Benefits and Limitations of CCP Preamplifiers and Prepolarized Microphones.

The CCP[1)] principle is a two-wire system using one wire for both the constant current supply and the signal.
In the late 1960's CCP was first implemented in piezoelectric transducers (i.e. accelerometers, force sensors, pressure sensors) to save cable cost and improve accelerometers' ability to drive long cables, but the quality of the micro-electronics was poor.
In the 1980's, the quality of the micro-electronics used within CCP sensors had improved to the level of traditional laboratory charge amplifiers. Comparisons between CCP and charge mode were based upon the simplicity, low impedance output and low cost of CCP systems against the high temperature and flexibility of charge systems.
In the 1990's simple preamplifiers for acoustic test and measurement were introduced, which enabled relatively low cost systems taking advantage of the input systems developed for the accelerometer technique. Until recently (within the last 5 years) microphones using CCP preamplifiers have not been able to reach the same specifications as the traditional acoustic preamplifiers, and the selection of precision prepolarized condenser microphones were limited to a few ½" models.

Today the G.R.A.S. CCP preamplifiers are having the same excellent specifications as our traditional preamplifiers except for the upper dynamic range. The CCP principle is limited to an output voltage swing of approx. 8 to $10V_{peak}$, where the traditional preamplifier limit is more than $50V_{peak}$. (with ±60V or 120V supply voltage)
On the microphone side, G.R.A.S. was the first in the world to introduce high precision prepolarized ¼" microphones and has just released a $^1/_8$" prepolarized microphone. So today we can offer most of our traditional microphone models in both $^1/_8$", ¼" and ½" in prepolarized versions.

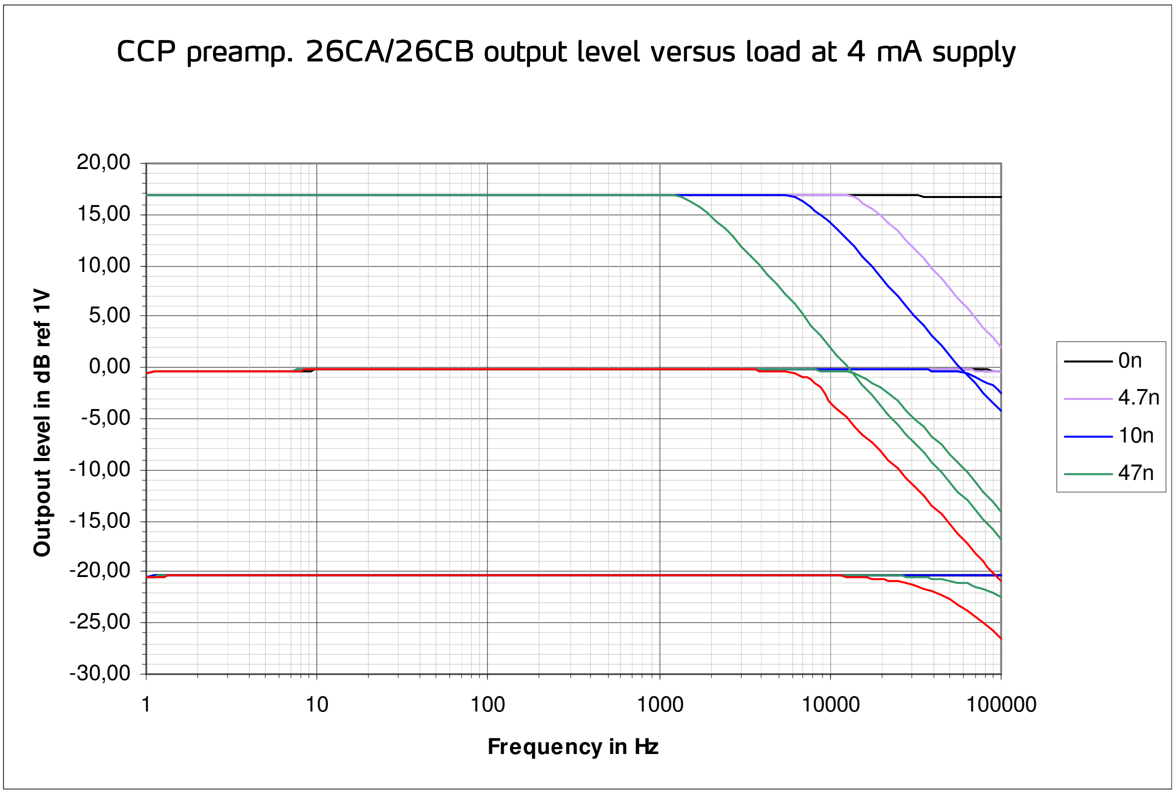
CCP benefits:

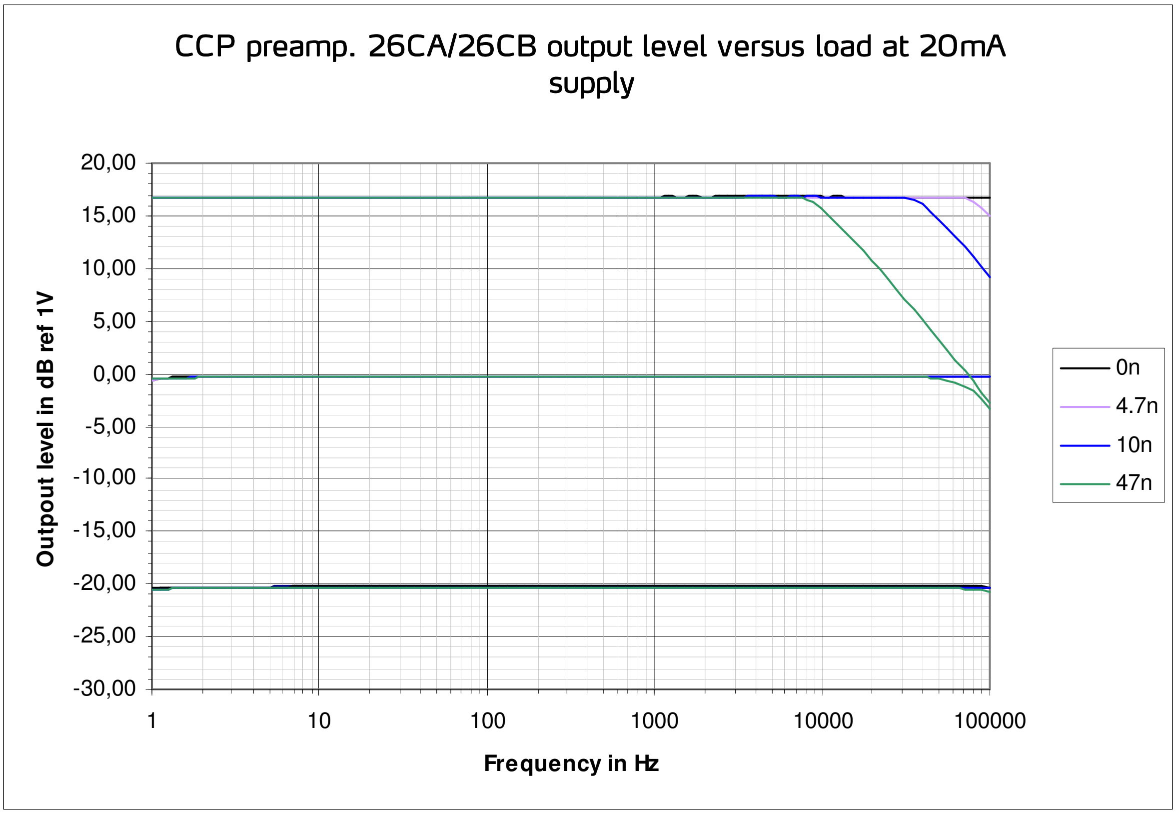
Preamplifiers cost less than traditional preamplifiers, power supply for CCP is very simple and inexpensive (commonly built into acquisition front ends), because there is no need for 200V polarisation voltage and 120V supply. Additionally, cabling is significantly less expensive, because it uses standard coax cable and either BNC, 10-32 Microdot connectors or SMB connectors rather than 7-conductor cabling with expensive LEMO connectors.

CCP limitations:

Dynamic range is limited due to the smaller output voltage swing and prepolarized microphones cost slightly more. Effectively, with only an 8 volt swing, the upper limit of the amplitude range for the microphone/preamplifier pair is limited by the CCP preamplifier (rather than the microphone itself) by approximately 8 dB. Therefore, a 50 mV/Pa ½" high sensitivity microphone (rated to 146 dB) would be limited to 138 dB. Lastly, precision prepolarized microphones are slightly more expensive than externally polarized microphones due to the additional manufacturing and aging processes, but overall the cost savings of CCP significantly outweigh this.

[1)]CCP (constant current power) is the same as IEPE (Integrated Electronic Piezo-Electric) and CCLD (Constant Current Line Drive) and is compatible with many other constant current driven products such as Deltatron®, Isotron, etc.





Rule-of-Thumb:

Equation: I = 8.88 * 10e-6 * C * f * V   I(mA),C(pF), f(kHz) and V(V)

CCP Power Supply and Dynamic Range

The dynamic range for a preamplifier or transducer depends on the CCP (or IEPE) power supply voltage and the transducer DC offset.

The supply voltage (also called compliance voltage) is determined by the input module to which the transducer is connected. This will normally be in the range from 14 V to 30 V.

The compliance voltage from the source delivers a constant current to the transducer. The transducer is designed with a certain DC offset, normally in the range from 8 V to 14 V.

The specific combination of compliance voltage input from the input module and the transducer offset voltage determines the upper limit for the dynamic range.

In fig 1 is shown a combination of a preamplifier (or transducer) with a 14 V DC offset and an input module with 28 V compliance voltage. As the signal will swing around the DC offset of the transducer, the signal can swing from 0 V up to 28 V compliance voltage, i.e. +-14 V signal voltage swing.

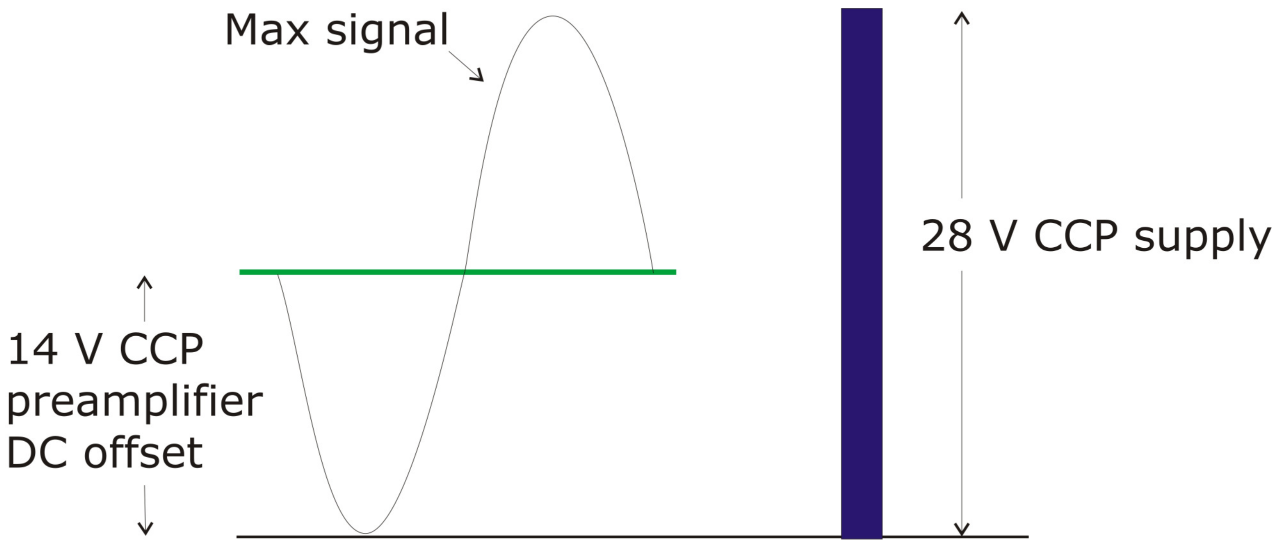


Figure 1: Transducer with 14 V DC offset and input module with 28 V compliance voltage.

In fig 2 is shown a combination of a preamplifier (or transducer) with a 14 V DC offset and an input module with 20 V compliance voltage. As the signal will swing around the DC offset of the transducer, the signal can swing from 0 V up to the 20 V compliance voltage, i.e., +6V and -14 V signal voltage swing. For a symmetrical sine signal this limits to a +-6 V signal voltage swing range.

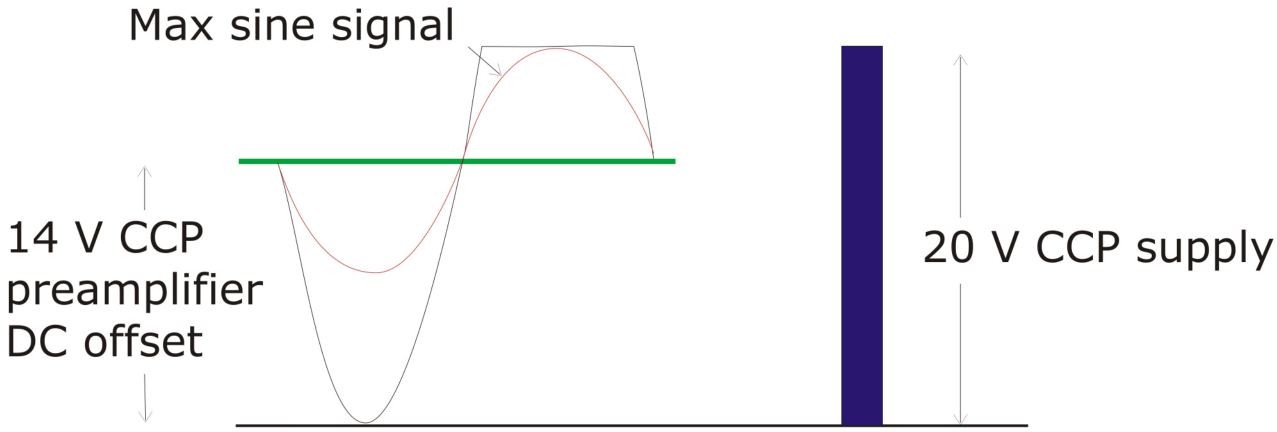


Figure 2: Transducer with 14 V DC offset and input module with 20 V compliance voltage.

In fig 3 is shown a combination of a preamplifier (or transducer) with an 8 V DC offset and an input module with 28 V compliance voltage. As the signal will swing around the DC offset of the transducer, the signal can swing from 0 V up to the 28 V compliance voltage, i.e., + 16V and -8 V signal voltage swing. For a symmetrical sine signal this limits to a +- 8 V signal voltage swing range.

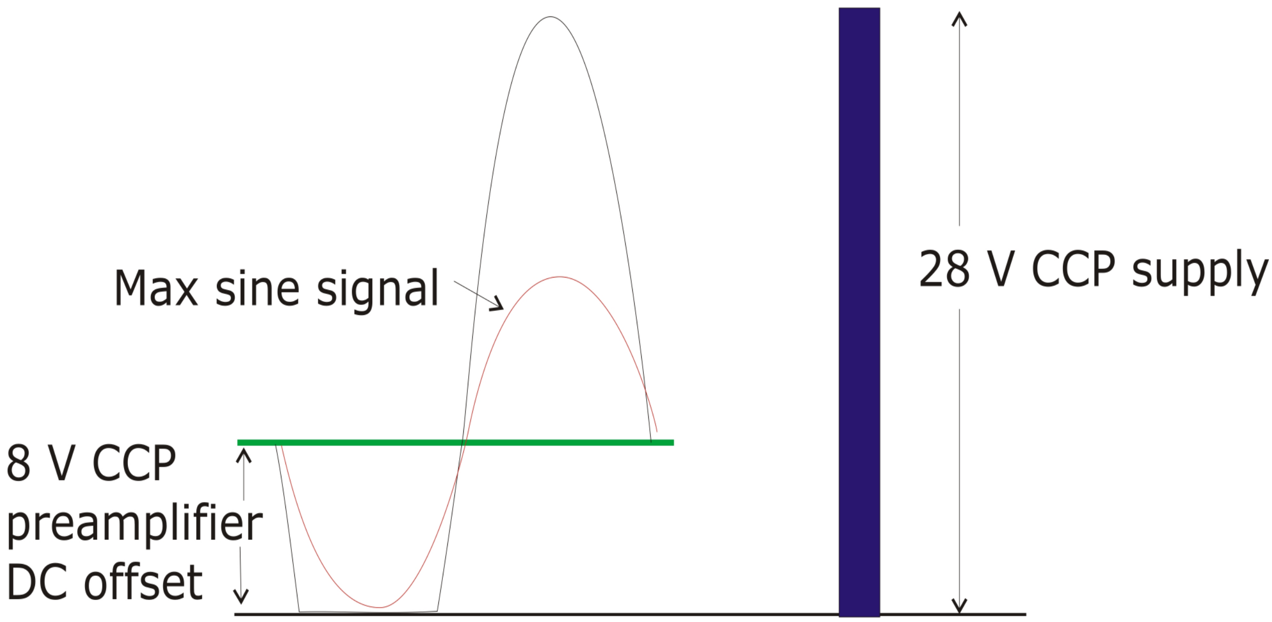


Figure 3: Transducer with 8 V DC offset and input module with 28 V compliance voltage.

So in order to get the maximum dynamic range from the transducer and the input module it is important that the transducer DC offset is at half the input module compliance voltage. Otherwise the dynamic range can be reduced by 3-6 dB.