

Lapel mics & the effects of Phase

by Chris North M.M.Inst.V

In this article I examine positive and negative phase mic signals and how they affect the nature of the sound produced by lavalier mics.



Many (probably most) two-wire electret microphones output their signal in negative (-ve) phase. These are the microphones most of us are familiar with, which terminate in a 3.5mm TRS plug.

In theory, it should not make any difference whether the sound signal is output in negative (-ve) or positive (+ve) phase, unless we have two or more microphones picking up some of the same sound source. That situation can cause 'phase cancellation' if one mic is out-of-phase with the other(s). But here I am talking about the change in the character of the sound that a single microphone produces when you switch from negative to positive phase.

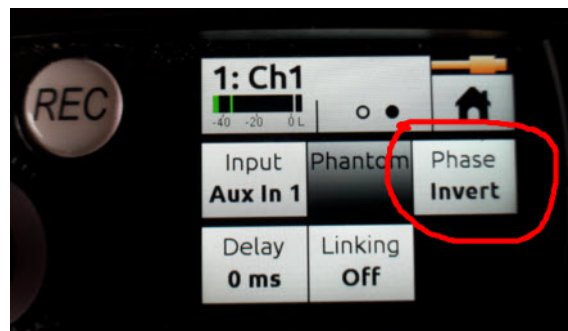
You will normally get a much nicer, fuller sound from a lavalier mic that produces positive phase signal, so we can often improve the sound of a lav mic by simply switching the phase from negative to positive. You can do this by engaging 'phase reversal' on your audio recorder or mixer or you can do it afterwards when editing (select Phase Reversal or Invert Phase).

What you hear is not always what you get

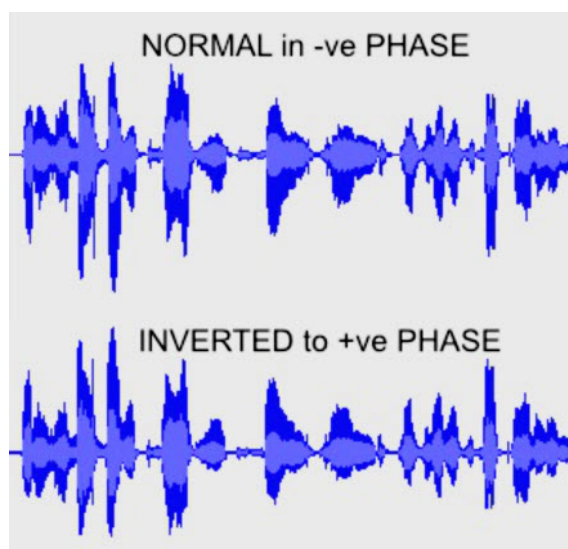
But how do you know whether your lav mic is producing a -ve or +ve phase signal? A quick test is to listen to your own voice in headphones as you speak and then switch in BASS CUT (the greatest amount you can). If the sound of your own voice gets DEEPER, (i.e. if the **Bass increases** when you apply **Bass CUT**) then the



Lavalier mics terminated with a multipin plug will output a normal positive phase signal



You can invert a negative phase signal to positive when you record or in your audio editing program afterwards



mic is outputting a negative phase signal. You have to do this test listening to your own voice live or you will not hear any difference. When you play back the recording the Bass Cut you applied will have reduced the Bass as you would expect. So beware, what you hear in your headphones is not always what you get! If you don't have the facility to do this live test then just reverse the phase of your recording in an audio editing program such as Audacity. If it sounds better inverted then your mic outputs a -ve phase signal. The difference is not as evident on loudspeakers.

Why do some lavalier mics produce a -ve phase signal ?

Not all two-wire mics produce a -ve phase signal. I have some that do and some that don't. It is a consequence of how the tiny IC 'amplifier' inside the mic capsule is configured. This amplifier has three terminals - one to bring in the power, one to take the audio signal out plus a ground terminal to complete the circuit. Two-wire mics have the source dropped to ground, which tends to produce a -ve phase signal on the power terminal.

If you invert the phase of a normal 'positive phase' mic it will probably sound harsher and thinner. Inverting the phase of a -ve output mic will usually improve the character of the sound it produces. So if your lav mic sounds a bit harsh (hard and stony) then give phase reversal a try. You can, of course, also fine-tune your signal with a bit of equalisation in the edit.

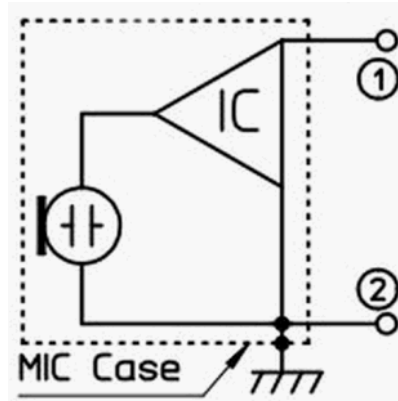
Three-wire and two-wire lav mics

Most mics terminated with a multipin connector utilise all three terminals of the amplifier and will produce a positive signal. Positive sound pressure on the microphone diaphragm will be reflected as a positive movement in the loudspeaker cone when it is played back.

You can convert a three terminal microphone capsule to work with a two terminal (two wire) input such as a 3.5mm jack socket, by simply connecting the source (audio signal) terminal to Ground. This changes the way in which the amplifier works - so it will output the audio via the power input - i.e. both audio-out and power-in are on the TIP of the jack. (The ring is not used unless to take a second audio channel or take

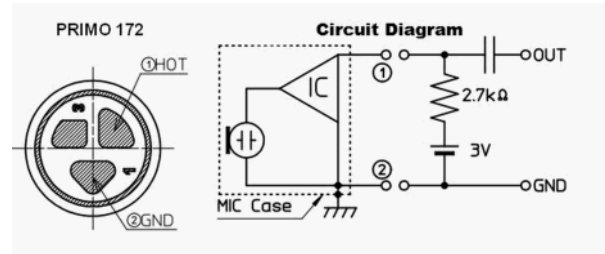


Three-wire mics terminate in a multipin connector

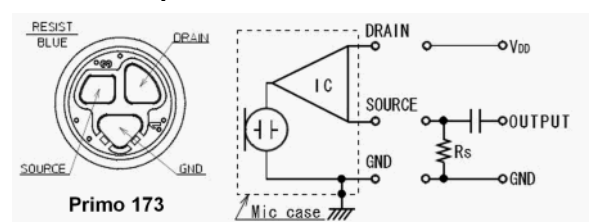


A 2-wire mic has the source connected to ground inside the mic capsule

A 2-wire output



A 3-wire output



the single output of one mic to both channels of a stereo input jack).

You can't, of course, get at the mic capsule in most lav mics because it is sealed in the mic housing but you can short the terminals at the plug end. I have made up an adapter cable to short the source to ground of my three-terminal Audio-Technica mics, which are terminated with three-pin mini XLRs, so that they can be temporarily converted to a two-wire (Tip and Sleeve) 3.5mm TRS jack plug. An important side effect of this configuration is that 'shorting' a three terminal mic capsule to work as a two terminal capsule increases its output (level) by about 10db. Now that can be very useful if you want to increase the sensitivity of your mic.

Hiss : Self-noise

One of the problems of very small diaphragm lavalier mics has always been hiss - the inherent noise generated by the internal circuit amp. *The cheaper the mic the louder the hiss* was the normal rule. But you can now buy quite inexpensive mic capsules which have extremely low inherent noise, with signal-to-noise ratios of up to 80db. That is a self-noise of only 14db, which is virtually silent. Compare this with some of the very expensive professional mics with S/N ratios of less than 70db. Of course it is not just a question of inherent noise; possibly of more importance is the actual tonal quality of the mic you seek - and its size, if it needs to be unobtrusive or concealed.

Low-noise Primo Mic capsules

I have been reviewing some of the low-noise Primo mic capsules and I am very impressed with their sound and extremely low inherent noise. The main downside is that the capsule housings are bigger than most modern miniature lav mics, but if you can live with a 10mm mic capsule in a 2.5cm housing then these are worth a look. You can build your own with capsules costing from about £6 to £35 or buy ready made. The Primo 172 Omni (2-wire) at around £12 for the capsule or £35 ready built, is superb, with a very flat frequency response and an incredible S/N ratio of 80db. There is also a 3-wire version, the EM173. The Cardioid 264 (S/N 74db) at around £15 is also excellent for speech, with a bass roll-off dropping to -10db at 80Hz. See <https://micbooster.com/>



Converting a 3-wire connected mic to 2-wire will produce a 10db increase in gain - but usually at the expense of turning the signal into a -ve phase signal



Inexpensive Primo mic capsules have very low self-noise

Share your thoughts and experiences

Have you experienced these strange effects ?

- Bass Cut boosting Bass when you listen to your own voice via mic and headset?
- The tone of a mic changing when you change from -ve to +ve phase ?
- Do you have a lapel mic that sounds a bit harsh and stony ?

[Share your experiences.](#)

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YouTube Review

If you are interested in hearing these capsules have a look at my YouTube review which also demonstrates the difference between +ve and -ve phase sound from these mics compared with the professional (and much more expensive but smaller) Sanken Cos11x.

<https://www.youtube.com/watch?v=svpVQBr5nul&t=1s>