Capacitor Chargers

Charging capacitors can be accomplished in two ways. The first way most people are familiar with is to connect a capacitor to a voltage source, with a resistor in series between the voltage source and capacitor. Now what happens is the voltage across the capacitor charges exponentially as a function of (e). Theoretically the capacitor never reaches the exact value of the voltage source, but for all practical purposes it does eventually reach an acceptable value.

Now the time constant (t) of the charge is a function of R the charging resistor value and C the capacitor being charged. The formula for the entire function is charge voltage $V(t)=Vs\ (1 - e^{-t/RC})$. Now the capacitor charges up to 64% of its uncharged amount in a period of one time constant. For the capacitor to charge close to the source voltage (Vs) you must leave it on at least for several more time constants (t). The problem is real power is wasted in the resistor throughout the charging cycle, and the charge voltage is very nonlinear, slowing down as it reaches its maximum value. If the source voltage is higher than the required voltage on the capacitor, the time to reach the required charge voltage will be shorter but you must be careful not to over-volt the capacitor.

The second way is the more preferred way as it does not waste power through a charging resistor that incidentally must consume the same Joulean energy that the capacitor stores. Our chargers use a programmable voltage that you set, and then simply push the charge button for the capacitor to charge from a current source and cease when it reaches the value of the programmed voltage. The charge equation is simply based on CV coulombs equals I(t) coulombs, or CV=It. When transposed, t = CV/I where V is the voltage you want the capacitor to charge to and I is the current charging the capacitor and t is the approximate time it will take to reach that voltage.

Now this equation is 100% valid for a real constant current source. Our chargers aren't perfect current sources as they have limited open circuit voltage preventing a real constant current function. But for practical use, this equation can be applied to our systems and get close results.

You will note there is very little power loss as current is controlled by a reactive component being an inductor. It simply does not waste the reactive currents except for the internal resistance of the windings. These of course would absorb minute amounts of real power.

Our systems use reactive charging with duty cycle control and programmable circuitry where the ballast current is reactive and recoverable and the only power consumed is the real power going into the energy bank. This is a great advantage when dealing with energy storage in the thousands of joules. These devices are excellent for testing the integrity of capacitors.