Using an Outboard Audio Mixer with Zoom for a CW Class

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Revision-1A

As a beginner partaking in a CW on-line Zoom class, you might immediately notice that some of the other participants to include instructors, have great sounding audio, to include both microphone and CW tone generator, and most use a headset (headphones with mic). In contrast to others whose microphone is picking up the CW tone generator speaker output and it is no surprise that in most cases the sound is not so good, but it is tolerable. How do they make the audio sound so good? Is it hard to do? How can I do that? Well, in this paper we will discuss three inexpensive outboard audio mixer designs with headsets that can be used to make your audio sound as good as others do. First, an examination about ZOOM & audio.

> *If you don't want to read through the audio terms and three scenarios and just "jump" to the recommended one, click here.*

Zoom and audio can be a challenge at times as it seems to do what it wants without asking us. In fact, it may force you use it a certain way concerning audio so as to suppress feedback and echo. Zoom also does not like the tone of a CW generator. You could say it is anti Morse Code, what a shame. What happens is this: You are using a camera with a built-in microphone and you are using speakers to hear the far end instructor. What prevents the far end's audio coming out of your speakers from getting back into your microphone and sending it back to the far end when your mic is not muted? See the problem; a feedback loop develops and you probably have heard the echo. So, Zoom, in all its wisdom, employs feedback suppression and echo cancelation to reduce this feedback but sometimes it thinks the CW tone is feedback too and it tries to suppress it. You will notice this from other's audio as the tone sounds low in volume and does not sound normal; wishy washy. At each of the below three mixer scenarios we will adjust the Zoom settings so as to allow better sounding audio. But beware, if you make these settings, essentially turning off the feedback suppression and echo cancellation while still using your cameras mic and speaker, you will most certainly cause feedback.

A quick note about audio and mixers in this paper. As you read through this it may seem complicated and intimidating at first but if you stop and study what is going on it is actually very simple; in's and out's while watching for feedback loops. Audio and mixers operate in a very logical manner so just follow the flow and you will be fine.

Jump to:

First, some terms to know.

Audio Terms

- MIC-LEVEL – A signal that is very low in level, typically around -60db. Mic signals are brought into a mixer via a "mic" channel. A mic channel has a pre-amp to boost the signal up to line level and usually they have EQ and phantom power settings. The quality of the pre-amps can be an issue; some are noisy when turned up high.
- EQ – The adjustment of the frequency response of a signal. In an audio mixer, some channels such as a MIC Channel, have controls to adjust the lows, mids, and High frequencies.
- PHANTOM POWER – Electret and condenser mics need power for them to work. Most mixers will have a button that turns on this power and it is called phantom power and typically it is +48v for professional microphones. Caution, make sure your type of mic requires +48v; it might only need +10v or lower.
- LINE-LEVEL – There are two line level signals found. One that is configured as a "balanced" signal and is usually around +4db. Line level signals that are un-balanced (consumer) are typically around -10db.
- BALANCED – A signal with three conductors. One is ground and the other two are balanced lines. This type of signal is used to reduce the amount of potential noise on the signal. The signal of a microphone with a three-pin male XLR connector is balanced.

- UNBALANCED – A signal that has two conductors. Commonly used for Line-Level signals. Our computers have a 3.5mm with three conductors (Tip Ring & Sleeve) with two unbalanced line level signals, left & right and ground.
- XLR CONNECTOR – A XLR connector has three pins and is around ½" in diameter. XLR connectors are typically used for balance signals and are used with professional gear. XLR connectors are used at mic inputs of a mixer.

- 1/4" & 3.5mm CONNECTORS – 1/4" & 3.5mm (1/8") connectors are typically used in consumer gear and can be mono or stereo and normally have unbalanced signals.
- FADER – The main level control (volume) of a single mixer input channel or output.
- MONO/STEREO – A stereo feed is a signal that has a left and a right signal for a total of two signals. Sometimes the signals on the left and right are exactly the same but it is still considered a stereo signal. A mono signal has a single signal. No left or right, just one signal.
- PROGRAM – The main feed from an audio mixer but it may not be the only feed, there may be other feeds as well, just not the main feed.
- CHANNEL – a single input (mono or stereo) into the audio mixer. This channel can have a mono input such as a microphone or it can be a stereo input (two connectors) but only one fader.

- PAN KNOB – This knob can force the audio to the left or right channels. Typically not used a whole lot and kept in the center position.
- PRE/POST FADER – A fader is the level (volume) control of a channel. Pre-Fader signifies that an auxiliary signal is pulled from a channel before the fader. This means that the signal is at a constant level and is not affected by the fader. Post-Fader signifies that an auxiliary signal is pulled from a channel after the fader. So, if the channel fader is adjusted it would affect the pulled signal as well.
- AUX (auxiliary) OR FX (effects) BUS – An audio mix of an audio mixer similar to the main mix. Each channel will have a separate knob that controls the level of that channel to the aux mix bus. This aux bus is used to send a separate signal to an outboard effects processor such as reverb. The output of the effects processor is then inputted back into the mixer via a separate connector(s) and mixed with the main program signal. Although the purpose is to add in an effect, these aux buses can be used for just about anything, such as a mix-minus feed, and in Scenario-1 we will use this bus to feed the computer with audio.
- MIX-MINUS – A mix of signals (channels) into the audio mixer that are mixed together minus one or more other channels to the mixer.
- TRRS, TRS, TS - TRRS: tip ring ring sleeve. TRS: tip ring sleeve. TS: tip sleeve.

- CONTROL ROOM MONITOR – An output with a volume level control to feed a pair of speakers in a control room or audio booth. Sometimes the output of the Control Room Monitor and Phones share the same volume control as one or the other is typically used.
- PHONES – An output of an audio mixer that is meant to feed a pair of headphones. This output has its own level or volume control knob.

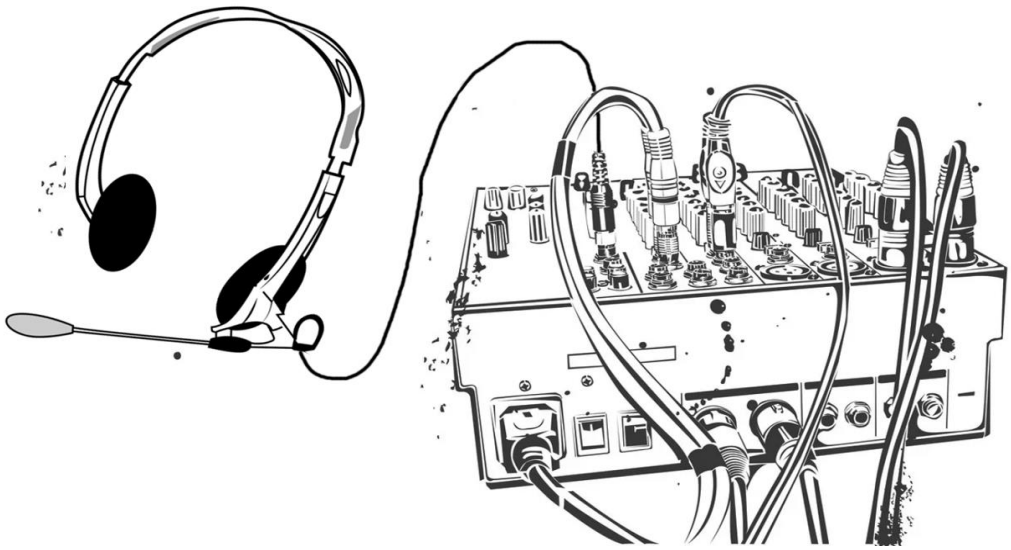
Mixer Scenarios.

A comment about the Behringer XENYX line of small mixers and USB. The USB connection is a two-way connection. It appears at your computer as a sound card (speaker & mic). However, the mixer does not like it when you use both at the same time. The audio going out from the mixer (mic input on the computer) signal will always be the main mix, unless you press the "TO MAIN MIX" button controlling the input USB to the mixer and if you do this you disconnect the other mixer channels feeding this output. If you press the "TO PHONES/CTL RM" the incoming USB audio will be fed to the headphones but nothing else will be fed to the phones. As you can see, it's not very user friendly.

Here is a YouTube video with more information on this subject: https://youtu.be/QHly7Vu2w-k

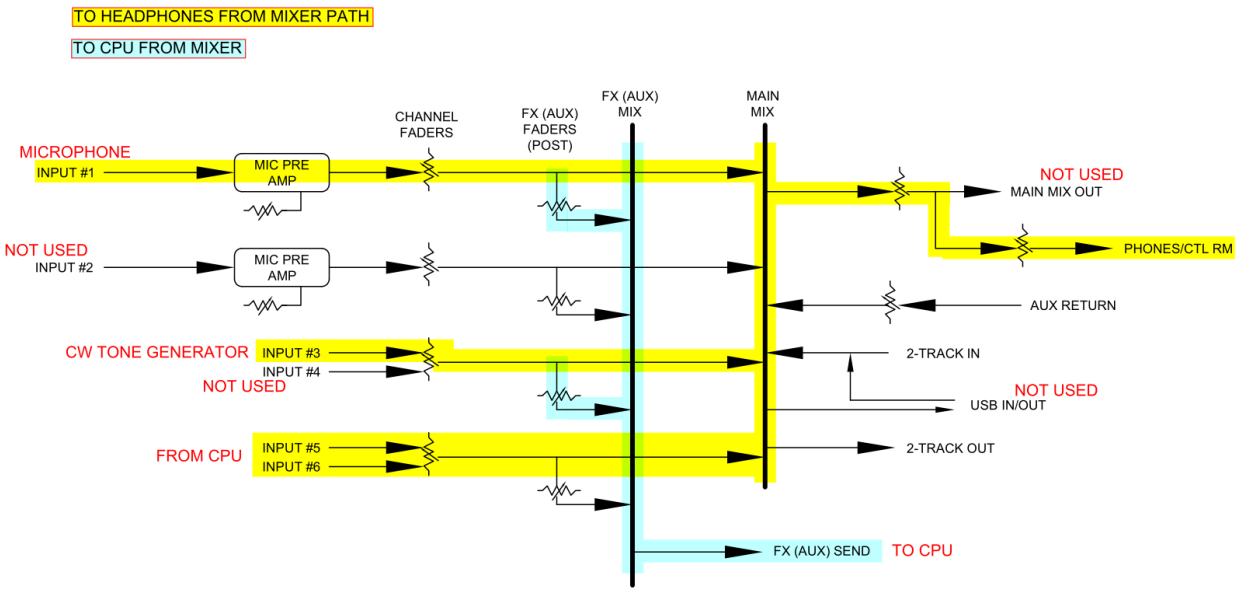
Note that most computer and gaming headsets use either a condenser or electret unbalanced mic with their headsets and will require some level of voltage applied to the mic to make them work. Dynamic mics on headsets will work directly without voltage and is what's shown in the scenarios. For headset examples you can use a Yamaha CM500 with a battery box (shown below) but the mic is not noise canceling nor directional. I use a cheap computer headset I purchased off of Amazon (Sennheiser PC5 for $20 – I don't think Sennheiser makes it though) with a battery box. There are a lot to pick from, get one that is comfortable.

The following three scenarios offer three different ways to use an outboard mixer with your CW tone generator and a headset into and out of Zoom. You may be able to use your camera's mic and computer speakers instead of a headset, but that setup is not discussed here.



Scenario 1

Small six-channel mixer using a Behringer Q802 (USB) mixer ($99).



Q802 Basic Schematic

DESCRIPTION

Refer to the above schematic and connection drawing A1 below.

The mixer we are using here is a Behringer Q802USB but we are not using the USB connection, either in or out. This mixer has an additional mix bus called FX. The knobs labeled FX are used to adjust the level of each channel going to this aux mix (post fader). The output of this aux mix is used to feed the computer sound card interface (and to Zoom).

On input #1 we have the headset mic with a custom adaptor cable (Amazon).

Input #2 (second mic input) is not used.

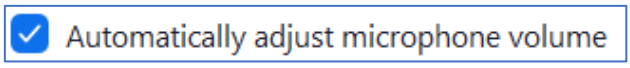
With input #3 we are sending to the mixer the output from the CW tone generator through a 1/4" to 3.5mm adaptor. Adjust the fader knob for a good sounding CW tone in your headset. This should be a mono unbalanced feed.

Input #4 (right side of the 3/4 input pair) is not used.

On input #5/6 we have the computer audio through a 1/4" L & R to 3.5mm jack adaptor from your sound card interface. The computer output can be set to 50%-100% allowing the fader of the mixer to control the level. You should see this at your computer sound volume and in Zoom:

Caution: be aware that the 1/4" inputs of a mixer channel are balanced/unbalanced single channel inputs that can take either a TRS or a TS (mono) connector but the output from a computer's 3.5mm or other similar equipment is unbalanced two channel (left & right). If you were to plug the TRS 3.5mm computer audio, via a 1/4" adaptor, into the mixer, the audio would be low in level and sound funny. To get around this use a "Y" adaptor with two mono 1/4" plugs to a 3.5mm stereo jack. This separates the left and right unbalanced signals.

In Zoom, you will want to pick the sound card interface you are using as your mic input. Turn up the FX (aux bus) knobs of the headset mic and the CW tone generator to about a 1/2 of the way up; in Zoom you can select "automatically adjust microphone volume" so that your audio at the far end is the proper level. The audio on the meter in Zoom should bounce from 0 to 100 and not appear to be clipping (hitting 100 most of the time).

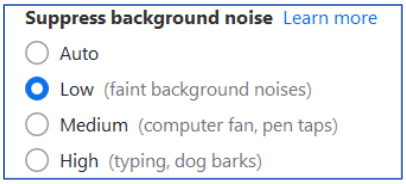


We want the FX (aux bus) knob of channel #3/4 (computer) to be all the way down; this is how we achieve the mix-minus. We do not want to send the computer audio back to itself but we do want to hear it through the main mix and headphones.

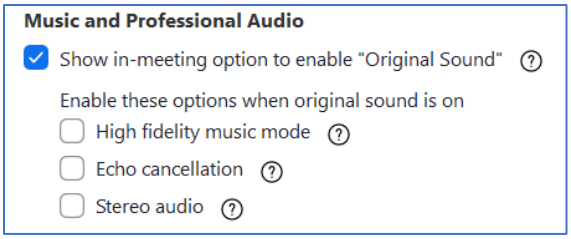
Take the phones 3.5mm of the headset and via an adaptor plug into the Phones jack of the mixer.

Adjust the Channel Faders, Main fader, and Phones fader level knobs so has to produce good sound in your headphones. Remember that the main output goes nowhere, just to your headphones.

In Zoom you want to select low for the background noise suppression. We can't turn this off so we select the lowest level.

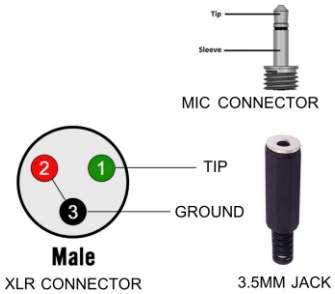


We also deselect all boxes in section "Music and Professional Audio." Then when in a call, in the upper left corner, you can select "Original Sound" with the audio interface you are using hoping to further limit Zoom in its echo cancellation efforts. When you enable original sound in Zoom, you are able to use the audio directly from your mixer without any of Zoom's echo cancellation or audio-enhancing algorithms affecting the audio.


Music and Professional Audio
Show in-meeting option to enable "Original Sound"
Enable these options when original sound is on
High fidelity music mode
Echo cancellation
Stereo audio

Refer to the **Drawing A1** for the below explanations.

① Custom adaptor to bring in microphone audio into a mic input of the mixer from a headset that uses a mono 3.5mm plug connector (such as Heil headsets). You can also buy these on Amazon with a stereo 3.5mm where the sleeve and ring of the mic get shorted (XLR pins 2 & 3) when plugged in.



② 1/4” mono left and right to 3.5mm stereo adaptor (Amazon).

③ 3.5mm stereo to 1/4” stereo adaptor.

④ Mic channel pre-amp gain control. Start in the middle position then use the fader control for additional gain. Too much mic pre-amp gain can introduce noise.

⑤ EQ controls for the Mic Channel.

⑥ FX (Aux) mix level controls. These knobs are used to generate an Aux Mix that we will send to the computer (and Zoom) as the main output of the mixer.

⑦ Channel level control.

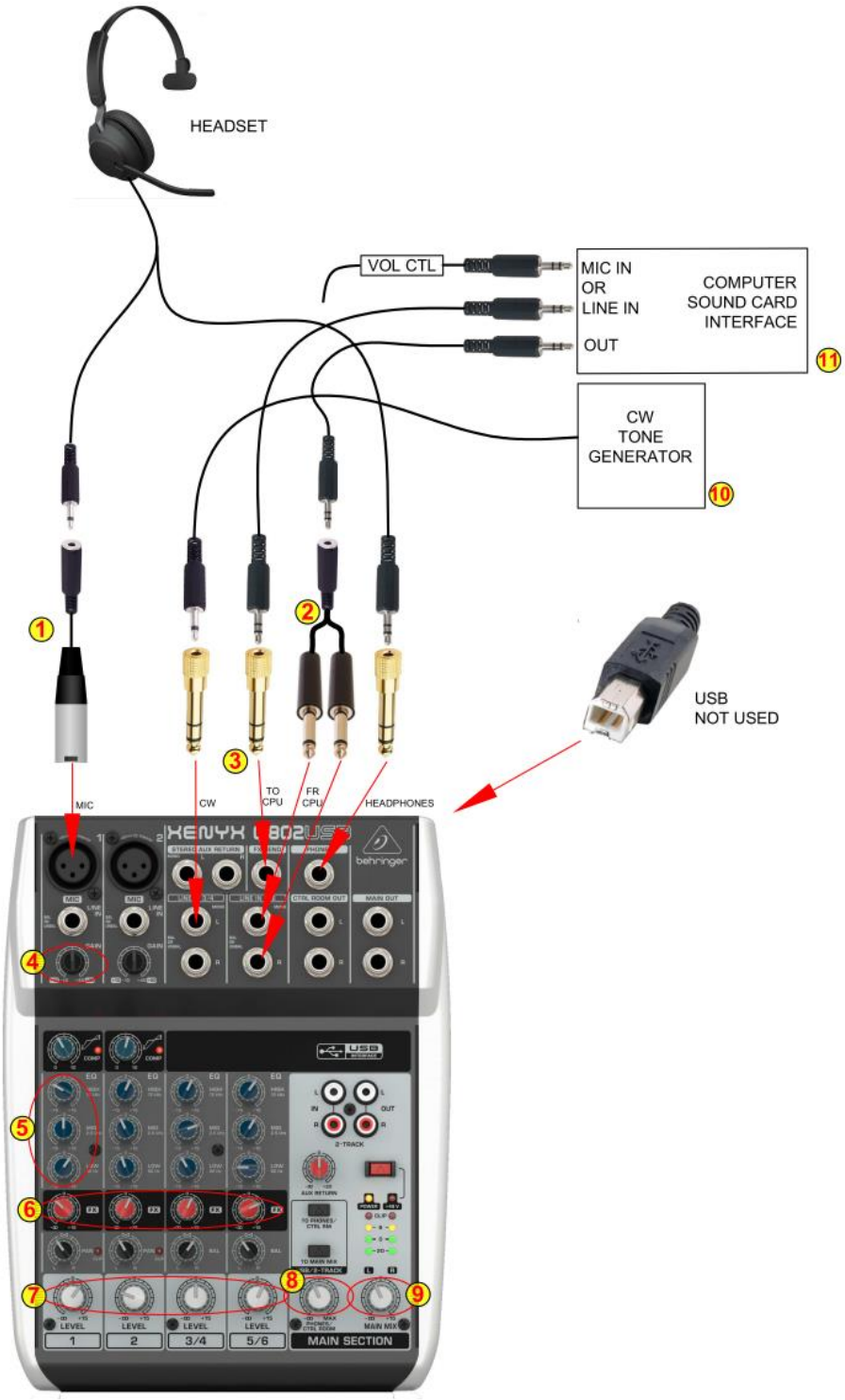
⑧ Phones & Control Room level control.

⑨ Main Mix level control. Only used in conjunction with the phones level control to send audio to the headset speakers.

⑩ CW tone generator with an audio output jack that produces a good sinewave signal (if available).

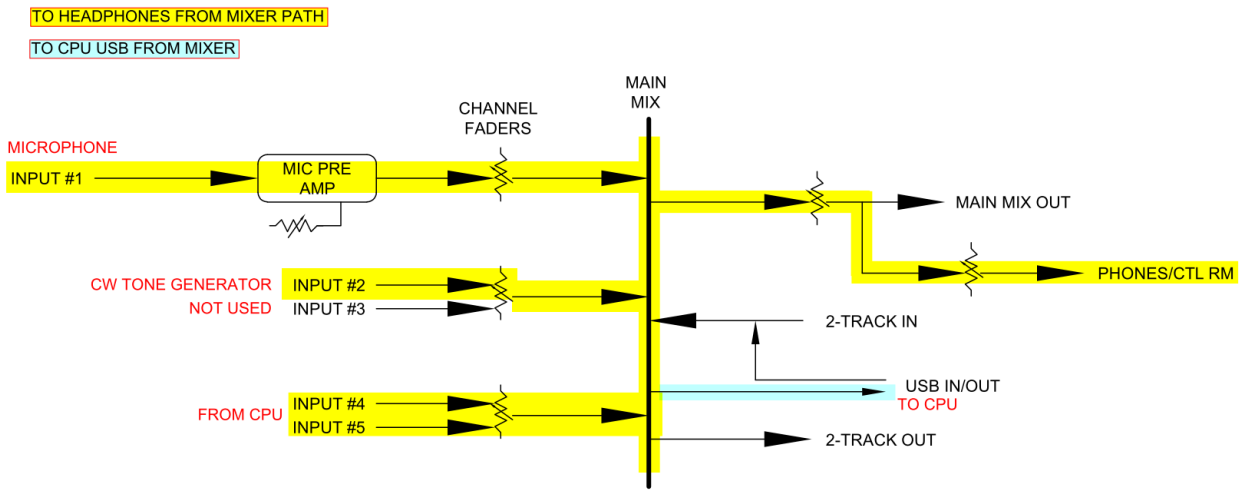
⑪ Computer sound card interface. The signal from the mixer is at line level (+4db) but most sound card interfaces have a mic input that is at -60db so this signal needs to be attenuated. You can get a volume control on Amazon to do this. Or, if the sound card interface has an option to make the input line level or if it has a separate input that is line level then use that.

Drawing A1


HEADSET
VOL CTL
MIC IN
OR
LINE IN
OUT
COMPUTER
SOUND CARD
INTERFACE
11
CW
TONE
GENERATOR
10
1
2
3
USB
NOT USED
MIC
CW
TO
CPU
FR
CPU
HEADPHONES
4
5
6
7
8
9
LEVEL
1
2
3/4
5/6
MAIN SECTION

Scenario 2

Small four-channel mixer using a Behringer Q502 (USB) mixer ($69).



Q502 Basic Schematic

DESCRIPTION

Refer to the above schematic and connection drawing A2 below.

The mixer we are using here is a Behringer Q502USB and we are going to use the USB connection's output to the computer only as it has issues when using both USB in and out.

On input #1 we have the headset mic with the custom adaptor cable (also available on Amazon).

With input #2 we are sending to the mixer the output from the CW tone generator through a 1/4" to 3.5mm adaptor. Adjust the fader knob for a good sounding CW tone in your headset. This should be a mono unbalanced feed.

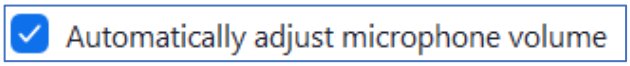
Input #3 (right side of the 2/3 input pair) is not used.

On input #4/5 we have the computer audio through a 1/4" L/R to 3.5mm adaptor. The computer output can be set to 50%-100% allowing the fader of the mixer to control the level. You should see this at your computer sound volume and in Zoom:

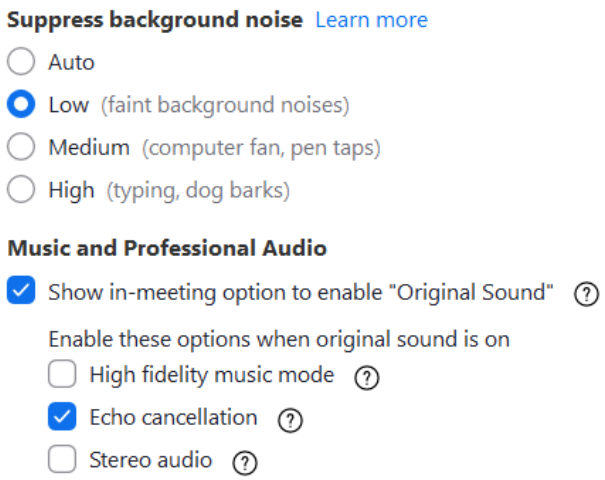
Caution: be aware that the 1/4" inputs of a mixer channel are balanced/unbalanced single channel inputs that can take either a TRS or a TS (mono) connector but the output from a computer's 3.5mm or other similar equipment is unbalanced two channel (left & right). If you were to plug the TRS 3.5mm computer audio, via a 1/4" adaptor, into the mixer, the audio would

be low in level and sound funny. To get around this use a "Y" adaptor with two mono 1/4" plugs to a 3.5mm stereo jack. This separates the left and right unbalanced signals.

In Zoom, you will want to pick the sound card interface you are using as your mic input (program feed from the mixer). Turn up the main output fader so you can see the meter bouncing in Zoom. You can have Zoom automatically adjust microphone volume so that your audio at the far end is the proper level. The audio on the meter in Zoom should bounce from 0 to 100 and not appear to be clipping (hitting 100 most of the time).



Since we are sending the mixer main audio output, via USB, to the computer and then we are also bringing in the computer audio via input 4/5 into the mixer we would normally get feedback. But in Zoom we want to turn on Echo Canceling and we do not want Original Sound turned on. But the only way to turn on Show in Meeting Echo Cancelation is first to turn on Show in Meeting Original Sound then click Echo cancelation then click off Show in Meting Original Sound. Should look like this:

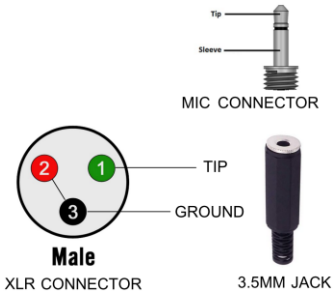


Take the phones 3.5mm of the headset and via an adaptor plug into the Phones jack of the mixer.

Adjust the Channel Faders, Main fader, and Phones fader level knobs so as to produce good sound in your headphones. Once the main output is set, don't touch it anymore. However, you can touch the phones level knob to adjust the volume in your headset.

Refer to the **Drawing A2** for the below explanations.

① Custom adaptor to bring in microphone audio into a mic input of the mixer from a headset that uses a mono 3.5mm plug connector (such as Heil headsets). You can also buy these on Amazon with a stereo 3.5mm where the sleeve and ring of the mic get shorted (XLR pins 2 & 3) when plugged in.



② 1/4” mono left and right to 3.5mm stereo adaptor (Amazon).

③ The 3.5mm line input of the computer is not used as we are using the USB connection for this.

④ Mic channel pre-amp gain control. Start in the middle position then use the fader control for additional gain. Too much mic pre-amp gain can introduce noise.

⑤ EQ controls for the Mic Channel.

⑥ Channel level control.

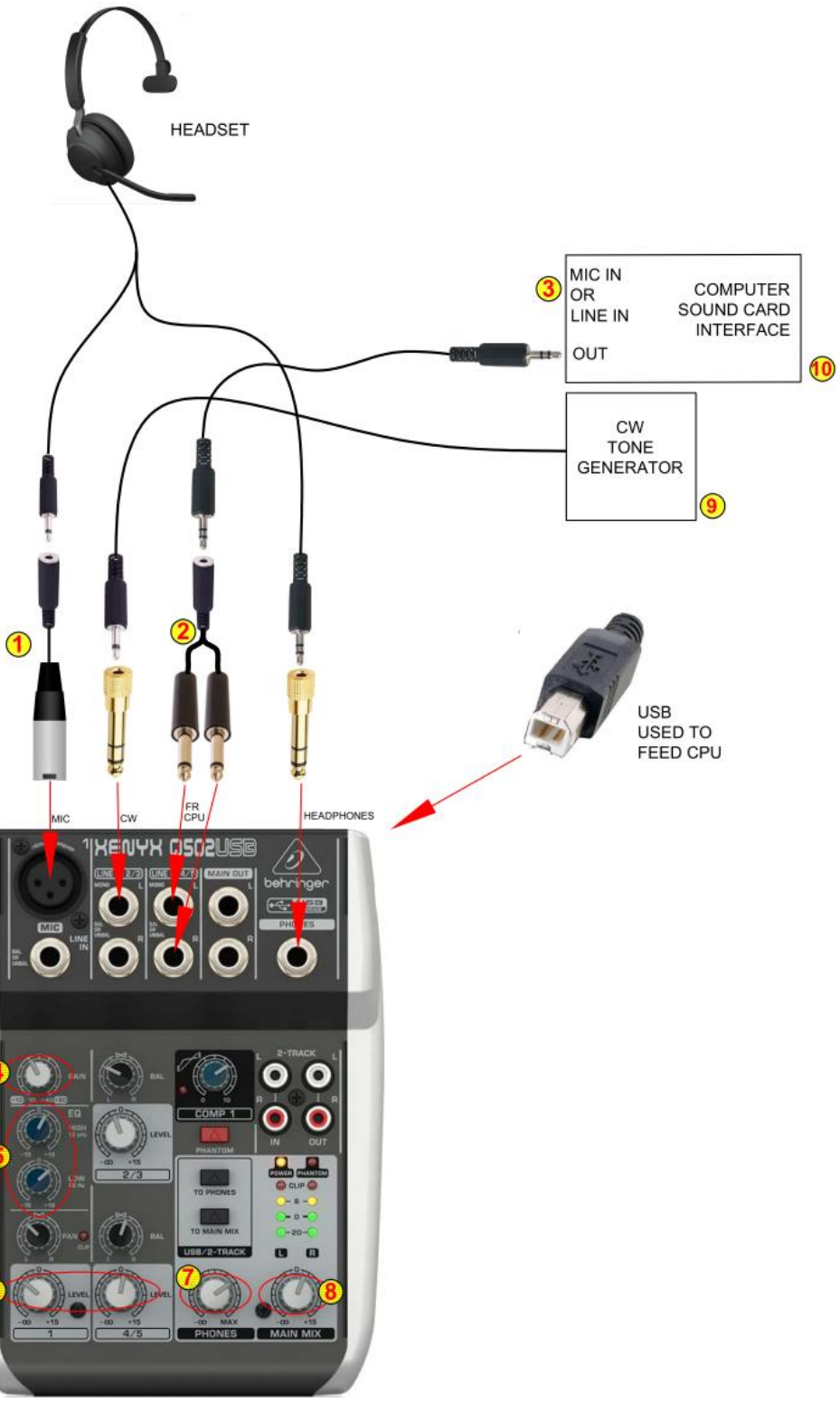
⑦ Phones level control.

⑧ Main Mix level control. This audio goes to the computer via USB.

⑨ CW tone generator with an audio output jack that produces a good sinewave signal (if available).

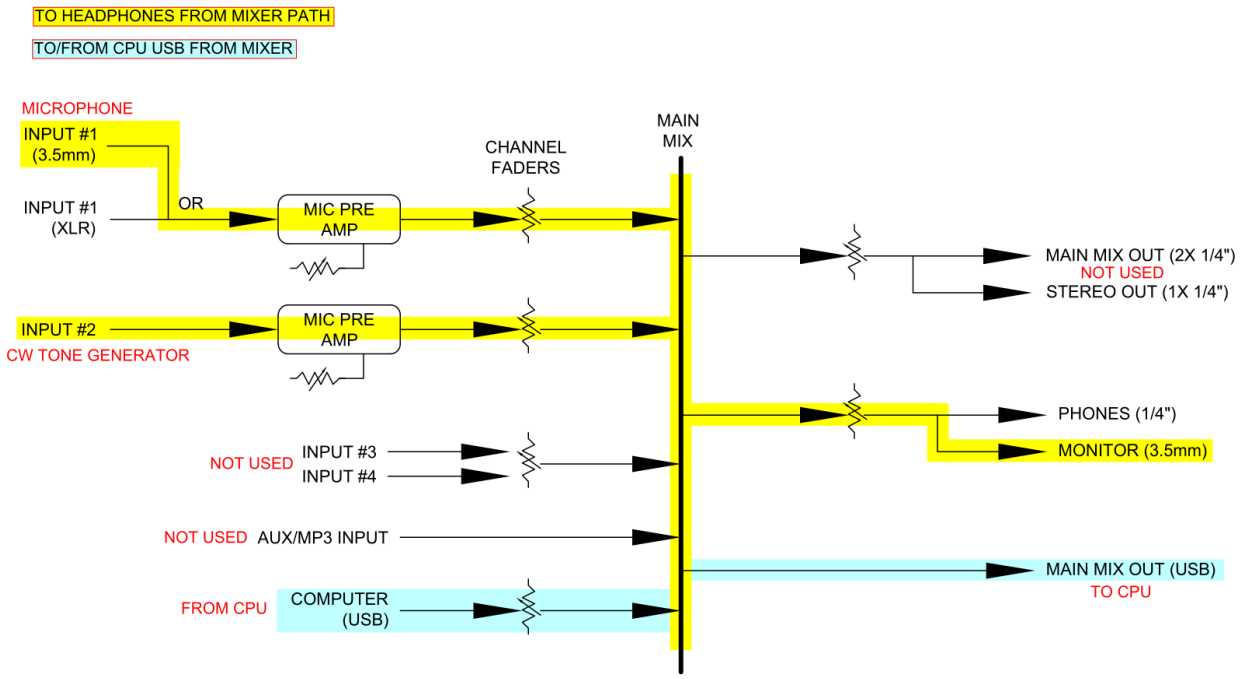
⑩ Computer sound card interface.

Drawing A2


HEADSET
MIC IN
OR
LINE IN
OUT
COMPUTER
SOUND CARD
INTERFACE
CW
TONE
GENERATOR
USB
USED TO
FEED CPU
MIC
CW
FR
CPU
HEADPHONES
XENYX Q502USB
behringer
COMP
2-TRACK
PHONES
MAIN MIX

Scenario 3

Small four-channel Rockville Rockmix-4 mixer with a USB connection ($65).



Rockmix-4 Basic Schematic

DESCRIPTION

Refer to the above schematic and connection drawing A3 below.

This scenario is the least inexpensive of the three, has the lowest count of cables and adaptors, and the USB connection works as you might expect; everything we need. As a bonus, there is no external power supply, the mixer is powered by the USB connection. But… the mic pre-amp is a little nosier and the gain is not what the Behringer is. The USB connection is 16-bit which is fine for us, however, if you want high-fidelity then 24-bit is more common. None of these are issues for our purpose.

The mixer we are using here is a Rockville Rockmix-4, also marketed by Art Mixers with a model name of USB Mix 4. We are going to use the USB connection's input and output to the computer.

Input #1 can either be used with the XLR connector as we did with the other two mixers but with this mixer we also have a 3.5mm input jack that is routed to the Input#1 channel. It's either or, can't use both. We have the headset mic plugged into the 3.5mm jack. We then can use the Mic Gain and EQ adjustments of channel 1 as desired.

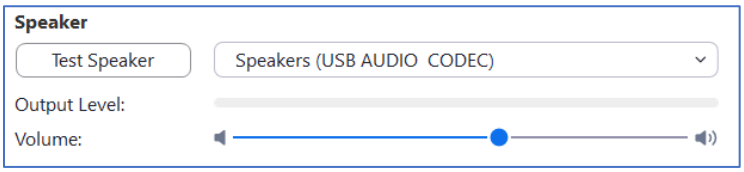
For the CW Tone we can either use input #2 or the mono input #3 of the ¾ pair. I have chosen input #2 so I can use the EQ on the tone. So, from the CW tone generator we have a cable ran to the mixer input

#2 via a 1/4” to 3.5mm adaptor. Push in the “Pad” button to lower the level if needed and adjust the channel 2 settings to include EQ for a good sounding CW tone in your headset. This should be a mono unbalanced feed.

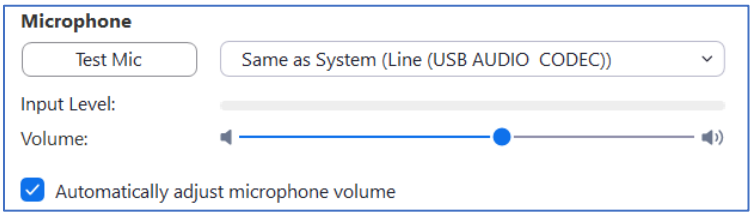
Input #3/4 pair are not used.

In Zoom USB connections:

Output of the computer (speaker), select the Mixer as your destination. On the top level meter of Zoom I have it set round 60%, then you can adjust the “Computer” level knob of the mixer, ⑥, to a comfortable level.



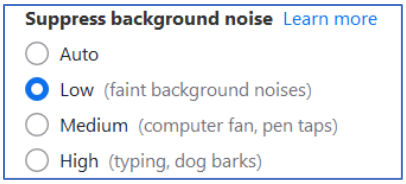
Input to the computer (microphone), you will want to pick the mixer USB interface for your mic input (program feed from the mixer). Note: the main output fader of the mixer does not affect the audio, over USB, to the computer, it is a fixed value. You can have Zoom automatically adjust microphone volume so that your audio at the far end is the proper level. The audio on the meter in Zoom should bounce from 0 to 100 and not appear to be clipping (hitting 100 most of the time).



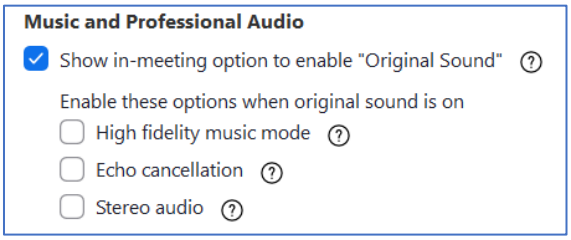
Record Source Switch, This is the magic switch that allows you to select how the mixer sends audio, via USB, to the computer. Select INPUT MIX.

- DRY CH 1-2: Only sends channels 1 & 2 to the computer.
- INPUT MIX: Sends everything but the received computer audio to the computer. This is basically the “mix-minus” of scenario 1.
- LOOPBACK: Sends everything to the computer.

In Zoom you want to select low for the background noise suppression. We can’t turn this off so we select the lowest level.



We also deselect all boxes in the “Music and Professional Audio” section. Then when in a call, in the upper left corner, you can select “Original Sound” with the audio interface you are using hoping to further limit Zoom in its echo cancellation efforts. When you enable original sound in Zoom, you are able to use the audio directly from your mixer without any of Zoom’s echo cancellation or audio-enhancing algorithms affecting the audio.



Take the phones 3.5mm of the headset and plug into the “Monitor” jack of the mixer, next to the 3.5mm mic jack (convenient).

Adjust the mic and CW channel faders for a good ratio and adjust the Phones fader level knobs so has to produce good sound in your headphones. Remember that the main output goes nowhere, just to your headphones.

Refer to the **Drawing A3** for the below explanations.

① Accepts the mic plug from your headset.

② 2nd Mic Channel.

③ The 3.5mm phones output of your headset.

④ Mic channel pre-amp gain control. Start in the middle position then use the fader control for additional gain. Too much mic pre-amp gain can introduce noise.

⑤ EQ controls for the Mic Channel.

⑥ Channel level controls.

⑦ Phones level control.

⑧ Main Mix level control.

⑨ Record Source Switch, This switch allows you to select how the mixer sends audio, via USB, to the computer. Select INPUT MIX.

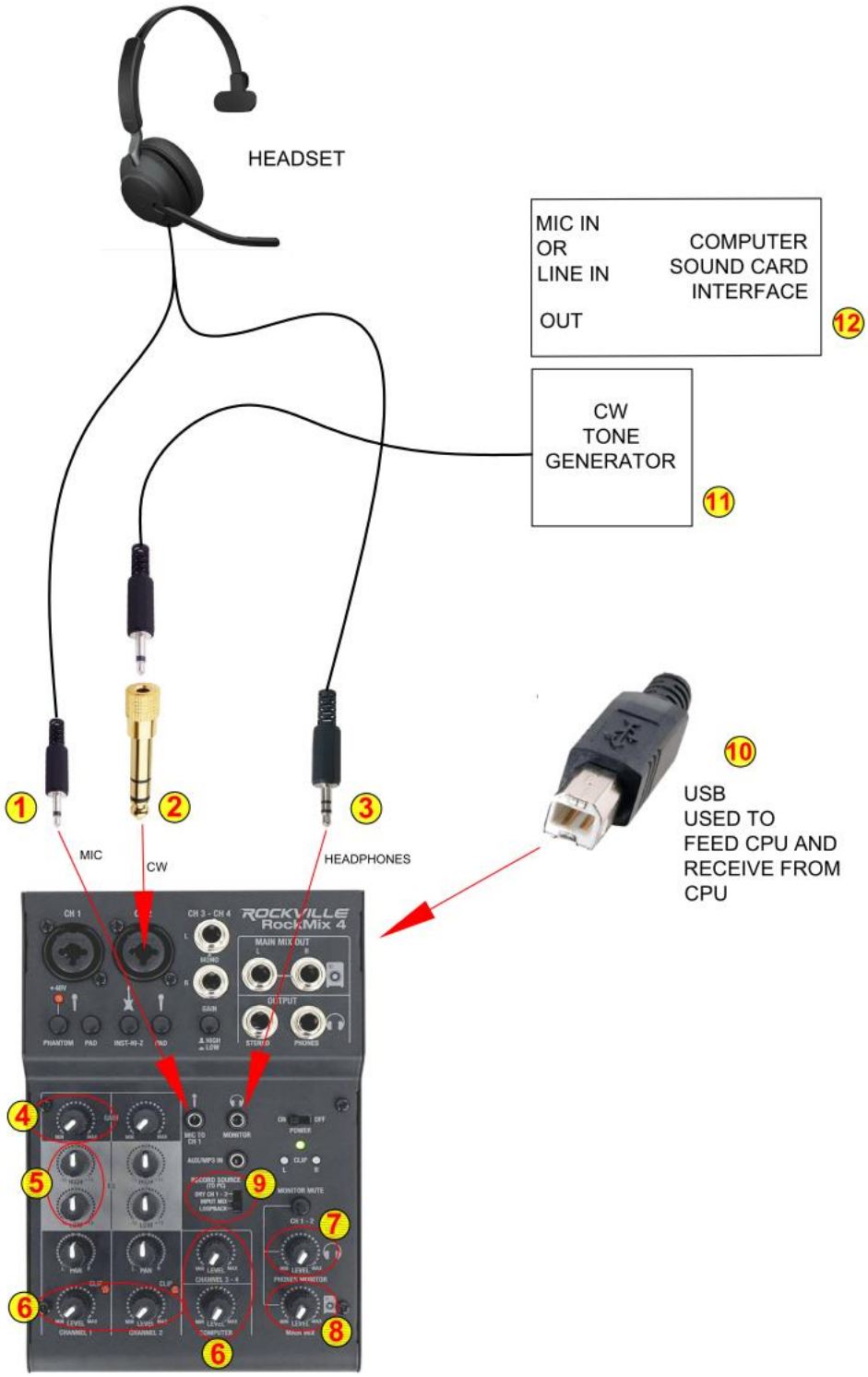
- DRY CH 1-2: Only sends channels 1 & 2 to the computer.
- INPUT MIX: Sends everything but the received computer audio to the computer. This is basically the "mix-minus" of scenario 1.
- LOOPBACK: Sends everything to the computer.

⑩ Computer sound card interface. We use both input and out to the computer.

⑪ CW tone generator with an audio output jack that produces a good sinewave signal (if available).

⑫ The computer analog sound card interface. Not used with this scenario.

Drawing A3

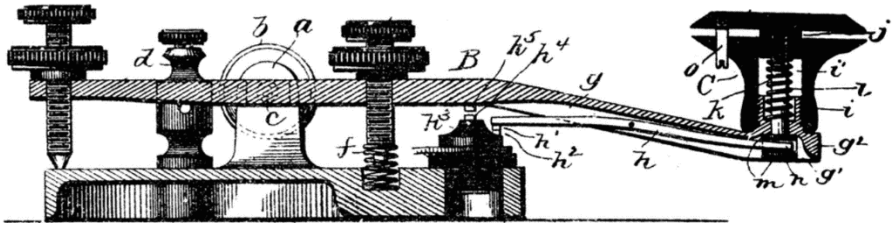

HEADSET
MIC IN
OR
LINE IN
OUT
COMPUTER
SOUND CARD
INTERFACE
12
CW
TONE
GENERATOR
11
10
USB
USED TO
FEED CPU AND
RECEIVE FROM
CPU
1
2
3
MIC
CW
HEADPHONES
4
5
6
7
8
9
ROCKVILLE
RockMix 4

Summary

Scenario – 1: Behringer Q802. Behringer's have the best mic preamps. This mixer scenario does not use USB connection at all but instead uses analog connections to your computer sound card. It offers the most versatility with the mix-minus bus but also requires the most cables. It is also the largest mixer.

Scenario – 2: Behringer Q502. Behringer's have the best mic preamps. This mixer scenario uses ½ of the USB connections (only to the computer) and uses Zoom's echo canceling to help with the feedback. It is smaller than the Q802 and uses less cables.

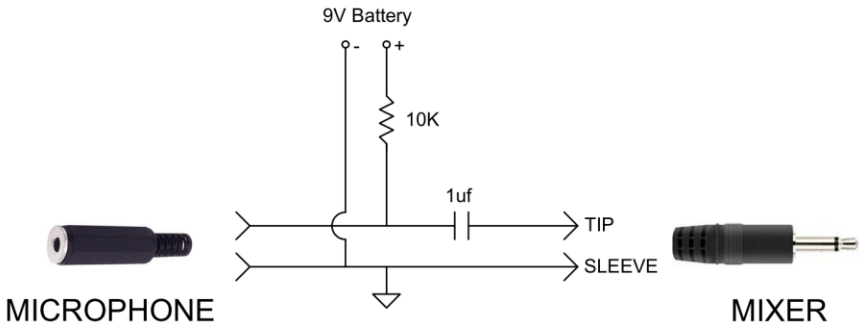
Scenario – 3: Rockville Rockmix-4. The mic preamp is a little noisy if turned up to high and does not offer the amount of gain the Behringer's do, but it still works. The smallest of the mixers uses the USB connections both ways (in & out). It has the magic switch to prevent the feedback that can occur on the USB connection. It also uses the least number of cables.



Battery Box

This is a simple way to add voltage to your condenser/electret computer microphone, build a battery box!

The values of the resister and capacitor are not exact. Experiment with these values so as to get the best performance and frequency response. When you are not using the Battery Box just unplug the microphone and that will act like an on/off switch.



If your headset has a single male TRRS  connector you will need a breakout for Mic and Phones. You can get one like this on Amazon.

NOTES:

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