Electret Microphone 2-Wire Connections

Conventional 3-wire connection

Sierra Peaks Tibbetts Corporation's 15x, 25x, and 35x series sub-miniature microphones are designed for 3-wire connection in low voltage applications, typically operating with a supply voltage of 1.3 volts. This configuration uses one wire each to connect the microphone signal output, supply, and ground (or common) terminals to the outside circuit. The commonly used color scheme for cabled microphone assemblies is red for supply, white for signal, and black for ground.

A low-pass filter consisting of a capacitor and a resistor can be used on the supply line in the connecting circuit to make the microphone pre-amplifier less susceptible to power supply disturbances. Figures 1 and 2 below show the microphone and a 3-wire connection with power supply filtering. The resistor R1 in Figure 2 should be chosen such that the voltage drop across R1 does not appreciably reduce the operating voltage of the microphone pre-amplifier circuit.

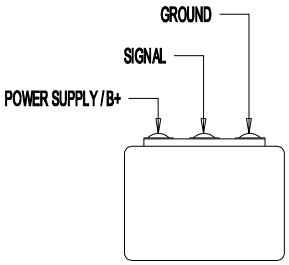

Figure 1. Microphone input / output terminals

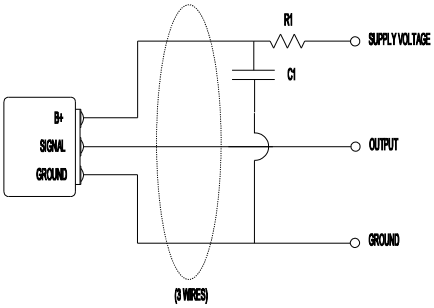

Figure 2. Microphone 3-wire connection

Modified wiring using 2-wire connection

These microphones may also be wired for operation using only 2 wires in several different configurations, some of which will be described below. Altering the standard connection to the microphone changes the operating characteristics of the microphone pre-amplifier, and thus alters the performance of the microphone. For each of the configurations described below, an external resistor is needed.

2-wire option A

In this configuration, shown in Figure 3 below, the additional resistor is connected to the ground lead of the microphone, which is where the output signal is taken from. The output terminal of the microphone is left unused (no connection), and the supply terminal receives the power supply voltage. The current drain of this circuit is the same as in the 3-wire configuration (approximately 20µamps for most models) as the biasing of the pre-amplifier is unchanged. The output signal from the microphone connected in this manner is of the same phase as that of the 3-wire connection.

Sierra Peaks Tibbetts - 5 Colcord Ave - Camden, ME 04843 USA ph: 207.236.3301 fx: 207.236.3303 www.sierra-peaks.com

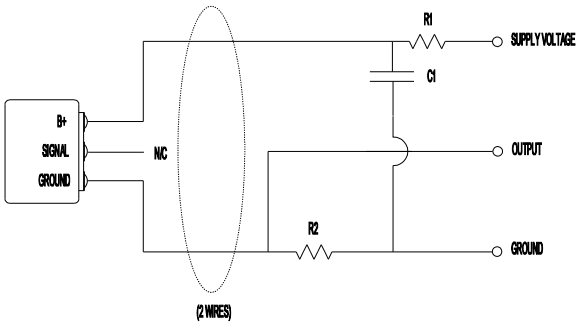

Figure 3. Microphone 2-wire connection option A

Component Selection

This configuration separates the microphone case ground from the ground of the connecting circuit which limits the voltage supplied to the microphone pre-amplifier. Care must be taken in the selection of resistor R2 for this reason, and for low voltage applications (supply voltage of ~1.3V), R2 should not exceed 10kΩ. For larger operating voltages of up to 10V, the suggested range of values for R2 is 10kΩ to 250kΩ.

Microphone Specifications

The gain of the microphone pre-amplifier is diminished compared to that of the standard method of connection, and as such the microphone sensitivity will also be decreased. As the value of R2 is increased, the microphone sensitivity will begin to approach that of the 3-wire connection. For a Sierra Peaks Tibbetts model 251-01 microphone, using a 5V supply and a value of 50kΩ for resistor R2 connected as shown in Figure 3, the microphone sensitivity is decreased by 3dB compared to the standard 3-wire connection.

The power supply feedthrough is decreased in comparison to the 3-wire connected microphone, although as the value of resistor R2 increases this figure approaches that of the standard connection. The major drawbacks of this particular connection are the decrease in sensitivity and the separation of the case ground from the circuit ground. There is an increased risk of feedback with this circuit because the ground of the microphone is not tied to that of the rest of the circuit.

Phantom powered 2-wire connections

The configurations described above use a separate line for the power supply voltage, isolating it from the other terminals. These microphones can also be powered by "phantom power," which is simply supply voltage that reaches the microphone through a signal line. In the following configurations, the microphone pre-amplifier is connected to the power supply through the same line the output signal is sent through. The microphone output signal for these 2-wire connections is reversed in phase compared to the standard 3-wire connection.

2-wire option B

One option for connecting a microphone in a 2-wire phantom powered configuration appears below in Figure 3. The microphone signal terminal is left unused (no connection) and the output is taken from the supply terminal. Power to the pre-amplifier is fed through the resistor R3 which is also connected to the

supply terminal. The current drain of this circuit is the same as in the 3-wire configuration as the biasing of the pre-amplifier is unchanged. It is important to note that R3 should not be so large as to impede normal circuit biasing and operation.

2-wire option B (cont.)

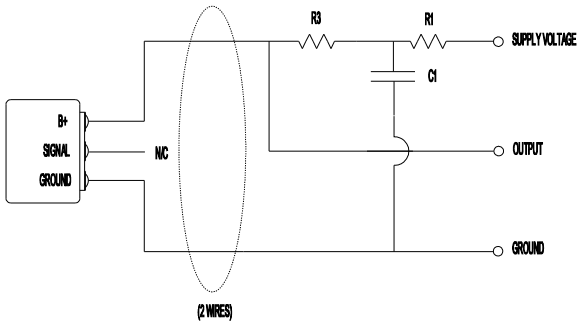

Figure 4. Microphone 2-wire connection option B

Component Selection

The value chosen for resistor R3 depends heavily on the supply voltage used to power the microphone. In order to reduce the sensitivity of the microphone to acoustic levels that may overload the output and to maintain the correct biasing of the circuit, R3 should be chosen to bias the output signal level at roughly half the supply voltage. Typical values of R3 are on the order of 5kΩ to 250kΩ using voltage supply levels of 1.3V to 10V.

Microphone Specifications

The gain of the pre-amplifier circuit increases with larger values of R3, and subsequently the sensitivity of the microphone increases as well. However, lower values of R3 (~5-10kΩ) can actually decrease the microphone sensitivity to below that of the 3–wire connection. For a Sierra Peaks Tibbetts model 251-01 microphone, using a 5V supply and a value of 100kΩ for resistor R3 connected as shown in Figure 3, the microphone sensitivity is increased by 6dB compared to the standard 3-wire connection.

The A-weighted noise of the microphone connected in this manner is slightly larger than that of the 3-wire connection, although the increased sensitivity of the microphone allows for a higher signal-to-noise ratio to be achieved. The power supply feedthrough decreases as R3 is increased, offering another improvement over the conventional method. The output impedance of the microphone is also increased by the addition of R3, ranging from about 7kΩ to 25kΩ using the previously mentioned values of R3. This increase in output impedance places further limitations on the minimum load that the microphone can drive, above those seen in the 3-wire configuration.

2-wire option C

This phantom powered 2-wire configuration also requires only one resistor in addition to the components needed for 3-wire operation, although the supply terminal of the microphone is connected to ground as shown in Figure 4 below. Resistor R4 connects the power supply to the signal terminal of the

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microphone, which is now used as the pre-amplifier output. This type of connection to the microphone biases the preamplifier circuit differently, and as a result the drain current is much higher (on the order of 400-500µamps).

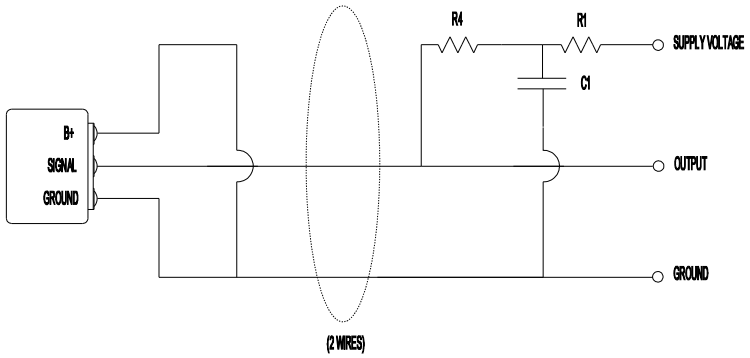

Figure 5. Microphone 2-wire connection option C

Component Selection

As for the previous 2-wire connection, the power supply voltage level is important in determining the value chosen for resistor R4. This component value should also be chosen to bias the microphone output at around half the supply voltage level to insure proper operation. Typical values for R4 are on the order of 1kΩ to 10kΩ using voltage supply levels of 1.3V to 10V.

Microphone Specifications

The results of this method of 2-wire connection are similar to that previously discussed, in that increasing the value of resistor R4 has the effect of improving the sensitivity of the microphone. As compared to the previous 2-wire connection, the added drain current allows for higher microphone sensitivity using much smaller resistance values. For a Sierra Peaks Tibbetts model 251-01 microphone, using a 5V supply and a value of 5kΩ for resistor R4 connected as shown in Figure 4, the microphone sensitivity is increased by 6dB compared to the standard 3-wire connection.

The A-weighted noise of this connection is the highest out of the three, at roughly 2-3 times that of the 3-wire connection. The power supply feedthrough of this connection decreases as resistor R4 is increased, to levels similar to those of the previous phantom powered 2-wire connection. The output impedance is lower than that of the previous connections (~1.5 kΩ), and the range is not as large as the previous 2-wire connection due to the limited range of resistance values for R4. The lower output impedance of this configuration allows the microphone to drive a wider range of loads than the other 2-wire connections. This configuration is also recommended over the others for applications involving distance, as it can drive the longest length of cable of the 2-wire connections discussed here, again due to the low output impedance.

For additional information:

Sierra Peaks Tibbetts
5 Colcord Avenue
Camden, ME 04843

ph 207.236.3301
fax 207.236.3303