Introduction to Field Recording Technology

phonographyaustin.org

workshop led by Alex Keller

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by Alex Keller, with contributions from
Phonography Austin members

Basic acoustics

SOUND

Sound is how we perceive changes in energy traveling through air molecules.

This room looks empty, but is full of air molecules. **Compressing** the air molecules (by clapping, for example) causes them to **contract**, then **expand**, **compressing** the air molecules next to them.

Our ears and brain detect that sequence of air compression and expansion as sound.

The **speed** at which the air molecules are compressed is expressed as FREQUENCY. This is not the speed at which that compression travels, just how quickly it happens.

The **intensity** of that compression is expressed as LOUDNESS.

FREQUENCY

How **high** or **low** a sound is.

In the national anthem (US), “land of the freeeeeee” progresses from a **low** to a **high** FREQUENCY.

Not all sounds have an easily definable FREQUENCY – radio static is a random mix of frequencies, described as **noisy** or **broadband** sound.

FREQUENCY corresponds to PITCH, and is measured in **Hertz** (**Hz**).

LOUDNESS

How **loud** or **quiet** a sound is.

LOUDNESS is measured in **decibels** (**dB**), which is slightly different between analog electronics, digital electronics and acoustic measurement.

VOLUME describes playback volume over speakers or headphones, not the actual LOUDNESS of a particular sound.

When we talk about **increasing** LOUDNESS we often will say **boosting**; **decreasing** would be **cutting**.

TIMBRE

How **bright** or dark a sound is. Rhymes with **amber**.

TIMBRE consists of additional tones (HARMONICS) that are a higher frequency than the primary one (FUNDAMENTAL). HARMONICS **can** correspond mathematically to the FUNDAMENTAL but don't always. HARMONICS are almost always quieter than the FUNDAMENTAL.

A kazoo has a **bright** or **rich** TIMBRE.

> Cutting bass and boosting treble creates a **bright** TIMBRE.

A foghorn has a **dark** TIMBRE.

> Cutting treble and boosting bass creates a **dark** TIMBRE.

Not easily measurable.

ENVELOPE

How the components of a sound change over time.

The three components of an ENVELOPE are ATTACK, SUSTAIN and RELEASE.

1. ATTACK

Describes the **beginning** of a sound.

A gunshot has a **fast** attack.

A gentle violin has a **slow** attack. Synonyms: **swell, fade in**, **build-up**.

2. SUSTAIN

Describes what happens right **after** the attack.

In the national anthem, the words “land of the” have a SUSTAIN that is **shorter** than the word “freeeeeee.”

A motorcycle shifting gears has a TIMBRE that varies from **bright** to **dark** while the sound is SUSTAINED.

3. RELEASE

What happens when the sustain **ends**.

A loud radio that is suddenly unplugged has a **fast** RELEASE.

An electric fan that is unplugged has a **slow** RELEASE.

Basic recording

TRANSDUCTION

A TRANSDUCER converts one type of energy into another.

Sounds start as

Mechanical energy – for example, applause, causing changes in

Acoustic energy – air molecules are compressed, causing changes in

Mechanical energy – the ear drum is compressed, causing changes in

Hydraulic energy – the fluid in the cochlea is compressed, causing changes in

Electrical energy – response in the auditory nerve system

ANALOG RECORDERS

ANALOG recorders take changes in acoustic energy, TRANSDUCE them into electrical energy, then store them as magnetic energy.

They are **typically** not as **accurate** as DIGITAL recorders but can sound interesting.

They are **typically more** forgiving of sounds that are much louder than the input level you've set. They cause **analog distortion**, which sounds more accurate to the sound source than **digital clipping**.

DIGITAL RECORDERS

DIGITAL recorders take changes in **acoustic** energy, TRANSDUCE them into **electrical** energy, then convert and store them as **digital data**.

BIT DEPTH refers to the range of loudness captured, typically 16 or 24.

- Higher BIT DEPTH yields more realistic audio.

SAMPLE RATE refers to the frequency range captured, typically between 44.1 KHz and 96 KHz.

- Higher SAMPLE RATE yields more realistic audio, but a higher BIT DEPTH is a greater improvement if file size is a consideration.
- Be aware that not all devices will play recordings made at higher BIT DEPTH and SAMPLE RATES.
- 44.1 KHz, 16 bit is most likely to play on any device.

BIT RATE options (not BIT DEPTH) means you are recording in a compressed format, which you should avoid.

- You will be losing data if you do.
- If you have to record in a compressed format, use the highest BIT RATE available.

DIGITAL recorders are **typically less** forgiving of sounds that are over the maximum input level. They cause **digital distortion** or **clipping**, which is a very inaccurate representation of the sound source.

Microphones

HOW MICROPHONES WORK

Microphones take **acoustic** energy and transduce them into **electrical** energy.

TYPES OF MICROPHONES

Dynamic

A paper diaphragm, suspended in a magnetic field, is moved around by acoustic energy and transduced into electrical energy via induction.

Dynamic microphones are very durable, and not very accurate.

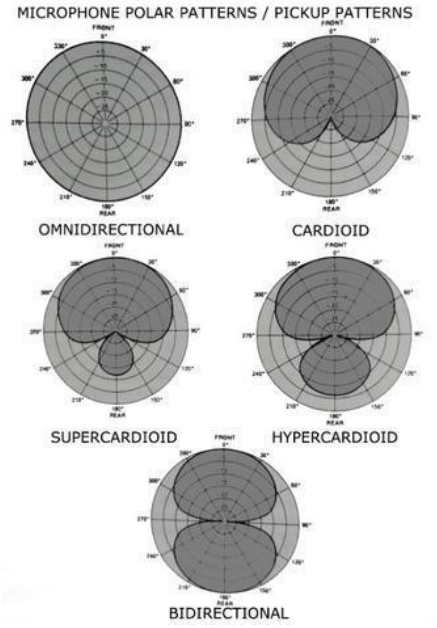
Condenser

Very small metal plate transduces changes in air pressure via the capacitance changes between the plate and a backing plate.

Condenser microphones are very accurate, and not as durable as dynamic microphones.

MICROPHONE POLAR PATTERNS

Show how a microphone responds to sounds coming from different directions.



Cardioid picks up sound mostly in front of the mic.

Omni picks up sound all around the mic.

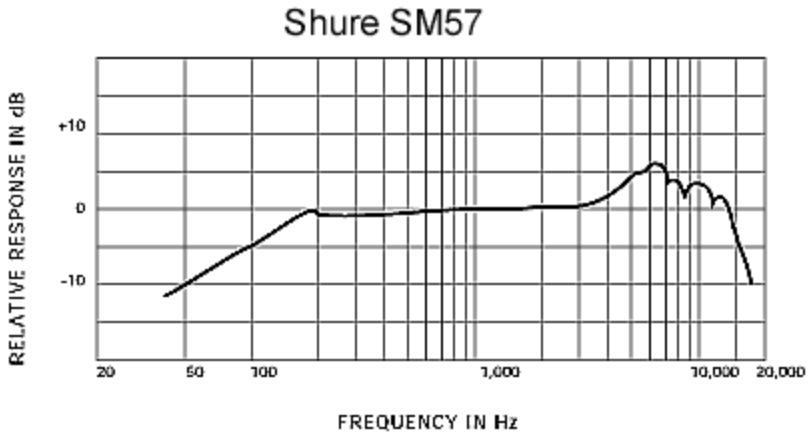
Figure 8 or **bidirectional** picks up sound on either side of the mic.

Hypercardioid aka **shotgun** picks up sound mostly in front of the mic.

Multiple polar pattern mics can switch between patterns.

Stereo mics output two separate signals.

MICROPHONE FREQUENCY RESPONSE



Shows how well a microphone responds to different frequencies.

Flat is usually ideal.

TYPES OF MICROPHONE CONNECTIONS

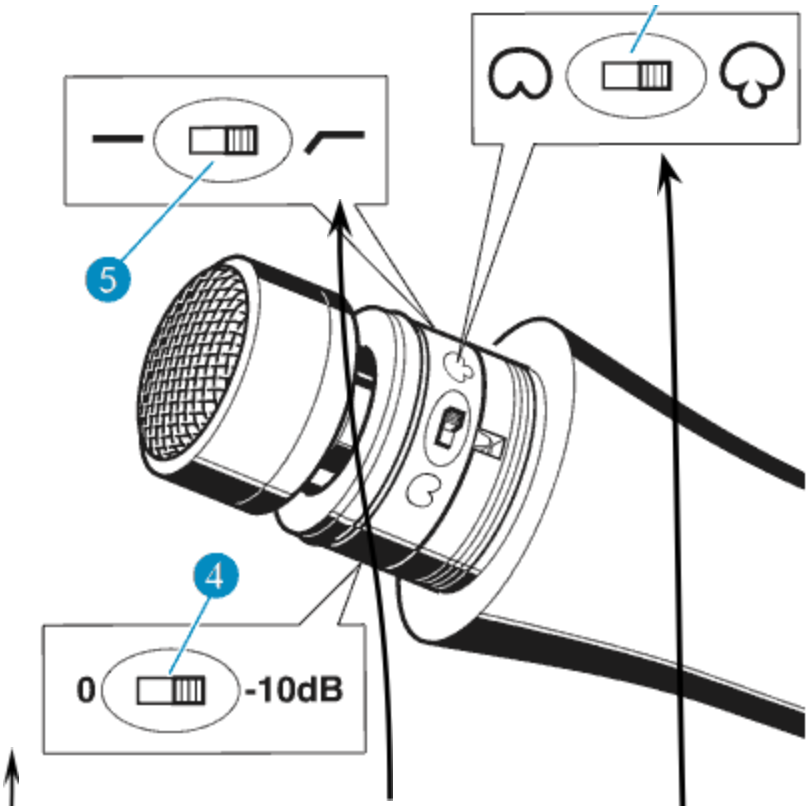
Lots of connection types – standard XLR, minijack, USB, proprietary.

The only one likely to be around in 20 years (IMO) is standard XLR.

MICROPHONE PROXIMITY EFFECT

A microphone within 6” of a sound source usually has an artificial bass boost.

TYPICAL MICROPHONE SWITCHES



High-pass/low-cut

Cuts low frequencies.

Polar pattern

Multi-pattern mics can let you switch.

Pad

Cuts input level (for recording very loud sounds).

Recorders

ANALOG

Analog cassette/microcassette

Typically have bad built-in mics, and sound bad.
Media is hard to find now.
Difficult to maintain.
Inexpensive (less than $50).

Analog portable reel-to-reel.

Production recorders for pro AV.
Typically use external mics.
Media is hard to find now, and expensive.
Difficult to maintain.
Can sound amazing.
Expensive ($300-up).

DIGITAL

Handhelds

Digital voice recorders.

Not high quality.
Rugged.
Convenient.

Discreet.
Inexpensive ($20-$100).

Digital handheld field recorders.

Some have proprietary mics.
Some have standard mic inputs.
Typically have built-in mics.
Discreet.
Mid-cost ($75-$400).

Digital production recorders

For pro AV.
Usually let you use standard (XLR) mics.
High quality.
Not discreet.
Expensive ($1K-up).

Smartphones

Can use external or built-in mics.
Many apps available.
External mics available.
Very discreet.
Use Airplane mode to reduce interference.

Laptops

Can use external built-in mics.
With an audio interface can use external mics.
Not preferred for field work as they are not rugged.

RECORDER OPTIONS

File format options (for digital recorders)

MP3 is **compressed data**; not a perfect representation of the recording.

WAV files are more accurate but take up more space.

Levels

Get hot levels: record as loud as you can.

Don't clip: don't let your levels go in the red.

Limiter/compressor

Useful to prevent **clipping/distortion**.

Overuse will make sound **flat/crunchy**.

Lower threshold is **more** limiting/compression; **higher** threshold is **less**.

Ratio is the **amount** of compression; 1:1 is none, 1:20 is very severe.

AGC (automatic gain control)

Typically for voice recorders or apps, boosts quiet bits and cuts loud bits.

Best to disable if you want an accurate recording.

High-pass/low-cut

Cuts low frequencies.

Monitoring

Headphones

Anything over $100 is a fashion statement.

Over-ear are more accurate than earbuds.

Earbuds are also not good for your ears.

Wireless headphones are inaccurate.

Speakers

Typically not used in the field.

- Speakers are heavy.
- Speakers would cause feedback through a live microphone.

Going without

Experiment with not monitoring your recordings over headphones.

- Easier to be more discreet.
- You won't detect any problems that might come up.

COMMON FIELD RECORDING PROBLEMS

Loud and low frequencies from wind

- Use a DIY or commercial wind screen.
- Position mic away from wind.
- Use a high-pass filter.
  - Not effective if the diaphragm is clipping.

Excessive low frequencies

- Use a high-pass filter.
- Experiment with microphone positioning.
- Try a different microphone.

Mechanical or handling noise vibrating mic

- Use a DIY or commercial shock mount.
- Practice holding microphone in a quiet room.
- Use a tripod/gorilla stand.

Too much ambient sound

- Use a boom pole or selfie stick.
- Get closer to the source.
- Use a more directional mic.

Electronic interference

- Turn your mobile phone or any other devices off.
- Move away from any electronic devices.
- Try other cables.
- Try other headphones.

About Phonography Austin

Phonography Austin is a new organization dedicated to exploring phonography (the creation and presentation of field recordings as art objects) and acoustic ecology (the study of the effects of the acoustic environment on those living within it). More information is available at **phonographyaustin.org.**

Field Recording Scavenger Hunt

- All recordings should be a minimum of 60 seconds.
- Slate them with the date, sound source, and any notes.

Source with excessive low frequencies

- [ ] At a distance of more than 1 foot
- [ ] At a distance of less than 6 inches
- [ ] With a high-pass filter engaged

A room or exterior space of your choice

- [ ] 1 foot from the ground
- [ ] 5 feet from the ground
- [ ] In a corner or against a wall

A sound source within a room or exterior space

- [ ] 1 foot from the source
- [ ] 5 feet from the source

Mobile phone

- [ ] Someone speaking
- [ ] Someone playing music/video

PHONOGRAPHY AUSTIN