



Tech Note 10 Microphone Amplifier Design, or, Why Does my C715/e22S have such a low output?

The electronics of a DC-polarized condenser microphone have a seemingly simple job: to take the output of the capsule and its charging circuit, and reduce the impedance enough so that practical cables may be used between the mic and the next audio stages. The problem is that microphones are mostly operated on internationally-standardized phantom power, which sets some hard limits on the amount of power available for such a circuit.

Modern sound recording requires a very wide dynamic range – it's not possible to preserve the lowest noise floor along with a high overload point to handle the loudest sounds. The required dynamic range is over 120 dB. With careful engineering, the microphone capsule can be made to handle this whole range, but the active circuit that carries the signal to the recording equipment has limits due to the limited power available. So, we have developed two different basic designs in our microphone electronics: a transformerless circuit that produces the cleanest sound possible but only to moderate sound pressure levels, and a circuit using a special transformer that can handle higher sound pressure by stepping down the high signal levels by a ratio of about 5 to 1. The transformerless circuit has a gain of about 1.5, so the difference between transformer and transformerless designs is little more than 9, or almost 20 dB, which is about the difference between the sensitivity of the two families of microphones. There are other differences too, of course, as the capsules are also different. The transformerless circuit is used in the C700, C716, C617 and in a simplified form in the C42. The transformer circuit is used in the e22S and C715.

Normally, microphone makers try to cover all sensitivity requirements by adding a “pad” or attenuator to reduce the signal level for loud sounds. Resistive pads can be added at the microphone preamp or inline with the cable, but microphone designers are typically constrained by the limits of phantom power and often need to incorporate pads inside the microphone itself to assure freedom from distortion, particularly with long microphone cables. For condenser microphones, capacitive pads used as part of the electronics may produce unacceptable changes in microphone performance, (distortion or frequency response) so we have chosen to implement two different circuit designs – one for high level signals and one for lower.

The challenge is to be able to accept a high signal level from the microphone element, while delivering enough audio current to the microphone line that cable capacitance and preamp loading don't have a major impact on the sound. The Josephson C715 addresses this challenge by using a custom Lundahl step-down transformer in the audio output. This reduces the signal *voltage* by about 14 dB, but likewise increases the *current* available to drive the microphone line. Even high level, high frequency signals can be handled cleanly without requiring more current than phantom power can supply. Users should select low noise precision preamps to preserve the low noise characteristics of the C715.

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