1 Farad Capacitor

P6-8012

INSTRUCTIONAL GUIDE

Contents

- 1 Farad NEC Supercapacitor
- Instructional Guide

Recommended for activities:

- Alligator Leads Pack of 10 (P4-3000)
- Genecon Hand Crank Generator (P6-2631)
- Digital Multimeter (P6-8017)

Introduction

Your capacitor has a capacitance of 1.0 Farads at a rated voltage of 5 VDC. It will hold a charge for about 200 hours at 20 degrees Celsius. Its leakage current is roughly 10 microamps at room temperature.

Because of the way it is constructed, the Supercap will not present a hazard if a voltage higher than recommended is applied. Above 12V, the individual cells become non-conductive as water in the sulfuric acid solution vaporizes. The Supercap will not explode like standard electrolytic capacitors; it will simply cease to work.

Background

A capacitor is a device which has the ability to store an electrical charge. Traditional capacitors are made of two pieces of metal, called plates, separated by an insulator called the dielectric. The capacitance of a capacitor depends primarily on the size of the plates, the distance between the plates, and the permeability of the dielectric to electric fields. Moving the plates closer together and enlarging the plates are two ways of increasing capacitance.

Capacitance is measured in Farads. One Farad is the capacitance of a capacitor which can hold one Coulomb of charge (6.25×10^{18} charged particles) when there is a potential of one volt across its leads. Most capacitors are measured in microfarads (10^{-6} F) or picofarads (10^{-12} F).

Fairly large capacitors (on the order of several thousand microfarads) can be achieved when one plate is simply oxidized and pressed against another plate. The very thin layer of oxidized metal acts as a dielectric; the distance between plates is greatly reduced and the capacitance increased accordingly.

It's done with activated carbon and sulfuric acid. It is believed that at every interface there exists an array of oriented dipoles (atoms or molecules with their ends oppositely charged). When an electric field is applied across this array, it orients these dipoles in such a way as to cause this layer to act as a dielectric (a very thin dielectric on the order of one or two molecules thick).

The two materials serving as interface media in this capacitor are activated carbon and sulfuric acid. Activated carbon is ground to a powder and mixed with sulfuric acid. The surface area of the activated carbon is approximately 1,000 m^2 per gram. The combination of this very large surface area with the

very small distance between the capacitor “plates” results in a capacitance of about 200 to 400 Farads per gram of activated carbon.

One problem with these materials is that if more than 1.2 volts is applied to this junction, the aqueous sulfuric acid solution breaks down. To remedy this, the Supercap incorporates a number of small cells, each consisting of a “sandwich” of the paste separated by a porous material. Each cell is encompassed by an impermeable gasket (to hold everything together) squeezed between two electrically conductive ends. The whole system is pressurized.

Individual cells are stacked in series (end to end) and squeezed into a metal outer cover. By stacking them in series, the effective voltage of each cell is multiplied to useful proportions.

Related Products

Investigating Electrical Circuits Kit (96-1500) With this easy-connecting kit, students learn the fundamentals of electricity by building various circuits, and then are introduced to the concepts of voltage, resistance, and electrical current.

Deluxe Electrolysis Apparatus (C6-0500) A simple and safe electrolysis apparatus that is used to make Hydrogen and Oxygen gas by passing DC current through water. Along with built-in platinized titanium electrodes, our Deluxe Electrolysis apparatus also features a safety-closed tank for the electrolyte that can easily be filled, refilled, emptied or replaced.