Discussion Session (90 minute)

- How does a simple Public Address (PA) system work?
- Tom's $224 PA system - Why I chose each piece

Definitions: PA system stands for public address. A public address system is an electronic system comprising microphones, amplifiers, loudspeakers, and related equipment.

Assumptions for our discussion:

Item #	Topic	Today's assumptions:
1	What kind of performance are we planning for?	Your performance is an accordion and one vocal mic. You can sing or use the vocal mic for speaking.
2	How many microphones for acoustic accordionist?	You use 3 microphones. You play one accordion with a left and right microphone placement, and you use a vocal mic to speak to the public.
3	How many items for digital accordionist?	You use 3 signals. If you have a digital accordion, that would be 2 instrument cables (bass and treble) and one vocal microphone.
4	How big of a PA system do I need?	You have been hired to perform in a library meeting room. I think anything bigger than that – the venue will already operate a PA system and you won't need to bring your own PA system.
5	Can I sing through an instrument amplifier instead of a PA system?	No. Many of the same principles apply to both PA systems and instrument amplifiers. The main difference is your vocal belongs in a PA system but won't sound good coming out of an instrument amplifier. Instrument amplifiers typically lack horns or tweeters to reproduce high frequencies. Therefore, vocals sound muddy through an instrument amplifier.

Five parts:

- Microphone – sound source
- Mixer – adjust each input's volume
- Amplifier – make everything loud
- Speaker(s) – sound output
- Cables – signal flow

Sound source
Microphone

Sound source
3 Microphones

Stage Microphones

There are many types of microphones. Microphones vary by construction method, power requirements and directional coverage. We will discuss just a few facts about a few stage microphones.

From Shure: The Challenges of Miking an Accordion

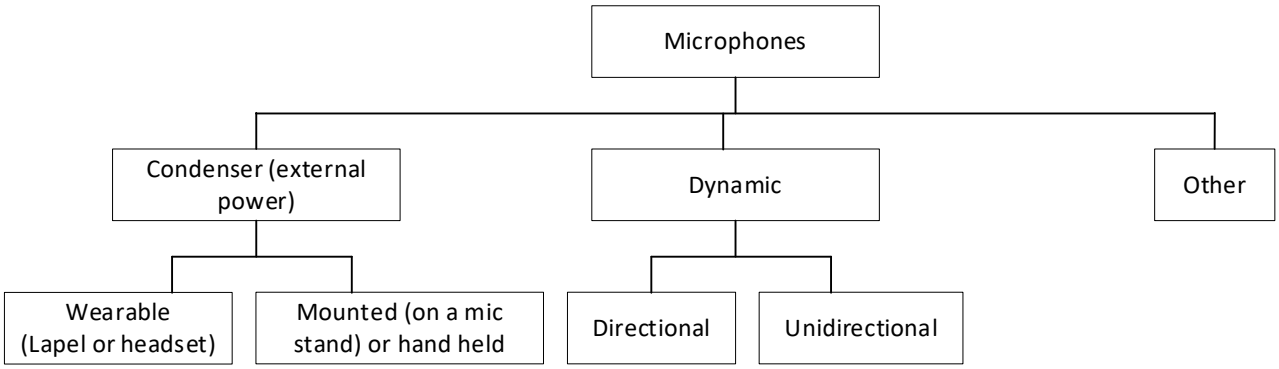
Miking a piano accordion for sound reinforcement or recording is a mystery to most players and even sound engineers. This is not an easy instrument to mic, and here's why:

- The sound comes from both sides of the instrument.
- The action of the bellows means that the instrument is always in motion.
- An accordion radiates a different timbre in every direction, and each accordion surface produces a distinct timbre

What requires a microphone?

- Vocals
- Acoustic instruments
- Digital accordions do not require a microphone because they can be connected to the mixer directly.

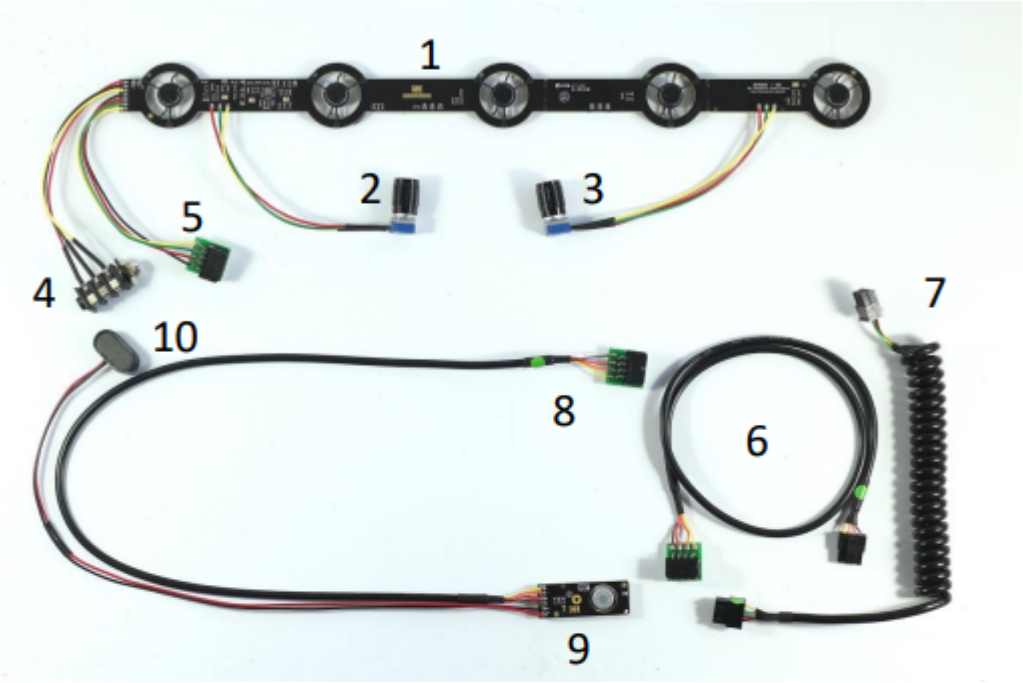
Disclaimer: will give you advice based on my experience. Everyone has experience with microphones, it is a rabbit hole of asking everyone which microphone they like best and why, also cost. There is no single truth in microphones.



Many people have microphones installed inside their acoustic accordions. These are usually condenser mics.

1. Identification

The Harmonik accordion microphone systems include:



1 – Main circuit board with 5 microphones, and *Shock Mount* system. Attached to the cover to capture sound from the right hand.

2 – Volume potentiometer for the Bass Section (left hand).

3 - Volume potentiometer for the Treble Section (Right hand).

4 –P10 1/4" mono jack. (Stereo on demand).

5 – Connection board.

6 – Treble Section to bellows connection cable.

7 – Spiral cable for bellows.

8 – Bellows to Bass Section connection cable.

9 – Bass microphone and circuit board.

10 – Battery clip.

- This example costs $749.
- Notice it has 1 output jack (mono or stereo). *Would I then break that signal into L and R?*
- Notice there are condenser mics for the left side and mics for the right side.
- Notice it requires a 9VDC battery.
- Looks like this must be professionally installed.

In contrast, a dynamic mics cost is less than $100.

Differences between Dynamic Mics and Condenser mics

We will discuss 2 kinds of microphones: Dynamic and Condenser.

- The main difference is that dynamic mics do not require an external power source to work. Condenser mics require an external power source, typically DC voltage. That voltage can come from a box on stage or it can come from the mixer.
- Dynamic mics are usually less expensive than condenser mics.
- Dynamic mics are rugged, simple to use and very reliable. Condenser mics are not as rugged.
- Every microphone that I bring to the accordion convention is a Dynamic mic. I run every show using only Dynamic mics. However, some NAA performers bring condenser mics for vocal use and some NAA performers have a set of condenser mics mounted inside their accordions.
- Why use an SM 57? The dynamic mic will be more directional. Condenser mics pick up everything and can be used from farther away distances.
- Many people have microphones installed inside their accordions. These are usually condenser mics.

Simplified comparison of Dynamic vs. Condenser Microphone features

Item #	Characteristics	Dynamic	Condenser
1	External power requirement	None	Yes (typically 48VDC phantom power)
2	Cost	Great ones cost less than $100	Really good ones can be $200+
3	Rugged	Very Rugged	Less rugged
4	How to position it	External, mounted on mic stand	Clip on, Lavalier, headset or internal
5	Feedback / hassle?	Can feedback if pointed at speakers.	Finicky. Loves to feedback.
6	Quality range	Good to Very good	Very good to Amazing

Jim Rommel has a headset condenser microphone for vocals. Also, his accordion has internal condenser microphones.

About the Shure SM57 and Shure SM58 Dynamic mics (Industry standards for stage performances)

SM57

SM58

Vocal mics pick up sound from a wide circle (unidirectional) and instrument mics pick up sound from a narrow area (more directional). **Why is that?**

The 57 and 58 microphones are based on the same cartridge design. The main difference is in the grille. The SM58 was designed for vocal applications, and therefore uses a ball grille with built in pop filter to eliminate plosives.

The SM57 is designed as an instrument microphone, where a smaller grille size is more practical and plosives are less of a concern. Subsequently, the SM57 does not use a ball grille with pop filtering and instead features an integral resonator/grille assembly, where the grille is actually part of the cartridge.

Each grille design places the diaphragm of each microphone in a different acoustical environment. The distance from the top of the grille to the diaphragm is shorter on the SM57 compared to that of the SM58, which allows for a more pronounced proximity effect through closer mic positioning.

Questions about microphone placement DISTANCE

Question: Why do I like SM58 (vocal mic) on an accordion?
Answer: Picks up sound in more directions. An accordion produces sound in a wide area, not a narrow area. It is More difficult to find an accordion sweet spot with an SM57. Additionally, many players are constantly shifting position.

Question: When do I like to use an SM57?
Answer: Something loud and pointy, like a Guitar amp, trumpet, snare drum.

Question: Should I use an SM58 on an accordion?
Answer: Must consider the risk of feedback from the monitors.
People like to “see” an SM57 as an instrument mic. They think the SM58 is a “vocal mic”. Is it?
Therefore, most people are comfortable to see an SM57 on an accordion. I prefer an SM58 for coverage.

Question: Can I mic an accordion with an SM57 and do a good job?
Answer: Yes, but I will need to push the microphone volume more to capture the sound.

Interactive questions for this topic:

Question	Answer
What are the two types of mics we find at the convention?	Dynamic and condenser
What is the main difference between condenser and dynamic mics?	Dynamic mics don't need external power supply
How many condenser mics do I bring to the convention?	Zero. However, I bring about 30 dynamic mics.
Why do I use dynamic mics?	Less prone to feedback. Fits in a mic stand. More rugged.
Who (in this room) owns a condenser mic?	
What is the main difference between the Shure SM57 and the SM58?	The SM58 uses a ball grille and the SM57 diaphragm is closer to the sound source.

Mic experiment: Are these $15 mics good enough?
Shure SM57 and Shure SM58 microphones cost $99 each, on Amazon.
I bought (3) Beyerdynamic mics for $15 each. *Try them out now in an A/B shootout, compared to an SM58.*

Feedback
Acoustic feedback occurs when the amplified sound from any loudspeaker re-enters the sound system through any open microphone and is amplified again and again and again.
It is super annoying.

One way to reduce feedback is to use microphones that probably won't pick up speakers sounds. Like a directional microphone. Most directional mics look like a pencil. If a microphone has a ball shaped cover, it may be omnidirectional and will pick up sound all over the place.

Avoiding feedback is the reason that, when you see an accordionist sitting in front of the monitors, I will use a directional mic. The most likely cause of feedback is someone holding a microphone directly in front of a speaker. It can be a floor monitor or a speaker on a table. Feedback can happen when the room speaker's volume is really loud, and a microphone starts to pick it up. In this case, I jump up and turn down the room volume.

During the convention, you will see me jump out of my chair when feedback happens:

- Norman is speaking into a mic while standing directly in front of the speakers. For some reason, he likes to walk in front of my speakers.
- If somebody is setting up to perform directly in front of the speakers.
- If somebody is holding a microphone in their hand, directly in front of a monitor.

Feedback is 90 percent preventable. Don't point a microphone at a working speaker. Point your speakers away from the performer.

Most likely mic to feedback? Lapel mic. It's turned up really loud to try and capture the voice from the lapel distance, it's probably a condenser mic. Always a feedback risk.

Least likely to feedback? Shure SM57. Directional, dynamic mic. Always sounds great, built like a tank.

Wireless microphones and instrument transmitters

- I will quickly mention wireless.
- Every wireless device has a small transmitter and a receiver.
- Wireless mics typically need batteries.
- Wireless mics can be very expensive to buy.

Not discussing wireless vocal mics today

- I don't use wireless vocal mics. I cannot risk a problem with batteries or interference or noise.
- If you want to discuss wireless mic systems, we can do that another time.

Not discussing wireless instrument systems today

- I occasionally use wireless transmitters for instruments with ¼" jacks. *Wave a set of these around.*
- They still need to be charged up to work and that's one more thing to worry about.
- An instrument cable is a simpler solution.
- If you want to discuss wireless instrument systems, we can do that another time.

For today, we will stick to microphones with cables.

Mixer channels (inputs). What is a mixer?
What does a mixer do? It allows me to change the volume of individual instruments.

What are Mixer "channels"?
A mixer has "channels" that are like a reserved parking spot. If I speak into a microphone, that microphone cable goes to the mixer and it takes up one parking place, called Channel One – nothing else can be plugged into Channel One. So, my vocal mic is Channel #1, and maybe I play guitar and that guitar microphone will plug into channel # 2. If I want to hear more guitar, I turn up the volume on Channel 2.

What if I play accordion and I don't use a microphone because I have a receptacle jack mounted directly to my guitar? No microphone at all, but I still have an instrument cable plugged into my accordion. That cable must plug in somewhere, so my accordion cable needs one channel on the mixer. What if my accordion has (2) instrument cables, one for the treble side and one for the bass? These 2 cords require 2 mixer channels.

Each microphone cable requires one mixer channel. For example, assume I'm a performing accordionist, how many mixer channels are needed?
I take a microphone and place it near my treble side. That's mic Channel #1 and it goes into the mixer. I take a second mic and place it nearby bellows. That's second microphone goes into the mixer on Channel #2. And I am going to sing, so I want a vocal mic, that will plug into the mixer on Channel #3.

Everything that comes to the mixer requires at least 1 channel, each device.

What if I play a drum kit? I've got a microphone on my kick drum, a mic on my snare drum, rack mounted toms and a floor tom. I've got cymbals. That's (count them) about 7 microphones to handle the drum kit. Plus, my drummer sings so he needs a vocal microphone, that's another channel. Altogether - my drummer needs 8 channels in the mixer – does everyone understand why?

Phantom power:
Question: What is phantom power? It's the power needed to use a condenser microphone.

Shopping for a mixer:

- Describe XLR and ¼" inputs and how this affects cabling, and therefore mixer and mics. Which do you need, ¼" or XLR? Converting them is a hassle.
- How many channels do you need? Number of channels. I am going with (2) for the accordion. If you want to speak or sing, add 1. Be careful of systems that include MP3, Bluetooth or USB as an input channel. I saw a used Samson MDR6264 "6 channel mixer" (selling for $40) that could only accept 2 XLR inputs. This would not be enough XLR inputs for a simple accordion and vocal unless you have cables that can go to ¼". Also, the ¼" channels lack some of the controls compared to the XLR channels.

My rule is: Buy a mixer with enough XLR channels to operate your show. Don't be swayed by a mixer with multiple inputs unless those inputs have enough XLR inputs.

Using a mixer:

We will examine one mixer channel.
Let's look at just this area and we will go from top to bottom.

The most confusing thing about this mixer is there are 3 volume controls for channel 1..

- GAIN
- LEVEL
- MAIN

Name of adjustment	What is does	Let's start out at
Gain	Is this a weak signal like a vocal microphone? It will need a little GAIN as it comes into the mixer. A microphone on a loud instrument (such as a tuba) might not need very much Gain. If the mixer's PEAK light comes on, we need to turn the gain down or it will distort. GAIN is a powerful volume boost, best if we use it minimally.	Pretty low = 10 percent
Level	This will be my best volume control, if I need more volume, I will turn this up. If I adjust the level more than 75%, I probably need more GAIN.	Pretty low = 25 percent and adjust it during sound check. This is best knob that I can adjust for volume control.
Main	This is the volume that I am sending out of the mixer, and into the amplifier. I want a healthy signal out of the mixer. So I will set this just below the ZERO mark.	High. Let's start at -5. I want this to be pretty high all the time. If the system is loud and my MAIN is around -30, I am probably doing something else wrong. Try lowering the GAIN adjustments.

One more look at mixer channels:

The manufacturer advertises this as a 6 channel mixer

It is designed to look very similar to my eBay mixer. HOWEVER, note that there is GAIN only on Channels # 1, 2.

Powered mixer

Some PA mixers have an amplifier built in. This device can be called a “head”.

Here is an example: Behringer Europower PMP550M 5-channel 500W Powered Mixer

- It costs $209
- It’s output power to 1 speaker is 140W, although it can drive 2 speakers.
- It weighs 10 pounds
- It has 5 inputs

Be sure your speaker matches this as closely as possible. You want a speaker that can handle 200W.

The basic rule is to use an amp that delivers equal to or up to double the IEC power rating of the loudspeaker; for example, a speaker rated at 300-watts capacity needs a 300- to 600-watt amp.

There is a Behringer speaker that would match this head (Behringer VS1220 600W 12 inch Passive Speaker) for $159. It weighs 38 pounds. You can also find lots of less expensive, used PA cabinets on Craigslist.

Cable selection - Start at your instrument (accordion mic or plugs, vocal mic, electric piano, whatever)

- Look at its output connection. XLR or ¼”
- Look at your cables (XLR or ¼’)
- Look at your mixer… do your mixer connections match your cables?

Example Problem: The Samson mixer only has 2 XLR.

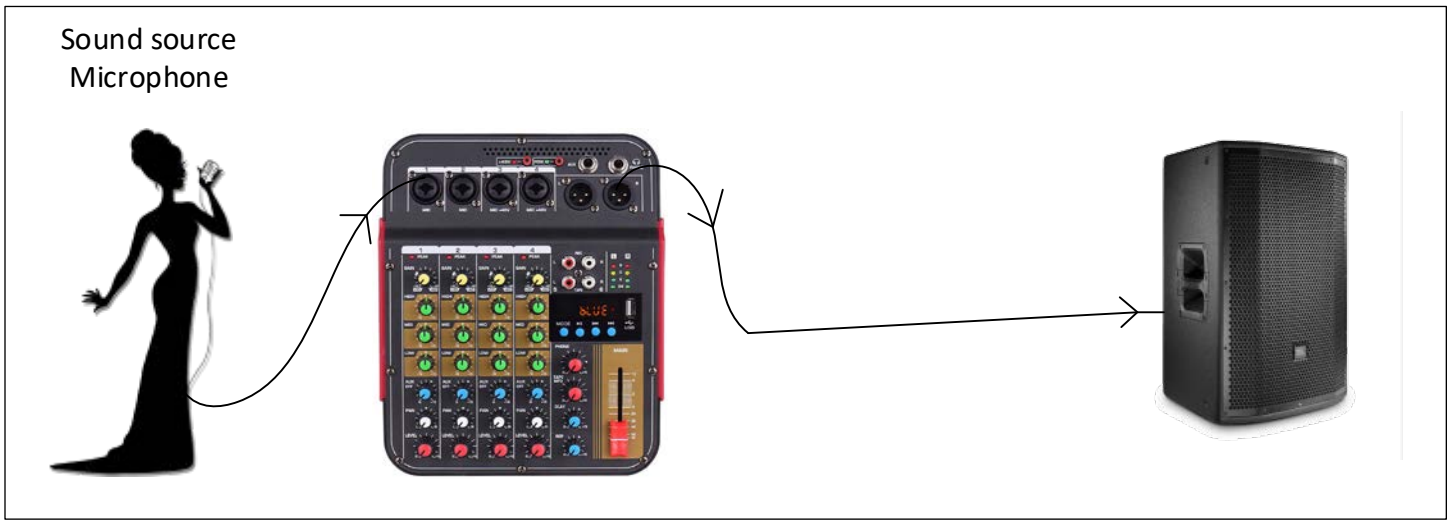
One solution is to convert my XLR cable to 1/4?”. I can use adapters to do this or conversion cables.

Ideally, buy a mixer with enough XLR and ¼” inputs to do what you need without converters.

When looking for a speaker:
Build quality – Read reviews on Amazon to ensure it will not break when it is moved. Cheap plastic latches, etc. For an accordion, you need some bass, so I would look for speakers at least 12". Generally, these cabinets also come with a tweeter for the high end.

If the speaker is powered, it can do the work of a mixer.
Basically, if there are several inputs available, a powered speaker is a combo "mixer and speaker".
Number of inputs - You probably need (3) input channels (accordion left and right, also a vocal mic).
Pro tip: Look at how many volume control knobs there are, and the shape of the connectors to see if it can work as your mixer.

Speaker is unpowered – it does not have an amplifier built in



Speaker is powered – it has an amplifier built in

Rockville RPG12 Speaker / Amplifier connections from the back of the speaker cabinet

Note that 2 channels have a volume control.

Example speaker	Type of amplifier?	Number of input channels?	Type of speaker?	Weight, in pounds
Yamaha S115V ($400)	None (can accept 500W continuous)	1 (4 cable receptables all to the same channel). No volume control.	Unpowered	64
Behringer VS1220 600W 12 inch Passive Speaker ($159)	None	1	Unpowered	37
Bose S1 Pro+ Multi-position PA System with Battery ($649)	150W	2 good ones, plus one “aux”. Basically, 2.	Active / powered	14
Alto Professional TX312 ($209)	350W continuous	1	Active / powered	29
Rockville RPG12 12" Powered Active 800 Watt 2-Way DJ PA Speaker ($122 used)	200-Watt RMS 400 watts Program power 800 Watts Peak	2 (several connection points but only 2 volume controls)	Active / powered	44

For example, I bought this Rockville RPG12 12" Powered Active 800 Watt 2-Way DJ PA Speaker.

- It has the amplifier built in, and it has only 1 input.
- So I bought a mixer (separately).

Separate volume controls: Note that some powered speakers advertise more channels than can be used, because there is 1 volume control for 2 channels, like for a CD player. This is useful for a music playing device, where both L and R volumes can be controlled as one unit. Not as useful for bass and treble side of accordion.

Cheap systems = Common complaints are plastic handles and plastic speaker stands break. All cheap stands were prone to break. Mics that were included are toys.

Why I selected my demo system pieces

<u>When looking for a mixer:</u>
I bought a cheap Chinese mixer for the first time. Just to see if it works. I usually buy a more expensive brand name (I buy Allen & Heath or Yamaha). I avoid Mackie, Behringer, Chinese because I have heard people describe reliability issues after years of use. I see new brands popping up, like Pyle. If you’re like me and have no experience with those, you should read the Amazon reviews! And there are these Chinese knock offs from reverb. I took a chance this time.

Effects: I don’t use them, based on stage traffic rate. If you want reverb, that is available on a mixer for a little more $.

Amplifiers
about wattage

Device power consumed is not equal to amplifier power.
Look for 100W or more.
Matching the amplifier to the speaker.

- Your amplifier puts out a certain amount of power that will be sent to the speaker.
- If your amplifier puts out too much power, you can damage the speaker.
- If your amplifier puts out too little power, you can damage the speaker.
- Therefore, it is important to match your amplifier and speaker.
- Usually, the speaker manufacturer will give you a power specification and that tells you which amp is appropriate.

Definition: What is a powered speaker?

Discussion question: Of the 5 PA components, what components does a powered speaker include?

Minimum: You need an amplifier and speaker that produce at least 50 watts of power for a small room.
Recommended: I would look for an amplifier and speaker that are rated at 100 watts or more for a small room.

If you buy a speaker with a built in amplifier (called a powered speaker), there is no need to match anything. I bought this speaker from Amazon (used like new) for $122. It includes the amplifier.

Rockville RPG12

Condition	**Definition**	**My example Speaker's Wattage**
RMS	The continuous power requirements for a particular speaker's usage.	200W
Program	This is usually double RMS, and what a speaker handles in bursts.	400W
Peak	This is what a speaker can handle in a very short time, before damage can occur to the speaker's voice coil.	800W

Let's test if it is loud enough (volume demonstration now).
After… The amplifier inside this speaker cabinet is a 200W amp and it seems loud enough.

Important: Turn the volume controls to zero before turning the amplifier on or off. If not, you may get a loud POP that can damage speakers and irritate your audience.

Why I bought:

Item	**Price**	**Why I bought them**
Behringer ULTRAVOICE XM1800S 3 Dynamic Cardioid Vocal and Instrument Microphones (Set of 3)	$45 for 3 mics new on Amazon	Quality check?
Rockville RPG12 12" Powered Active 800 Watt 2-Way DJ PA Speaker System Black	$ 122 (used) on Amazon	12" speaker I feel like is the min acceptable for accordion
4/6 Channel BT USB Audio Mixer Live Sound Mixing Console +48V Phantom Power D5R6	$57 ebay	Looks like a Chinese knock off of the Pyle (model DSP- PMXU63BT) which costs $96.77 on Amazon. Has enough inputs. Accepts 1/4" and XLR, has gain, EQ.