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Battery Cable Inductance

What is Inductance?

When current passes through a conductor a magnetic field is set up around the conductor. As this magnetic field builds, it induces voltage in any conductor which is close by, and it induces a voltage in the original conductor. The voltage induced into the original conductor is called self-inductance, and tends to oppose the current which produced it.

The magnitude of the self-induced voltage is proportional to the size of the loop formed by a wire. The larger the loop, the larger the self-induced voltage. The positive and negative battery cables in a system are in reality only a single circuit (wire), and so the inductance of the battery circuit depends on how the cables are physically positioned or arranged with respect to one another.

Tape Battery Cables Together to Reduce Inductance

If battery cables are separated by a distance, they have much more inductance than if they are close together. If the two battery cables were coaxial there would be virtually no induced current flow since the magnetic fields would cancel one another. However, we don't have coaxial battery cables, but we can approximate them by taping the cables together every four to six inches. When the cables are taped together the magnetic fields around each battery cable tend to cancel each other. When cables are separated the magnetic fields add together and increase the inductance of the battery cables. If you aren't convinced that taping battery cables together helps reduce inductance, consider the following table of information collected by Trace Engineering. We tested two sixteen foot long #4/0 AWG battery cables connected together at one end and parallel to one another.

Distance Between Battery Cables	Inductance in micro-Henries
Taped Together	3.3
12" Separation	6.0
48"+ Separation	8-9

The above table shows that with only a foot of distance between the battery cables the inductance almost doubles, and at four feet between cables the inductance is almost three times the inductance of cables taped together.

Since the induced voltage in a conductor varies as the inductance times the rate of change of current in the inductor, the induced voltage may be three times greater than it would be if cables were not taped together. For more advanced readers, consider flyback effects and the induced voltage spikes can get into the thousands of volts range if the battery were suddenly removed from the circuit (worst case).

These induced voltage changes cause ripple in the battery cables and must be absorbed or filtered by the filter capacitors in the inverter. This ripple will lead to eventual premature breakdown of the filter capacitors and performance loss in the inverter.

In addition to the problems mentioned, the induced current opposes the applied current (battery current) which directly causes a loss of inverter performance as greatly reduced efficiency.

Hopefully this technote gives a much more realistic and clear idea of why battery cables should be kept short and close together. Maximum performance is the goal of any well designed power system and the detail items such as this will help achieve the goal.