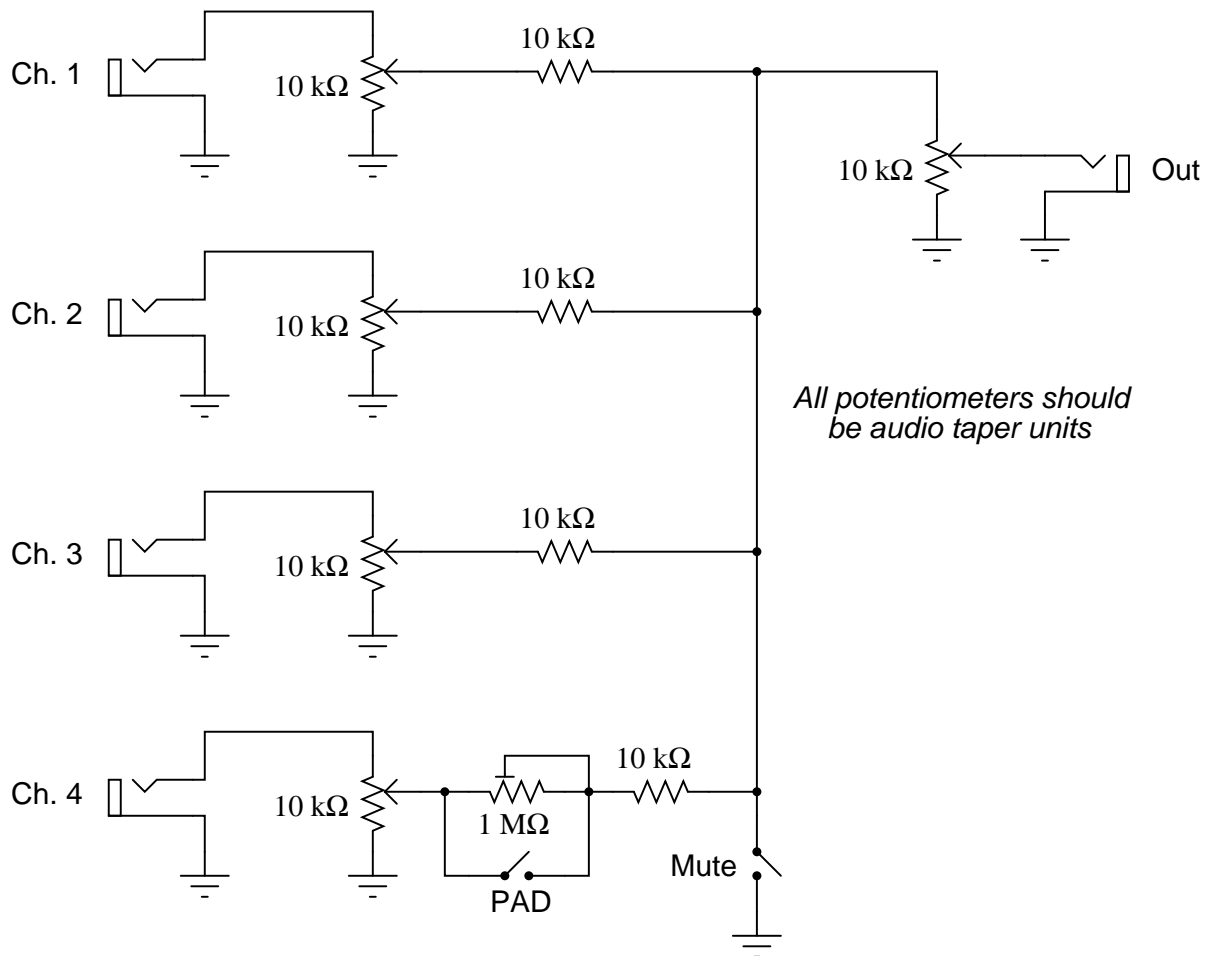


## Four-channel audio mixer

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Your project is to design and build a four-channel audio mixer, suitable for mixing four different audio-signal sources together prior to amplification (a bass guitar amplifier is recommended for this). Here is a sample diagram for you to follow when designing your system:



Of course, you are not restricted to using this exact design. Feel free to experiment with potentiometer values and additional features such as independent mute switches.

Deadlines (set by instructor):

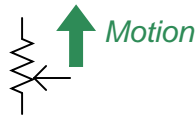
- Project design completed:
- Components purchased:
- Working prototype:
- Finished system:
- Full documentation:

## Questions

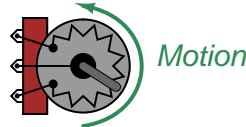
### Question 1

A very common misconception students have about potentiometers is the relationship between resistance and direction of wiper motion. For instance, it is common to hear a student say something like this, “Turning the potentiometer so the wiper moves *up* will increase the resistance of the potentiometer.”

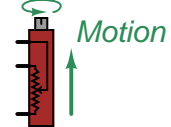
Schematic symbol



Internal view



Internal view



Explain why it does not really make sense to say something like this.

[file 03673](#)

### Question 2

Potentiometers are manufactured in two different "tapers": *linear* and *audio*. Linear taper potentiometers provide a direct, linear relationship between wiper position and resistance division, so that equal changes in wiper position result in equal changes in resistance. Audio taper potentiometers provide a non-linear (logarithmic, to be exact) relationship between wiper position and resistance division, so that the same amount of wiper motion at one end of its range gives a much greater change in resistance than at the other end of its range.

Linear taper



Audio taper



*This is not a real schematic symbol, but it graphically represents how an audio taper potentiometer is constructed.*

Suppose you have a potentiometer, but do not know whether it has a linear or audio taper. How could you determine this, using a meter?

[file 00338](#)

## Answers

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### Answer 1

Moving a potentiometer wiper changes *two* resistances in complementary directions: one resistance will increase as the other will decrease.

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### Answer 2

A linear taper potentiometer will exhibit resistance measurements between the wiper and the other two terminals, proportional to the wiper position.

## Notes

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### Notes 1

Ask your students to identify which resistance (which two connection points on the potentiometer) increases and which decreases, and how they know this from the "internal views" of the potentiometers. This is a very important thing for your students to learn.

Year after year of teaching has revealed that a great many students have difficulty grasping this concept. This is especially true when they become accustomed to using a potentiometer as a rheostat and not as a voltage divider. The more you can make them think carefully about the operation of a potentiometer, the better!

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### Notes 2

Discuss with your students the purpose of an audio taper potentiometer: to provide logarithmically proportioned increases in audio power for volume control applications. This is necessary for a "proportional" response when turning the volume knob on an audio amplifier, since human hearing is not linear, but logarithmic in its detection of loudness. In order to generate a sound that the human ear perceives as twice as loud, ten times as much sound power is necessary.

A challenging question to ask your students is *which way* an audio taper potentiometer should be connected as a voltage divider in an audio amplifier circuit. Being that audio taper potentiometers are non-symmetrical, it truly matters which way they are connected!