outputs from stereo recording devices e.g. handycorders

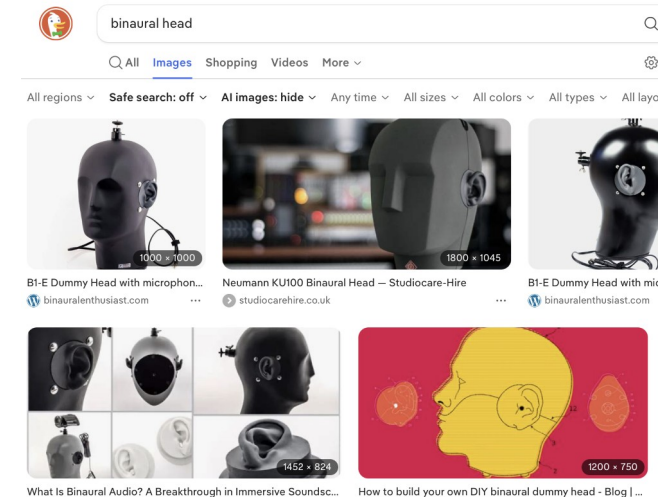
Mono >>

Stereo >>



Panning and Stereo

- Panning is the L/R balance between two speakers. A mono track is “panned left” if its output is louder in the left channel than the right channel
 - A “hard” pan means that 100% of a track’s output is only playing out of one speaker
 - Output has to be adjusted to compensate for only one speaker playing back. Typical “pan rule” in DAWs is for hard-panned sounds to be 6db louder per speaker than mono
- Stereo perception extends beyond panning
 - Humans are very attuned to reverb, equalization, time difference between ears, etc
 - e.g. A mono track panned hard-left could sound disorienting in certain contexts
 - “true” stereo should really use multiple mics per source



Recording into a DAW

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Pro Tools	Expensive	Industry Standard

Recording Sessions

How am I gonna organize this session?

- What is the fundamental rhythmic driver of the track?
 - Often wanna record that first
 - Do you wanna use a click/scratch track?
 - What do they need to hear to play the best take? If band/multiple people, do we need a scratch track? Who plays live?
- Can we record together? What about the track is “final” vs up in the air?
 - E.g., maybe the rhythm guitar and riffs are finalized and can be tracked with the band, but the solo can be overdubbed after because the guitarist wants to try a few ideas

Typical order of recording for bands

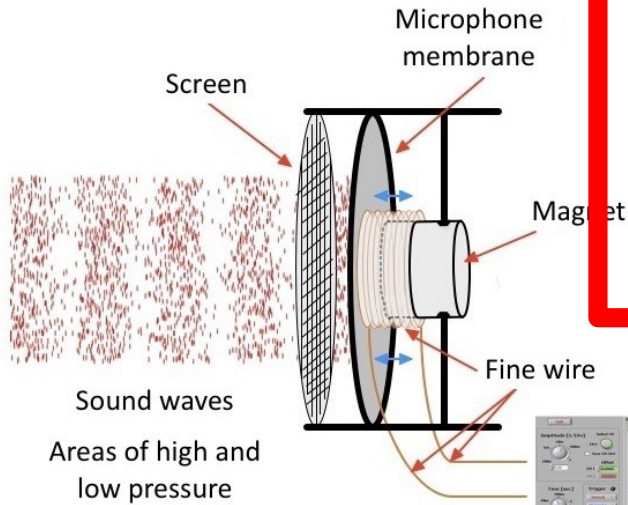
- 1) Drums (sometimes to a scratch)
- 2) Bass (pretty easy to track with drums)
 - 1) Optional here are scratch vocals/scratch other parts
- 3) Guitars
- 4) Any other instrumental overdubs
- 5) Vocals (generally last or at least after main components)

Metronome/"Click"

- Keeps time to grid. Good if track is steady, huge PITA if track has time signature/tempo changes
- Without metronome you'll have to manually time things like delay (easy to do)
- Allows easy copying/pasting of different sections/being able to easily use, e.g., the same lead part on multiple choruses
- Some drummers/practiced musicians are used to playing to click, others are not
- I generally do not use a click unless a band is struggling, then we can try one
 - If they really want locked, like, disco tracks, maybe worth practicing to one in advance of recording
- Be mindful of bleed into the room
- I often turn off once the core rhythm of the track is finalized
- Very helpful to at least start with one if there's a pickup. E.g., if the song starts with a vocal line, that will be recorded after everything else, it is very hard to time without a click/count in

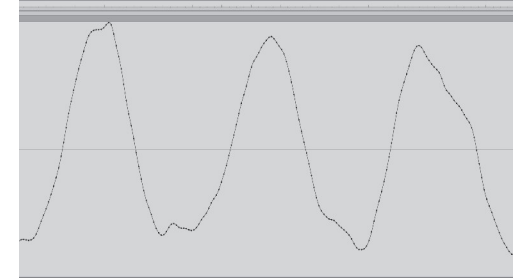
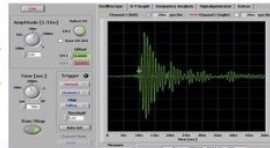
Getting audio into computer

Digital Recording



{Encode
analog >
digi}

Electrical
signal



{Decode
digi >
analog}

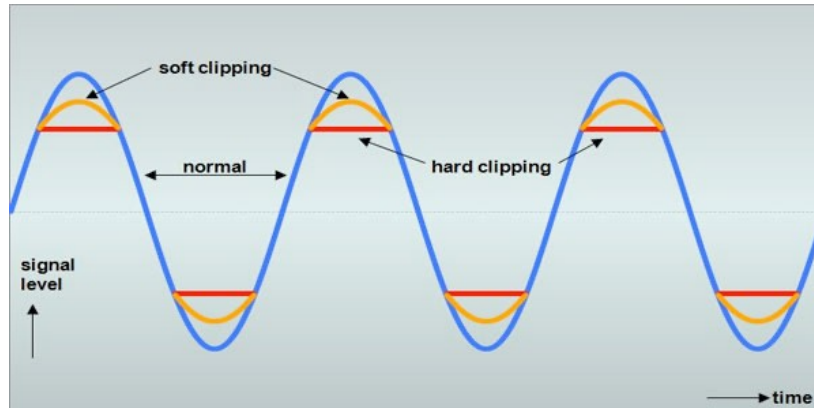
Line-Level

- “Line-level” is the baseline level most audio devices work with
- E.g., microphone output is amplified to line-level by **microphone preamps**
- Instrument-level also should be converted to line-level (ever try and plug a microphone or mp3 player into a guitar amp?)

Recording Levels

Clipping

- Analog clipping produces pleasing harmonics/overtone (think guitar overdrive or “tape warmth”)
- Digital clipping is very harsh (“enharmonic”) and should almost always be avoided when recording



Recording Levels

- Focusrite 18i20 has about 116db of dynamic range
- Tape has at most about 90db of dynamic range and saturates when pushed
- Basically, there is no reason to digitally clip. Ask the artist to play the loudest they will play during soundcheck and this should not exceed -10db peak
 - You should be recording at a level where, on most metering systems, you should only barely see yellow at the loudest moments and never see red
- 0db is the loudest digital signal possible
- Ideally best to adjust gain between moments of playing. It's very easy to boost/lower a discrete section of audio, harder to match slower changes

Input Types

	Unbalanced		Balanced	
	Instrument	Phono	Mic	Line
Sources	Instruments	Turntables	Microphones, DI boxes	Synthesizers, Preamps, Samplers (aux cords/RCA)
Properties	High Impedance	RIAA curve (need specific phono preamp which will likely be line out)	Quietest, needs a mic preamp	Standard between devices, loudest
“Main” Cable type	“Instrument” = TS (“Tip-sleeve”)	RCA	XLR	TRS (“Tip-ring-sleeve”), RCA on older home audio stuff



=

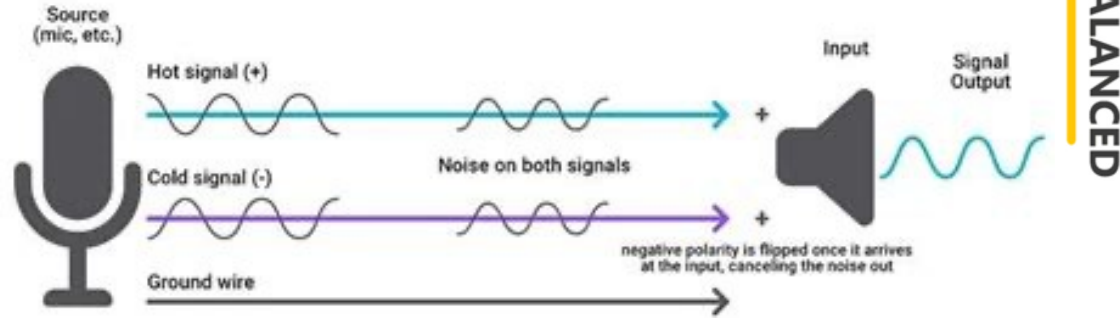


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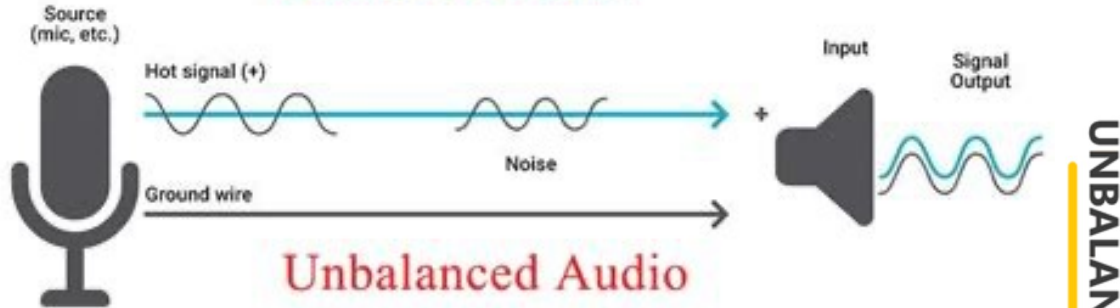
Balanced VS Unbalanced Audio?

Long cable runs
with little
degradation/noise
(you can daisy-
chain mic
cables)



Balanced Audio

Cheaper
Simpler



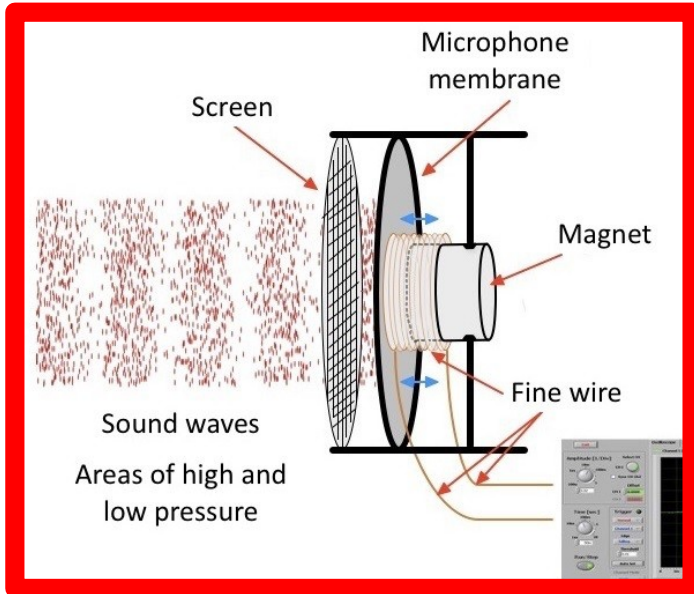
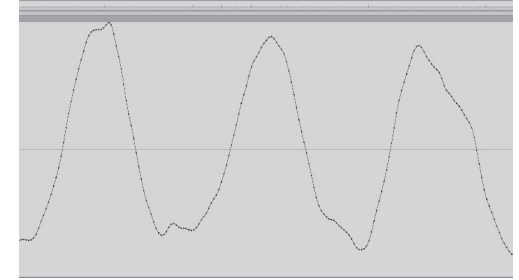
Unbalanced Audio

VS



Microphones

Digital Recording



{Encode
analog >
digi}

Electrical
signal

{Decode
digi >
analog}



Microphone Pickup Patterns

Microphone polar patterns

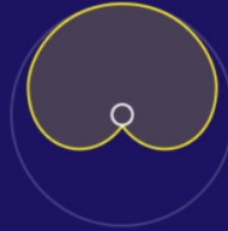
Omnidirectional



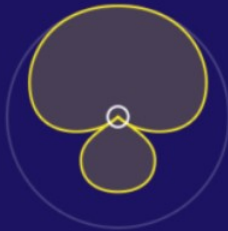
Subcardioid



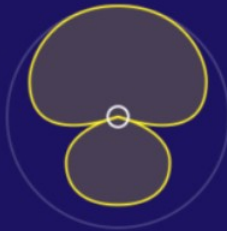
Cardioid



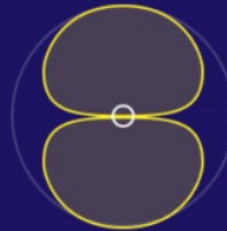
Supercardioid



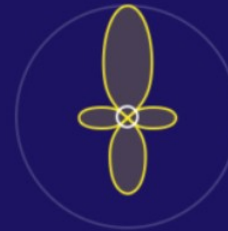
Hypercardioid



Bi-directional



Shotgun



The Podcast Host

MODEL SM57 DYNAMIC MICROPHONE

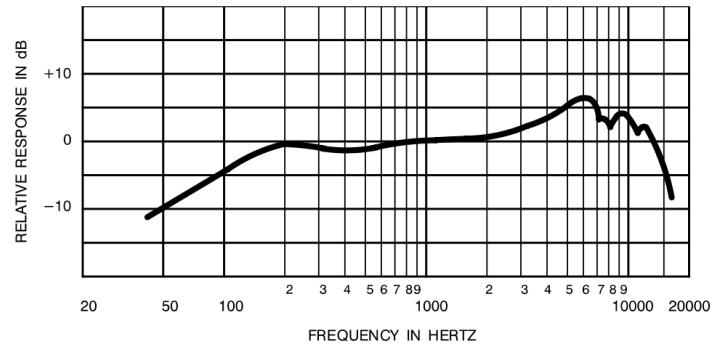
SPECIFICATIONS

Type

Dynamic

Frequency Response

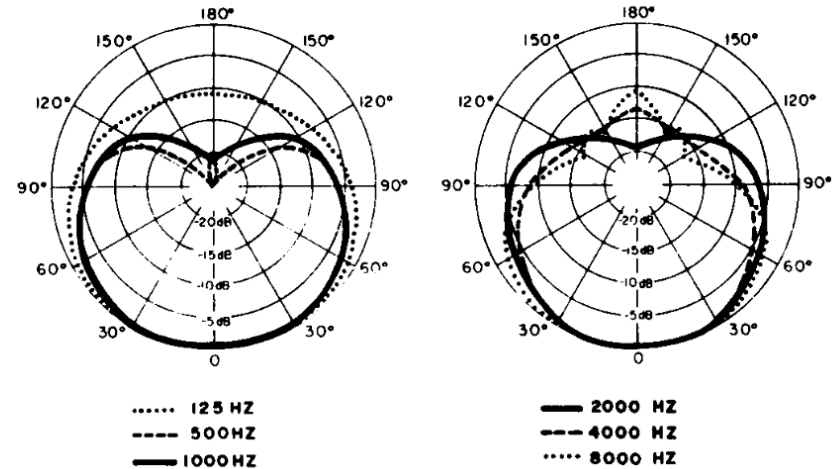
40 to 15,000 Hz



TYPICAL FREQUENCY RESPONSE

Polar Pattern

Unidirectional (cardioid), rotationally symmetrical about microphone axis, uniform with frequency.



TYPICAL POLAR PATTERNS

Proximity effect

- Directional mics accentuate bass frequencies when close to a source
 - E.g. radio broadcast voice is deep due to being really close to the mic

Microphone Types

Type	Dynamic	Large-Diaphragm Condenser	Small-Diaphragm Condenser	Ribbon
Pickup Pattern	Cardioid , sometimes omni	Cardioid , sometimes omni, figure 8	Cardioid sometimes omni, figure 8	Figure 8
Room sensitivity	Lowest	Most	Medium	Medium
Output	Medium	Loud	Loud	Low
Phantom Power?	No	Yes	Yes	No!!! (sometimes active)
Loud stuff?	Great	Fries at high SPL	Fries at high SPL	Great
Best for?	Vocals, amps, percussion (loud stuff)	Treated rooms, vocals	Strings, drum overheads	Overheads, horns
Examples	SM57, SM58 , SM7	U87, Aston Origin, Rode NT-1	SM-81	Royer R-121

SM57 (dynamic)

MODEL SM57 DYNAMIC MICROPHONE

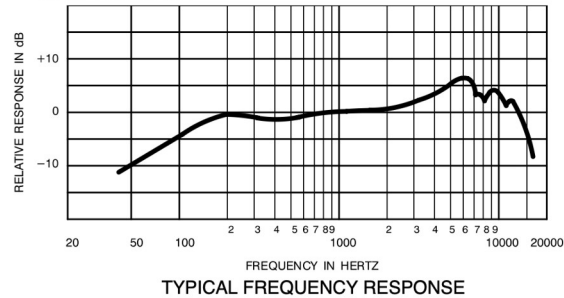
SPECIFICATIONS

Type

Dynamic

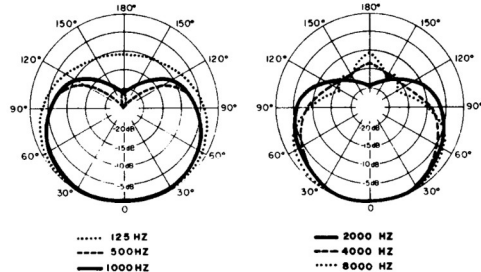
Frequency Response

40 to 15,000 Hz

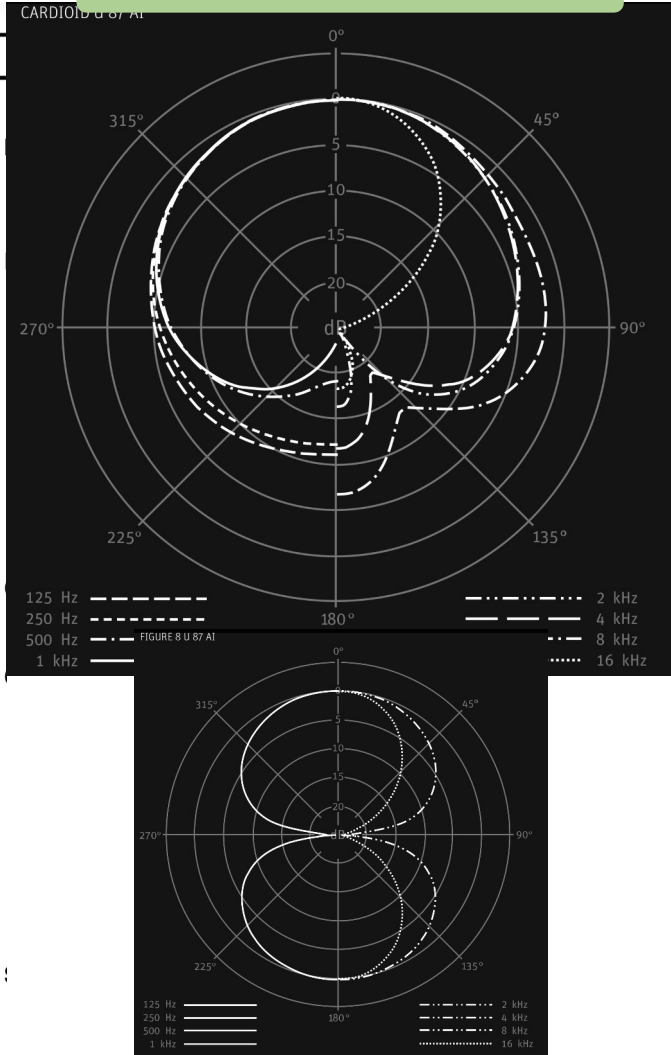


Polar Pattern

Unidirectional (cardioid), rotationally symmetrical about microphone axis, uniform with frequency.



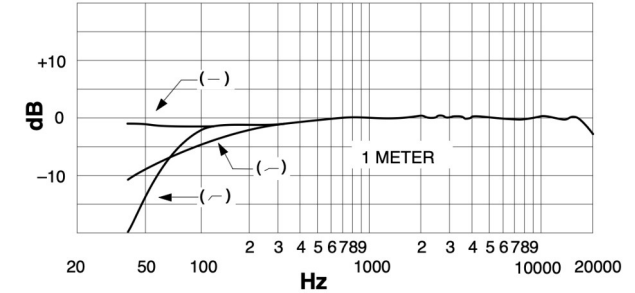
U87 (LDC)



SM-81 (SDC)

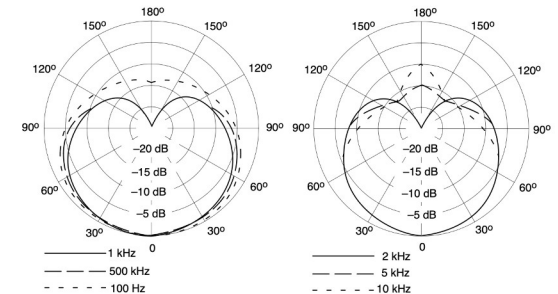
Frequency Response

20 to 20,000 Hz



Polar Pattern

Cardioid (unidirectional) response—uniform with frequency, symmetrical about axis (see Figure NO TAG)



Synthesizers

- Line output (can use instrument cable)
- If stereo outputs try recording both
- Make sure you aren't clipping. Noise floor should be very low

Electric Bass

- Generally mono
- Beware of amp bleed with other instruments in room (bass frequencies especially omnidirectional)
- Bass is often recorded “direct”, i.e. not amped, very easy to edit and record live with other instruments
- Bass amps often have line-outs
- Bass guitar will generally be instrument-level
- Dynamic mics work well on bass amplifiers, proximity effect can be nice

DI boxes and Re-amps



DI boxes convert line/instrument inputs to mic level



Reamps convert line-level to instrument level so you can play DI signals through amps

Electric Guitar

- Instrument level, often played through an amplifier and recorded with a microphone
- The louder the amplifier, the quieter background noise will be
- “Recording 101” mic position is 3-6” off the speaker, right on
- Changing the angle off the speaker/directing slightly off the center of the cone will change the sound
- Play around with a room mic to capture the loudness
 - You can pan this mic to a different part of the mix to create a truer stereo sound
- DI boxes can be used to capture and save performances
- Amps often recorded with dynamic or ribbon mics
- Pro tip: use a phone light to find out where the speaker is



Acoustic Guitar

- Sound coming from many places
- Recording 101 mic placement is about 12" off where the neck meets the body
 - I recommend trying a small diaphragm condenser
- Avoid placing mic right next to the soundhole, very boomy and bassy
- Sensitive to bleed from other instruments, tough to record with other things. Best recorded on its own
- Closely married to vocals. Important decision whether to record singing/playing together or overdub
- DIs/electric acoustics generally suck imo. Worth recording if you have the inputs but are not gonna sound like an acoustic guitar. Could be useful in a mix/combined with miked signal
 - Much bassier and fuller midrange, kinda plastic-y sounding highs

Vocals

- Vocals most dynamic instrument
 - Can go from whisper to scream in the same track
- Vocals generally most important track
- Getting singer comfortable + hearing good playback most important
- Be mindful of bleed to headphones, use closed-back
- Singers like hearing their voice in the room
- Some producers (Brian Eno, Phil Weinrobe) advocate for monitoring vocals on speakers
- Highly advocate for dynamic mics in small spaces
- 101 position is 6"-8" from the mic with a pop filter
 - If pop filter unavailable, point mic at side of mouth/avoid singing directly into the mic



Vocals (cont.)

- Singers are microphone players
- Can move further from the mic when louder

Pop filters

- Prevent plosives which can overload input and sound unnatural
- Can use pantyhose on a hanger
- Push the singer a little back to avoid proximity effect



Violin/Viola



recording violin

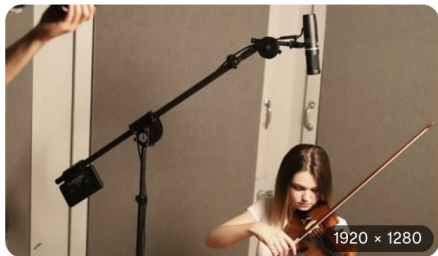


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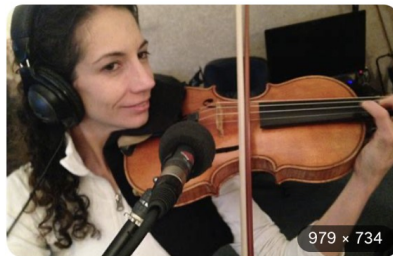
Q All Images Videos News More ▾



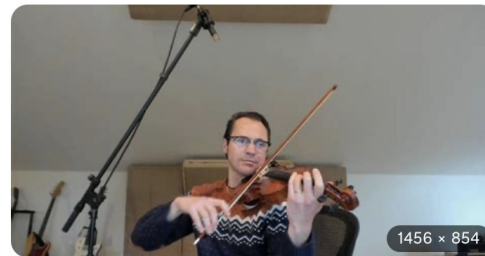
All regions ▾ **Safe search: off** ▾ **All images: hide** ▾ Any time ▾ All sizes ▾ All colors ▾ All types ▾ All layouts ▾ All Licenses ▾



Ribbon Microphone For Violin at Nina Pierson blog
 storage.googleapis.com ...



Violin recording session | Bauman Sound
 baumansound.com ...



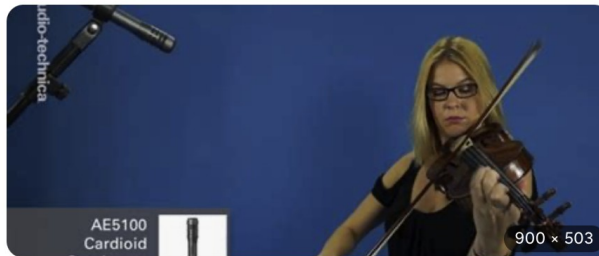
9 Tips for Recording Strings — Pro Audio Files
 theproaudiofiles.com ...



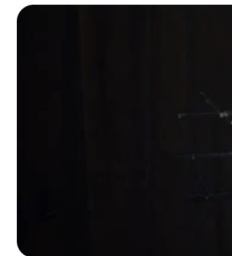
Violin Vid
 gettyir



The 7 Best Pickups & Microphones for Violin Recording (2024) - Music...
 musicalhow.com ...



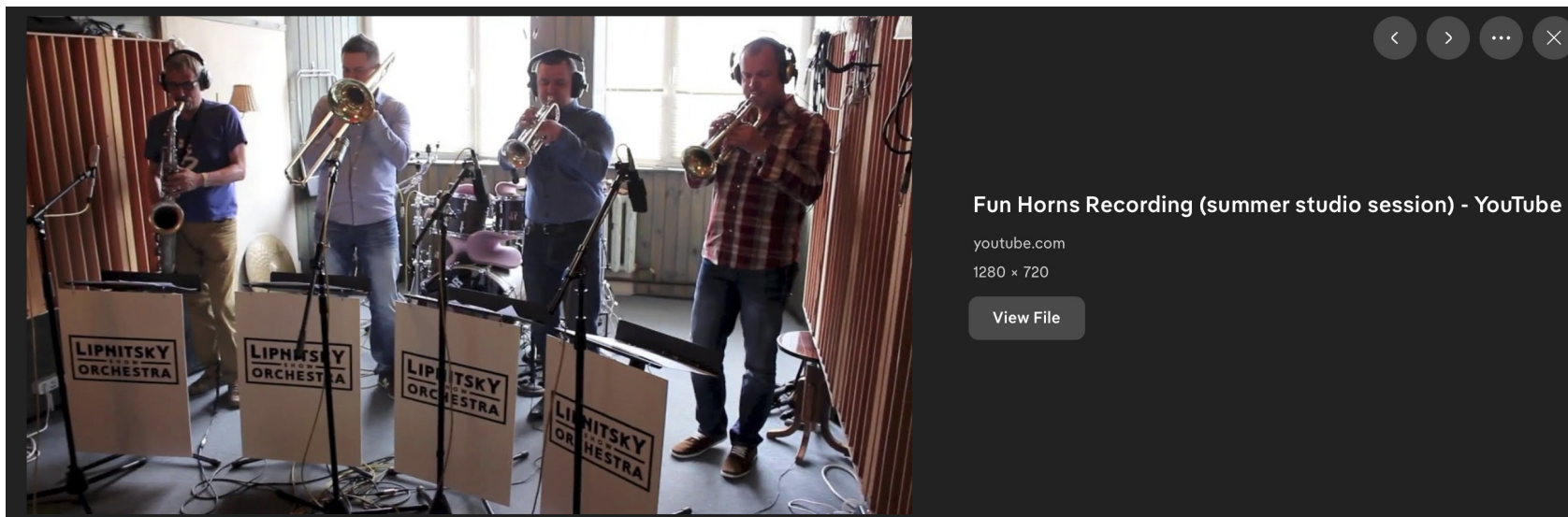
Miking a Violin - Kiara's Blog
 kiara Crane.wordpress.com ...



How To Mic Violin Live - Mus...
 musicalhow.com

Horns

- Generally place mics further back (at least an instrument length is advised)
- Watch for plosives
- Wind instruments produce sound through the whole body



Accordion

- Accordion produces sound out of both sides
- Decide if you want mono or stereo
 - Be mindful of stereo phase



Accordion Recording Studio Experience -
RecordingGift.com

recordinggift.com

600 × 400

[View File](#)

Drum kit

- Kit most involved thing to record
 - Often will have 20+ mics on it in a pro studio for digital recordings and takes most of setup time
- Drums can be very loud
- There is lots of bleed between drums
- Often the first thing tracked

Drum tips

- Figure out what kind of stereo spread the part needs
- The kick will be hard to monitor with headphones. It is also the least important part of the recording process (hot hot take) and can be most easily replaced with a sample
- Much bleed between the mics. Get the kit sound correct first
- Plays very well with room mics and compression

Drum cheat sheet

# of mics	1	2	3	4	5+
Suggestions	• Over shoulder mic to get the whole kit • Check balance on toms	• “Ken Scott” stereo pair behind drummer and in front of kit • Can try just overheads	• OHs + mic in front of kick • Kick/snare/one OH	• Kick/snare/stereo OHs • ^^I like this one	• Kick, snare, stereo OHs, room/distance mic

Other things

- First question: mono or stereo?
 - I love stereo recording. I will almost always have at least an auxiliary room mic if I'm recording anything
 - Worst case, you can mute this secondary mic
 - Accurate binaural stereo recordings are best done with a matched pair of mics, often small diaphragm condensers
- Use your ears when monitoring!
 - Microphones work differently than ears. Wear closed-back headphones and monitor your source. Play around with mic placement
- When in doubt use more mics lol

The non-technical (but most important) stuff

- Anyone can google where to place a mic
 - Your role as an engineer/producer, above the baseline, is getting good takes
- Monitoring for the musicians is super important
- Pace and comfort is super important
 - Every artist is different
- You are an airline pilot
 - Artist is trusting you with one of the most important things they will ever do
 - Even if you are unsure, can-do!!
- The worst thing you can do as an engineer is miss a take
 - Phone voice memo is always an option
- Recording stresses many people out
 - Neil Young would record people as they were learning parts/warming up and then be like... okay cool we got the take

What you'll need, imo, at a minimum

- Audio interface
 - I highly highly recommend getting one with **at least** 2 mic inputs
- Couple mics
- Couple xlr cables
- At least one mic stand w/clip
- Closed-back headphones
- Free rentals at colemakuch.com/rentals

Workshop