Episode Book

EPISODE #5718

How Far Can You Run RCA, XLR, and 3.5mm Cables?

PUBLISHED	4 October 2026 at 14:31 UTC
DURATION	20:12
LISTEN	myweirdprompts.com/episode/audio-cable-length-physics/
HOSTS	Corn, Herman, Hilbert
SCRIPT MODEL	deepseek-flash
VOICES	chatterbox-regular (chatterbox-local)
PIPELINE	V5.2
BOOK GENERATED	19 October 2026 at 17:39 UTC

SYNOPSIS

Ask ten sources how far you can run an RCA cable and you'll get answers from three meters to two hundred feet — a sixty-to-one spread. This episode digs into what actually limits cable runs: capacitance forming a low-pass filter with your source impedance, common-mode rejection in balanced lines, and the counterintuitive fact that loud line-level signals are harder to drive long distances than tiny mic signals, because current — not voltage — is the constraint. Along the way: why audio cables are not transmission lines, why a single article can contradict itself about the same connector, and the five variables nobody hands you in a table.

TRANSCRIPT



Corn

Daniel's looking at a PA speaker. It's got an RCA input, a 3.5mm input, and an XLR input that's meant for a microphone. And he wants to know how far he can run each one before it stops sounding right.



Herman

Which is a much harder question than it sounds.



Corn

That's the thing. He wrote in that even audio engineers he's met don't have an intuitive grasp of how long you can run RCA before you're rolling the dice on degradation. And he wants the balanced versus unbalanced question answered properly. What each of those options actually offers at different run lengths. He's framing it against the IEC and display cable conversations we've done before, the same way of thinking about where a cable stops being a cable and starts being a component.



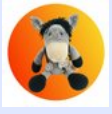
Herman

And the honest answer is that the numbers people quote are all over the map. You'll see ten feet for RCA from one source and a hundred and fifty feet from another. That's not a rounding error. That's two completely different claims about how the world works.



Corn

So let's dig into the physics and the practical guidance, and why the two often don't match.



Herman

Start with what the wire actually is. Unbalanced cable, so RCA, quarter-inch TS, 3.5mm, that's two conductors. You've got the center signal conductor and you've got the shield, and the shield is doing double duty as the return path. That means anything the shield picks up gets injected straight into your signal. There's no second copy of the signal to compare against.



Corn

Whereas balanced.



Herman

Three conductors. Hot, cold, ground. The hot and cold carry the same signal in opposite polarity. Any interference that hits the cable hits both conductors essentially equally, and at the receiving end the input stage subtracts the two. What was common to both disappears. That's common-mode rejection. It's not that balanced cable is magic wire. It's that the receiving circuit gets to throw away everything the two conductors agree on.



Corn

And the shield in a balanced cable isn't carrying signal at all.



Herman

Right. It's grounded, it's doing shielding, and it's not part of the audio path. That's the structural difference. Unbalanced has two jobs crammed onto one conductor.



Corn

So that's the noise story. But Daniel's question is about length, and length is a different mechanism.



Herman

That's where it gets interesting. The length limit isn't really about the cable rejecting interference. It's about capacitance. Every cable has capacitance between its conductors, distributed along the whole run. Typical figure is somewhere between a hundred and twenty and three hundred picofarads per meter. Cheap PVC-insulated cable sits up around three hundred. Polyethylene gets you down around a hundred and fifty.



Corn

And capacitance against what?



Herman

Against the output impedance of whatever's driving the cable. You've got a resistor on one end and a capacitor along the wire, and that's a low-pass filter. The cutoff frequency is one over two pi times source impedance times total capacitance. Total capacitance being capacitance per meter times length. So the cable doesn't have a frequency response on its own. It has a frequency response in the context of whatever is feeding it.



Corn

Which means "how long can I run this cable" is not a property of the cable.



Herman

Not even slightly. Change the source and you change the answer, with the same wire.



Corn

Give me the actual numbers, because I want to know how bad this really is.



Herman

Worst-case simulation that Tonestack published, and this is the pessimistic end. Ten meters of cable, three hundred picofarads per meter, driven by a six hundred ohm source. Attenuation at twenty kilohertz is zero point two one decibels. That's it. Twenty kilohertz is above what most adults can hear anyway.



Corn

So the ten-foot rule is not about treble loss.



Herman

Not remotely. And the table makes it clearer. With that same three hundred picofarad cable, a six hundred ohm source hits zero point one decibels of loss at seven meters, which is twenty-three feet. Half a decibel at sixteen meters, fifty-two feet. Now swap to a hundred ohm source, and you get zero point one decibels at forty meters, a hundred and thirty-one feet. Half a decibel at ninety-three meters. Three hundred and five feet.



Corn

Same cable.



Herman

Six times the length for the same loss, because the source impedance dropped by a factor of six. And if you use hundred and fifty picofarad cable instead of three hundred, you double all of those lengths again.



Corn

So a hundred-ohm source on good cable gets you past six hundred feet before you've lost half a decibel at twenty kilohertz.



Herman

Which is why the ten-foot rule is nonsense as a general statement. But here's the counterintuitive part, and this is where most people's intuition is actually backwards. Line level is harder to drive long than mic level.



Corn

Say that again.



Herman

Mic level is tiny. Minus sixty to minus forty dBu. A few thousandths of a volt. Line level is around a volt, roughly a thousand times stronger. Everyone assumes a bigger signal travels better. It doesn't, because the limiting factor for a line-level signal isn't voltage, it's



Herman (continued)

current. You have to charge and discharge that cable capacitance every cycle, and the higher your signal voltage, the more current that takes.



Corn

Slew rate.



Herman

EAW worked the numbers. A device outputting plus twenty-four dBu, which is about twelve point three volts RMS, driving three hundred feet of thirty-two picofarads per foot cable at thirty kilohertz, needs thirty-one milliamps to charge the cable. The device only supplies twenty-nine milliamps into a six hundred ohm load. So it can't. It slew limits. And slew limiting doesn't just roll off the top end, it generates high-frequency intermodulation distortion.



Corn

So the loud signal is the one that runs out of current.



Herman

With a ten kiloohm load you get about two hundred and sixty feet of usable length. With four ten kiloohm loads in parallel, two thousand five hundred ohms, it drops to two hundred and thirteen feet. Derate that by twenty percent for safety and you're at a hundred and seventy feet.



Corn

And the mic signal?



Herman

A hundred ohm mic on five hundred feet of thirty-two picofarad cable, minus three decibels at a hundred kilohertz. Comfortable. Swap in a six hundred ohm distribution amp output and the same five hundred feet collapses to seventeen kilohertz. That's audible.



Corn

Because the source impedance changed.



Herman

Same cable, same length, same signal level. Seventeen kilohertz versus a hundred kilohertz.



Corn

One more myth while you're at it, because I've heard people talk about audio cables as transmission lines.



Herman

They're not. Transmission-line effects kick in when the cable length approaches a quarter wavelength. At twenty kilohertz, a quarter wavelength is about two point three miles. Three point seven kilometers. Unless you're running a cable across a small town, you're not dealing with transmission-line behavior. You're dealing with an RC filter and a noise antenna.



Corn

Which is the part I keep coming back to. Daniel asked specifically about RCA and how long you can run it, and the answer isn't a number.



Herman

The frequency response of the cable on its own is meaningless. That's the direct quote from Tonestack, and it's correct. If you tell me a cable is ten meters long, I can't tell you anything useful. I need the source impedance, the capacitance per meter, the length, the load at the other end, and what's in the room around it.



Corn

Five variables.



Herman

And that's before we get to the practical guidance, which is a mess.



Corn

So we've seen the physics. Now let's look at what the practical guidance actually says, and why it's all over the map.



Herman

Kettner Creative says XLR is theoretically good for a thousand feet, three hundred meters, and RCA shouldn't be run more than ten feet.



Corn

Ten feet.



Herman

Three meters. AudioCalcs gives you a different set entirely. XLR around a hundred meters. Balanced TRS about twenty-five. Quarter-inch TS about six. 3.5mm TRS two to three meters. RCA five to six meters. HomeRecordingSetup says unbalanced starts losing highs past about twenty feet. Home Studio Guys says under fifteen to twenty feet for unbalanced, over a hundred feet for balanced is routine. Hosa says keep unbalanced under fifteen to twenty feet. And then Calendar-UK, in the same page, says both fifteen to twenty feet maximum and, quote, "Most RCA audio cables that are built reasonably well with shielding can be run effectively from one hundred to two hundred feet."

Corn

In the same article.



Herman

That's not a source with a view. That's a source that copied two paragraphs from two different places and never noticed they disagree.



Corn

So for RCA the published answers range from three meters to two hundred feet. That's a sixty-to-one spread.



Herman

And the reason is that there's no single dB-per-meter figure, because each cable class fails by a different mechanism. Unbalanced long runs fail by picking up noise and by creating ground loops. Long runs from a high-impedance source fail by treble rolloff. Long runs from a high-level source fail by slew limiting. Those are three different failure paths and they kick in at wildly different lengths.



Corn

So the limit is not a property of the connector.



Herman

The limit is a property of the system. Source impedance, cable capacitance, length, load, and the electromagnetic environment. Five variables. Nobody hands you five variables in a table because a table can't hold them.



Corn

Let's make that concrete, because I think people hear "five variables" and it stays abstract. Walk me through one specific setup.



Herman

Take a laptop with a 3.5mm output. Output impedance on those is often somewhere between fifty and a few hundred ohms, honestly it varies wildly and nobody publishes it. Say it's two hundred ohms. You run thirty feet of typical consumer RCA, call it two hundred



Herman (continued)

and fifty picofarads per meter, so about nine meters, total capacitance around two and a quarter nanofarads. Cutoff frequency comes out somewhere north of three hundred kilohertz. You will never hear that. The treble loss is not the problem.



Corn

So what is the problem?



Herman

The problem is that the laptop output is unbalanced, the shield is your return, and you've just laid thirty feet of antenna next to a power strip and a monitor. If there's a ground potential difference between the laptop and the speaker, that difference rides on the shield and shows up as hum. If there's a switching supply nearby, you get whine. None of that is on the capacitance table.



Corn

And if you swap the laptop for a cheap USB turntable with a high-impedance output?



Herman

Then the capacitance matters. High output impedance, say ten kiloohms, same cable, and now your cutoff is down in the audible range. You get the dull, closed-in sound people describe. Same thirty feet, same connector, completely different failure mode, because the source changed.



Corn

So the cable was never the variable that mattered.



Herman

The cable was one of five. The source is the one that flips the answer.



Corn

That brings us to the PA speaker scenario. What happens when you try to send line-level audio into a mic-level XLR input?



Herman

That XLR input on your PA speaker is almost certainly wired for a microphone. Mic level, minus sixty to minus forty dBu. And you want to feed it a signal from a phone or a laptop, which is line level, about a volt. That's roughly a thousand times stronger. Shure's guidance on this is blunt. Connecting a line-level source to a mic-level input produces sound that's loud and distorted, because the input simply isn't built to accept that much signal.



Corn

So it'll work in the sense that sound comes out.



Herman

Sound comes out. It just comes out clipped and ugly, and if the speaker has any gain staging on that input you may also be driving the preamp into clipping before the amplifier even sees it. The fix is a pad, an attenuator, a DI box, or a cable with resistors built into it. Something that knocks the level down before it hits the input.



Corn

And there's a second problem there, which is impedance.



Herman

There is. Best practice is that the input impedance should be seven to ten times the source impedance. A mic input is typically around fifteen hundred ohms. If your source is a guitar pickup at twenty to forty kiloohms, you're way outside that ratio, and what you get is a rolloff at both ends. Thin and dull. That's the classic problem a DI box exists to solve, because it presents a high impedance to the instrument and a low impedance to the mixer.



Corn

So for Daniel's speaker, the XLR input is the balanced path, which is what you want for a long run, but it's the wrong level.



Herman

Both things are true at once. The XLR input gives you common-mode rejection and it's the right electrical interface for distance. It's just expecting a signal a thousand times smaller than what you're sending.



Corn

So what's the actual recommendation?



Herman

If you're going more than a few meters, run a balanced XLR line and put a DI or an attenuator at the speaker end. If you're staying short, the RCA or the 3.5mm is fine, you're not going to hear any treble loss over three meters, and you avoid the level mismatch entirely.



Corn

The "right" answer depends on which failure you're more worried about.



Herman

Short unbalanced run, your risk is the environment, so keep it away from power cables and lighting rigs. Long balanced run through a DI, your risk is the source impedance and the current demand, so check what's driving it. Different problem, different solution.



Corn

Which gets us to the meta-question Daniel actually asked, which is why engineers don't have intuition here.



Herman

Because the guidance is environment-dependent and it's repeated without the math attached to it. Somebody reads "keep RCA under ten feet," repeats it, and it becomes folklore. Meanwhile the same person ran a fifty-foot RCA from a CD player to an amp for fifteen years and never noticed a problem, because a modern CD player has a low output impedance and there was nothing in the room radiating interference.



Corn

The folklore and the experience don't match, so neither one builds intuition.



Herman

Right. EAW's line on this is the most honest thing in the whole literature. "There are no shortcuts or rules of thumb. You need to do the math." And then, "Foolproof? Plug-and-play? Definitely not."



Corn

Which is a strange thing for a company selling audio equipment to write.



Herman

It's an unusually candid document. And there's a good reason it reads that way. The engineering answer is "it depends on five things," and the marketing answer wants to be "run it a hundred feet, it's fine." Those two positions can't both survive.



Corn

Daniel's instinct that this is confusing across subject areas is correct. It's not that the audio world doesn't know the answer. It's that the answer isn't a number.



Hilbert

I agree with all of that.



Corn

Good.



Hilbert

I had a boss at a small touring outfit who would not use an RCA cable longer than ten feet. He had a whole theory about it. Said anything longer would suck the life out of the highs. So what he did instead was chain four or five ten-foot cables together with barrel connectors whenever he needed to reach the PA. Which is thirty, forty feet of the same cable, just with more connections in it.



Herman

Did you tell him?



Hilbert

I was nineteen and he owned the van. I did what I was told and I coiled the cables at the end of the night.



Corn

The physics we just described never got tested, because he found a way to obey the rule and break it at the same time.



Hilbert

He was not a stupid man. He was a careful one. Someone had told him ten feet and he never had a reason to ask why.



Herman

What actually went wrong on those gigs?



Hilbert

Hum, mostly. We played a lot of places with bad power. One night the whole rig picked up a local AM station during soundcheck. Very faint, but you could hear a voice in the mains. We spent an hour swapping cables before we figured out it was the long run from the mixing desk. The shield was acting like an antenna and feeding the radio straight into the audio path.



Corn

Which is the mechanism the physics section underweights. Capacitance tells you about treble. It says nothing about what the cable picks up along the way.



Hilbert

The ten-foot rule isn't really about the treble. It's a rule about not having a long piece of wire lying around near lights and power amps.



Herman

That reframes the whole thing. The number everyone quotes is a horse-trading approximation of an environment risk, not a filter calculation.



Hilbert

We switched to a longer run with a transformer on it after that. Not because the treble improved. Because the radio went away.



Corn

The limit for unbalanced cable is often set by the room you're in, not by the wire.



Hilbert

You can have a hundred-foot run that's dead silent and a fifteen-foot one that hums. Depends what it's lying next to.



Herman

Which is exactly why the tables don't work. The number that matters is the one on the page, and the page is wrong half the time because it can't see the room.



Hilbert

I've still got the barrel connectors in a box somewhere. I don't know why I kept those.



Corn

If the limit is system-dependent, how's a listener supposed to evaluate their own setup? Nobody's going to sit down and measure their source output impedance on a Sunday afternoon.



Herman

Start with the source. If it's a modern phone, laptop, or a dedicated audio interface, the output impedance is probably low enough that treble loss over a reasonable run is a non-issue. Then ask what's near the cable. If it's running alongside mains wiring or a lighting dimmer, you've got a noise problem, not a capacitance problem, and the fix is routing or a balanced connection, not shorter cable.



Corn

If you can't move the cable?



Herman

Then you buy a DI. Which is cheaper than replacing a hundred feet of cable you've already run.



Corn

There's a version of this where the answer becomes a niche skill, though. Phones with headphone jacks are disappearing. Everything's going wireless or digital or over a network. Does any of this survive?



Herman

The physics doesn't care about fashion. Capacitance is capacitance. But the need to know it drops. If your speaker takes a Bluetooth or a network connection, the analog run is zero feet and the whole question evaporates.



Corn

Which means the people who still need to know this are the ones doing high-fidelity work, live sound, installs. The people who care about the last half a decibel at twenty kilohertz.



Herman

Those people are exactly the people who were never going to trust a rule of thumb in the first place.



Corn

Which is Hilbert's point, in a way. The mentor who chained ten-foot cables together wasn't wrong about wanting short runs. He was wrong about why.



Herman

He had the right instinct and the wrong model. Which is most of audio.



Corn

If you got something out of this one, a review wherever you listen helps other people find the show. Our producer is Hilbert Flumingtop. This has been My Weird Prompts, the human-AI collaboration podcast.



Herman

Email us at show at my weird prompts dot com. We'll be back soon.