

Phantom Power and Bias Voltage: Is There A Difference?

Many users of professional audio equipment believe there is no difference between phantom power and bias voltage. Not true! Phantom and bias are not interchangeable. This bulletin explains the differences between phantom and bias, and addresses common misconceptions.

Phantom power is a dc voltage (11 - 48 volts) which powers the preamplifier of a condenser microphone. Phantom power is normally supplied by the microphone mixer, but may also be supplied by a separate phantom power supply. Phantom requires a balanced circuit in which XLR pins 2 and 3 carry the same dc voltage relative to pin 1. So if a mixer supplies 48 volts of phantom, XLR pins 2 and 3 of the microphone cable each carry 48 volts dc relative to pin 1. Of course, the mic cable carries the audio signal as well as the phantom voltage.

Mixers that supply phantom power contain current limiting resistors which act as control valves. If the microphone or cable is improperly wired, these resistors limit the flow of current to the microphone and thereby prevent damage to the phantom supply circuit.

A balanced dynamic microphone is not affected by phantom power. However, an unbalanced dynamic microphone will be affected. Although the microphone will probably not be damaged, it will not work properly.

Bias is a dc voltage (1.5 - 9 volts typically) that is provided on a single conductor.

Unlike phantom power, bias does not require a balanced circuit. Bias supplies power to a Junction Field Effect Transistor (JFET) connected to the output of an electret condenser mic element. The JFET acts as an impedance converter which is a necessity in any microphone design that uses a condenser element. A condenser element has a high output impedance (>1,000,000 ohms). The JFET input loads the output of the condenser element with an even higher impedance (>10,000,000 ohms) to minimize loss of signal level. Also, the JFET output provides a low source impedance <1,000 ohms> to feed the microphone preamplifier.

In some condenser microphones, the bias voltage must be supplied on the same conductor as the audio. Condenser elements with a built in JFET use this configuration and employ a single conductor, shielded cable. Other condenser microphones utilize separate conductors for bias and for audio. Consult the manufacturer's data sheet to find out the exact wiring configuration.

A dynamic microphone should not be connected to an input that supplies bias voltage (such as a wireless transmitter) because the audio and the bias voltage will travel down the same conductor. If this occurs, the frequency response of the microphone may be altered or the audio signal distorted. If a dynamic microphone must to be connected to an input with bias voltage, a blocking capacitor must be used. The blocking capacitor is placed in series with the hot conductor of the microphone. The capacitor passes the audio that is present on the hot conductor while blocking the dc bias voltage. The capacitor must have enough capacitance to pass the audio signal without degradation. The exact value depends upon the electronic characteristics of the microphone circuit and must be calculated for each situation.

Remember, in a typical electret condenser microphone, it is the JFET that requires unbalanced bias and the preamplifier that requires balanced phantom power. Therefore, a condenser microphone that requires phantom power will not work with an input that only supplies bias, e.g. a wireless transmitter.

Once again: phantom and bias are not interchangeable!