A SIMPLE EXPLANATION OF WHY THE ALBER MEASUREMENT METHOD IS MORE ACCURATE, RELIABLE AND REPEATABLE THAN ANY OTHER OHMIC METHOD ON THE MARKET

Testing batteries may seem to be fairly straightforward, but the battery as a test object presents some challenging problems that must be considered. This Tech Note addresses three specific test problems you need to be aware of when selecting your test system. It is specifically written for those people who were blessed by not having to study EE 101 or Battery Chemistry to make a living.

The Capacitor Effect

If you look at a battery as an electrochemical generator and the internal resistance path through which current flows as an electrical pipe, you will more easily understand this explanation of Albér's measurement technique advantages.

Figure 1 shows a simplified model of DC current easily flowing through a pipe offering minimal resistance. When an external load is applied to the battery, the electrochemical generator supplies current through the electrical pipe as illustrated in the figure. All is well as long as the generator is working and the pipe is in good shape. However, a battery doesn't live forever. It has a specific life span, so, sooner or later, it will fail. As the battery ages and deteriorates, the battery's capability to supply power becomes more limited. It's as if the pipe starts to clog up.

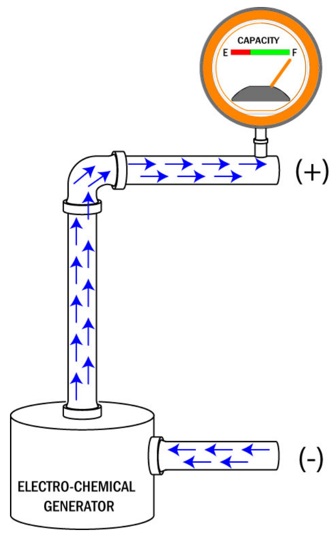


Figure 1. Normal DC flow

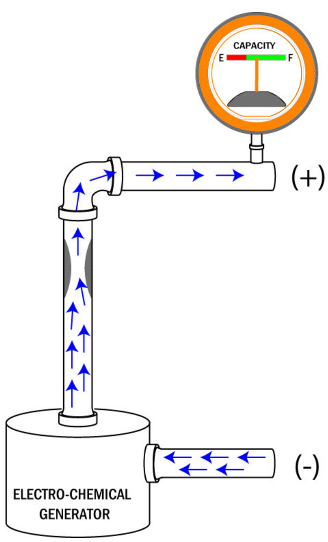


Figure 2. When the pipe clogs, resistance to DC flow increases and reduces the capacity.

Figure 2 illustrates that, as the pipe clogs (the battery ages), the friction in the pipe increases and causes less flow through the pipe.

This is what happens in an electrical circuit as the resistance increases. This restriction causes the terminal voltage of the battery to drop when it's time to deliver energy to the load, and the result is that the battery cannot deliver the desired capacity.

It is important to note that, under normal operating conditions, the battery supplies DC current, not AC current, through the pipe shown in the figures.

Albércorp • 990 So. Rogers Circle, Ste 11 • Boca Raton, FL • 33487
Telephone (561) 997-2299 • Fax (561) 997-5588
www.alber.com • sales@alber.com

When a battery is tested using an AC test current (which is what AC conductance and AC impedance testing does), the test current not only flows through the normal (DC) electrical pipe, it also flows through the internal capacitor (the AC path) that is also a part of the battery. (All the parallel plates inside the battery form a gigantic capacitor.)

A capacitor is a useful electrical component used in a variety of electrical and electronic designs. One of the operating characteristics of a capacitor is that it allows AC current to flow through it while blocking DC current. Figure 3 shows this. Note that the electrical path through the capacitor acts like a pipe in parallel with the normal pipe. The size of the parallel AC pipe varies, depending on the size of the battery and the frequency of the test current, but it can be much larger than the normal electrical path.

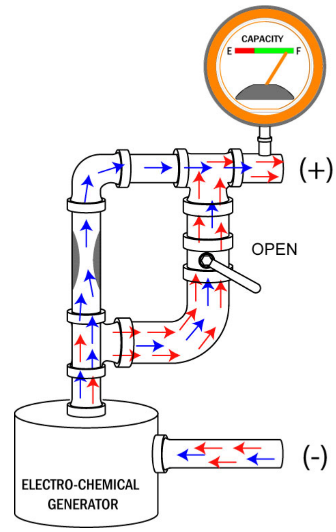
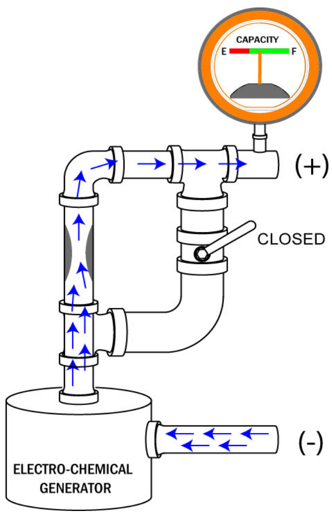


Figure 3. The capacitor forms a parallel path for AC current to flow.

When the AC test is performed, a great part of the current flows through the AC path, rather than the DC path that needs to be tested. This means that, as the DC electrical pipe starts to clog, the AC test current flows through the larger pipe and never recognizes any of the problems in the DC pipe. The clogging appears as a minor problem, and the user is misled into believing the battery is at full or near full capacity.



4. The Alber measurement method measures only the DC path, which is critical to the battery's capacity.

When the Albér Cellcorder or Battery Monitor tests the state of health of the battery (the quality of the electrical pipe), it forces the battery to supply current through the normal DC pipe and then measures the terminal voltage to see if there are any developing problems. This simple test, patented by Albér, simply forces the battery to perform the way it normally should while its performance is being measured.

Since the Albér technique is a true DC resistance measurement, the capacitor in the AC path acts like a closed valve, and the Albér Cellcorder or Battery Monitor evaluates the condition of the DC pipe alone, as Figure 4 shows.

Test Current

The most basic law of electricity, Ohm's Law, states that V=I*R. In plain English, this means the voltage you read across a resistor is a function of how much current is flowing through the resistor and how big the resistor is. Why is this important? Because, if the test current used is very low, then the voltage across the resistor is so low it can't be measured with the average test equipment.

The amount of test current, therefore, is a very important factor when assessing the internal resistance of a battery. Large batteries have very low resistance, so, if a small test current is being used, the voltage used to calculate the result will also be very small. Most test instruments on the market use approximately 1 Amp of test current, which means the resulting voltage is in microvolts (0.000001). There are instruments that can measure very small voltages, but they are very sophisticated and, consequently, cost more than $20,000.

If you look closely at test equipment and monitor specifications, you'll find that some of the reading resolutions are as high as ±100 micro-ohms. This means the instrument or monitor is equipped with measurement circuitry that cannot resolve very small voltages and can, therefore, only present values in ±100 micro-ohm increments. For practical purposes, such test equipment is worthless for use on individual 2 volt batteries.

How does that relate to our pipe diagram? In essence, a low-test current is analogous to a very small flow through the pipe. A flow of just a few drops will not fill the entire pipe and, therefore, will not indicate a clog has developed until the pipe is almost fully clogged. But, in a mission critical system, you can't wait that long to take corrective action.

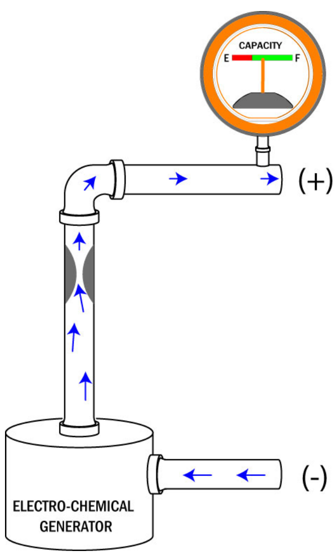


Figure 5. Low test current makes it difficult to show there is a clogged area.

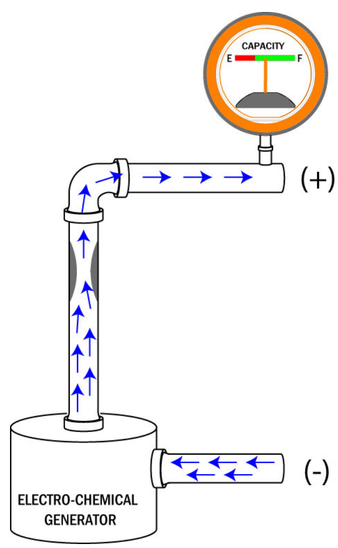


Figure 6. Higher test current means higher voltage (or flow), which allows for more accurate readings.

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Tech Note

Written for Non-Electrical Engineers

Test Noise

Ohmic test methods were developed so batteries could be tested without disconnecting them from the charger and/or the load. On-line testing is much easier and cheaper, but it's not easy to design test instruments capable of handling this application. The problem with testing batteries on-line is that the charger and the load generate a lot of noise (ripple) that affects the accuracy of the test. See Figure 7.

Ripple is a low voltage AC signal that interferes with the on-line test signal if a low current, AC based test system is used. A popular analogy is it's like having a conversation in a noisy room. If you each talk in a loud voice (Alber high test current), you can hear one another. But, if you talk in a quieter voice (low test current instrument), the surrounding noise will interfere with the conversation and lead to misunderstandings. Would you select a noisy environment for a serious discussion, where attention to detail will determine the outcome? Most likely, no.

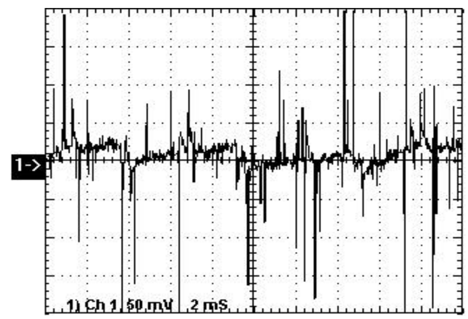

Figure 7. Typical ripple signal measured on a UPS battery.

Another analogy used to visualize electrical noise interference is to recall what sometimes happens to a television picture or stereo system when someone in the household turns on a motor. The poorly designed systems react to the noise.

When evaluating technologies for on-line ohmic testing, we suggest you put the available equipment to the test. Connect the different instruments to a battery where you can change the charge voltage and add load to the battery while comparing test results. The superior test instrument will provide you with repeatable results, whether the battery is off line or on-line with full load.

What All This Means

The Alber measurement method used in the BDS and MPM monitor systems and the portable Cellcorder is the only one that solves all the problems discussed in this note. Alber instruments don't inject a test signal into the battery; they apply a brief, temporary load – the same operating condition the battery experiences during a normal discharge. This load doesn't harm the battery, and the capacitor in the battery doesn't skew test results.

Used for years in countless applications and varying environmental conditions, Alber battery monitors always prove accurate, repeatable, and reliable. Alber monitors give you the facts that help you avoid costly battery failures and optimize battery life.

For more information about Alber battery test equipment, please visit our web site at www.alber.com, e-mail us at sales@alber.com or call (561) 997-2299.

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