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PHANTOM POWER EXPLAINED

If you're new to the audio scene, let's start with a few basic electronic concepts then move on to Microphones and see how all of the connections are made, audio and phantom power.

Before taking the time to understand Phantom Power, let's look at the specs so you have a better understanding of why your microphone or direct box might not be working.

Answers to Frequently Asked questions...

- The Phantom Power spec is 48 volts dc from a standard 3-pin XLR connector.
- Phantom Powered microphones have a wide operating range, from 9vdc to 48 vdc.
- Some console / mixer manufacturers take advantage of the above range by not supplying the full 48-volts. They do this because it is easier and cheaper.
- Computer microphones that use a mini 1/8-inch (3.5mm) phone plug do require power, but not phantom power. No simple adapter will make these microphones work in a pro system.
- The power supplied by the computer / sound card to the 1/8-inch (3.5mm) jack not configured to power professional microphones (or powered direct boxes).

AC/DC

What's that you say? You don't know your AC from your DC? Audio is considered an Alternating Current, a.k.a. "AC." (So is 120-volt "wall" power.) But electronic circuits need Direct Current (DC) to turn them on, from batteries or power supplies. Like a speaker in reverse, a dynamic microphone consists of a coil of wire suspended in a magnetic field. When vibrations move the cone or "diaphragm," the energy stored in the magnet is transferred to the wires. (A Dynamic microphone is ***passive*** and needs no power.)

A DEDICATED SUPPLY

The preamplifier inside Vacuum Tube microphones requires both plate and filament voltages. Power and audio are delivered via special, multi-conductor cables and non-standard connectors from a dedicated power supply. Only then does the mic-level signal appear at a standard three-pin XLR connector. Transistorized microphones require much less power and can operate from a battery, hence the idea for phantom power, a system of distributing a DC voltage through a standard microphone cable. All condenser microphones (except electrets) requires a fairly large, but low current DC polarizing voltage that is applied to a diaphragm — similar to a drum head, but thinner and plated with a molecularly thin conductive layer that is typically gold. The signal is not strong enough to venture into the outside world without an internal buffer / preamp (active electronics) that also requires power.

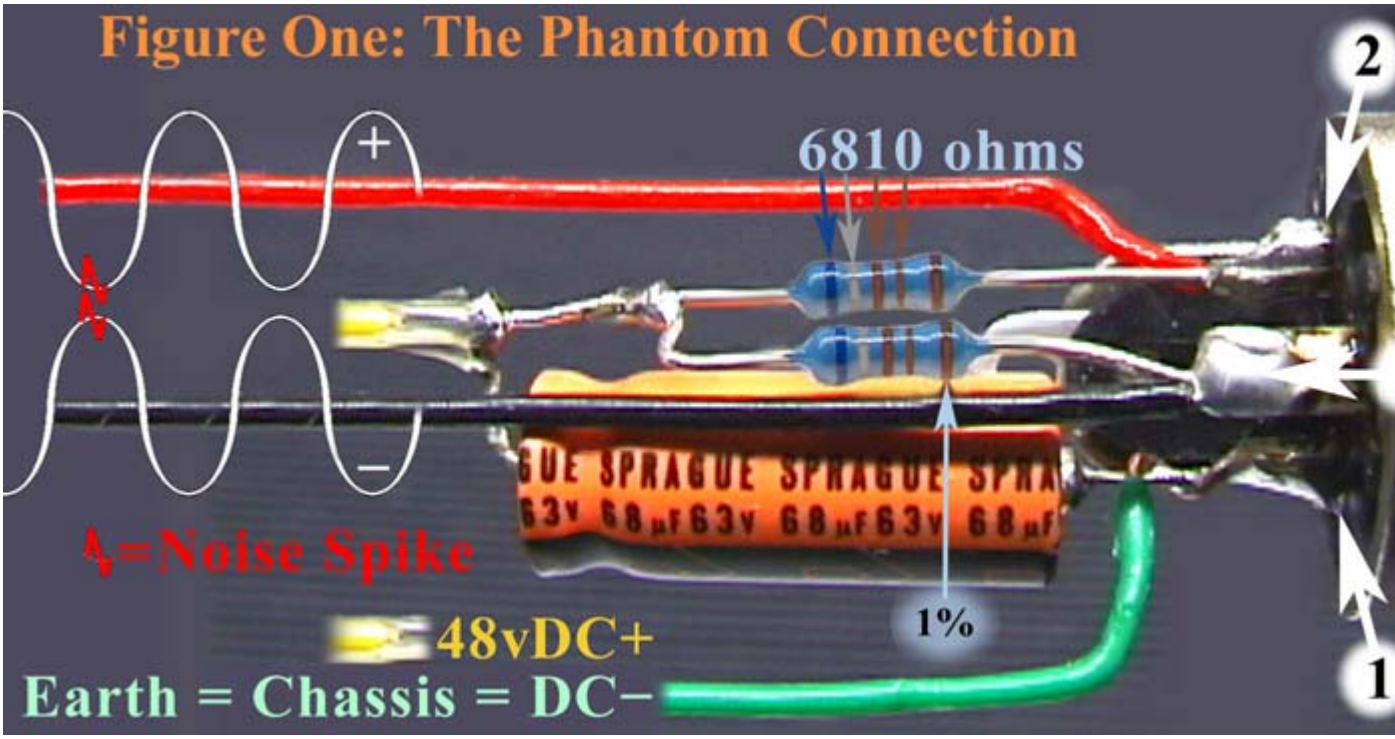
A BALANCED BREAKFAST

Compared to both consumer (-10dBV) and professional (+4dBu) Line levels, Microphones produce a signal that can be considerably lower in level, hence the need for an external preamplifier. Every precaution is taken to minimize noise. By design, this begins with using two wires for the signal — referred to as "balanced" — ***plus*** a shield. Contrast this with a ***passive*** electric guitar — that is, one with no ***active*** internal electronics (i.e., a battery is required). A guitar cable uses a single conductor plus a shield, an***unbalanced*** signal.

PHANTOM POWER: First you see it, then you don't

The rear of a Female XLR is shown in **Figure One** with a Red wire on Pin-2 and a Black wire on Pin-3. Pin-1 is called "ground" and the reference to terra firma implies that the metal body of the microphone will

ultimately connect to the "earth" and is therefore safe to touch even if you are barefoot in a pool of water (the Green wire). A good ground connection also improves noise immunity.



HOT AND COLD

In most cases, a "balanced" signal appears on both pin-2 (hot) and pin-3 (cold.) "Hot and cold" refer to Polarity, plus and minus (+ and —), respectively. As you can see on the left side of **Figure One**, the same signal appears on pin-3 with reverse-polarity, that is, 180 degrees "out-of-phase." Even though the AC signal is constantly changing, it is important to establish a reference, in the same way that a loud speaker has "polarized" terminals. A kick drum creates air pressure that moves the microphone diaphragm, generating a positive going voltage on pin-2. After trips to and from all of the processing and recording gear you can imagine, a woofer should recreate that same in-your-face gust of air. (Only better, of course!)

HOT STUFF

With properly designed balanced gear, output polarity equals input polarity, so it doesn't matter whether Pin-2 or Pin-3 is designated as "hot," so long as the input and output wiring is consistent — with regard to polarity — throughout your system. You will occasionally have to interconnect unbalanced gear, in which case the tip (of a quarter-inch plug) or the center-pin (of an RCA connector) are always "hot." **However, be very careful when interfacing unbalanced gear that uses XLR connectors.** If one is designated pin-2 hot and the other as pin-3 hot, all you will get is ***NOT!***

LOW, SEE?

A microphone's source impedance is 200 ohms (W). Speakers are lower at 4W , 8W or 16W , but a Professional "lo-Z" microphone is optimized to drive a long cable without signal degradation. This is in direct contrast to a passive electric guitar, which is an unbalanced, hi-Z device that is susceptible to every snap, crackle and pop technology can generate.

Please Note:

The built-in preamps in modern condenser microphones do not necessarily produce signal on pin-3, but the impedance of pin-3 must match that of pin-2 for noise immunity.

FEELING REJECTED

Two (identical but) out-of-phase signals do not combine on a mixer, they cancel. A Mixer, by nature, "sums" all of the channels together. But subtracting a balanced signal — by using a "differential" input amplifier (active) or a transformer (passive) — generates two results. First, the audio signals "add up" instead of cancel. Second, any noises common to pin-2 and pin-3 (like the red "spike" in **Figure One**) are left behind. "Common Mode Rejection" is the term used to describe how well a preamp can ignore the fact that you ran a microphone cable right next to a wall wart. Try that with a guitar cable!

TRANS-SENSUAL

A vintage preamp is ***not*** likely to have phantom power because either dynamic microphones were used or the condenser microphones of the day had their own external supplies. In addition, you will occasionally run into a piece of gear with a quarter-inch microphone input. To connect a balanced dynamic microphone, you will need a transformer/adapter, microphone phantom power pack (MPPP).

DON'T BE SCARED

Though miniaturization started before "solid state" electronics, transistorized circuitry ushered in a new era of devices whose power requirements were considerably lower than their vacuum tube counterparts. Older versions included a "window" in the case to expose a meter that indicated the presence of either the internal Battery or the "external" Phantom power.

Battery operation implies that very little current was required. That a system was devised to send power down a standard microphone cable was even more clever. Quite simply, +48 volts DC is piggybacked on top of both AC signals — on pin-2 and pin-3 — via two resistors, without disturbance. (This is the "Phantom" signal.) The negative or "return path" to the DC supply is connected to pin-1.