

BITE3-SPECTRUM ANALYZER

The BITE3 battery impedance tester comes standard with a built in spectrum analyzer. The spectrum analyzer gives the user the ability to examine the frequency content of the ripple current on their batteries. By examining the ripple frequency the health of the charger can be verified.

Charger Rectifiers

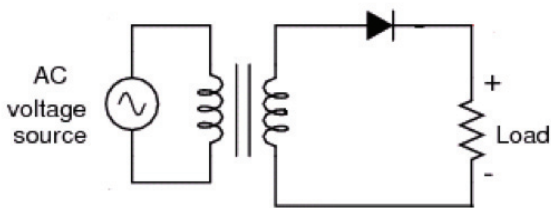
A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC). Rectifiers have many uses. Rectifiers are key components of battery chargers.

The devices in a rectifier that converts the AC to DC are called diodes. They convert the AC to DC or “rectify” the AC by blocking the negative or positive portion of the waveform. Almost all rectifiers are comprised of a number of diodes in a specific arrangement for more efficiently converting AC to DC.

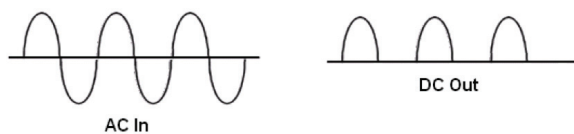
There are many types of rectifiers that use different diode configurations.

Half-wave Rectifier

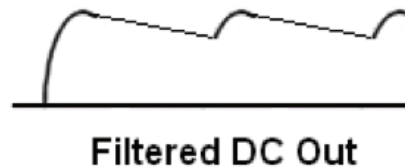
The half wave rectifier uses 1 diode in the following configuration.



This is used to convert single phase AC to DC. This type of rectifier blocks the negative portion of the wave.

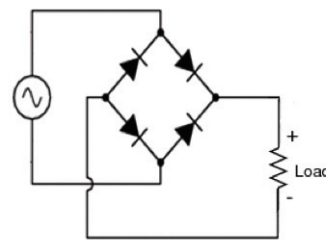


Then filter capacitors are used to smooth out the waveform.

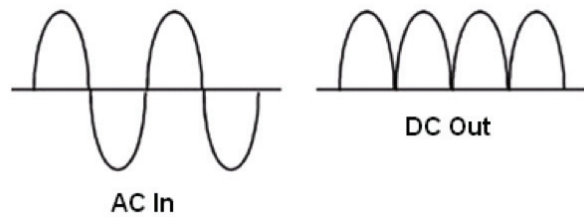


Full Wave Rectifier

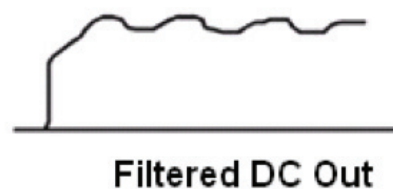
The full wave rectifier uses 4 diodes in the following configuration.



This is used to convert single phase AC to DC. This type of rectifier is more efficient than a half wave rectifier.

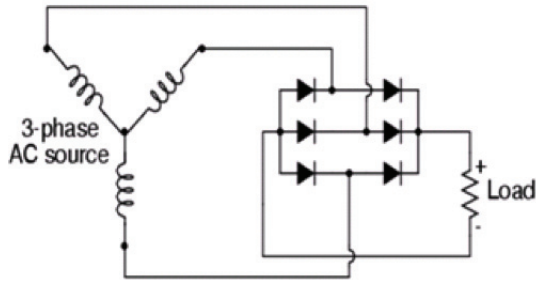


Then filter capacitors are used to smooth out the waveform.

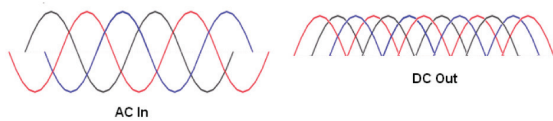


Six Pulse Rectifier

The six pulse rectifier uses 6 diodes in the following configuration.



This is used to convert three phase AC to DC. This is a typical type of rectifier used in today's battery chargers.

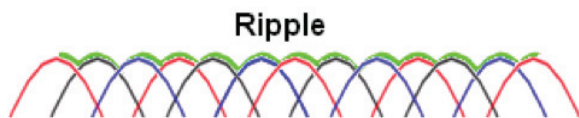


Then filter capacitors are used to smooth out the waveform.



Ripple Frequency

No rectification process is 100% efficient. There is always some level of AC left riding on the DC signal. The amount of AC voltage mixed with the rectifier's DC output is called ripple voltage. In most cases, since "pure" DC is the desired goal, ripple voltage is undesirable. In today's modern chargers ripple current is very low. This can change as the charger ages and components begin to fail. Ripple in excess of 5 Amps per 100Ah of battery capacity can cause heating effects in batteries. This can dramatically reduce the battery's life span.



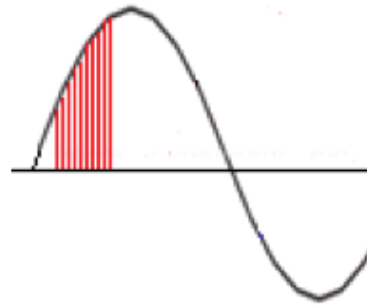
Rectifiers with different configurations have different frequencies of ripple. Sometimes, the method of rectification is referred to by counting the number of DC "pulses" output for every cycle. A single-phase, half-wave rectifier circuit, then, would be called a 1-pulse rectifier, because it produces a single pulse during the time of one complete cycle (360°) of the AC waveform. A single-phase, full-wave rectifier would be called a 2-pulse rectifier, because it outputs two pulses of DC during one AC cycle.

A three-phase full-wave rectifier would be called a 6-pulse converter. The normal ripple frequency can be determined by taking the number of pulses and multiplying it by the fundamental frequency. A full wave rectifier with a 60Hz input would have a ripple frequency of $2 * 60\text{Hz} = 120\text{Hz}$. A six pulse rectifier with a 60Hz input would have a ripple frequency of $6 * 60\text{Hz} = 360\text{Hz}$. By examining the frequency of the AC ripple of a charger we can determine if the rectifier is healthy.

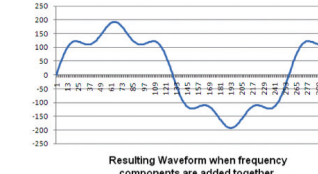
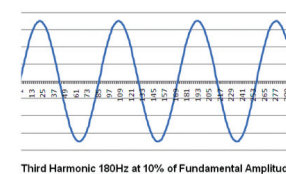
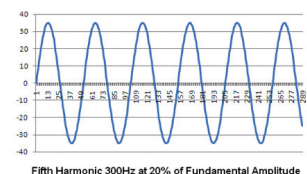
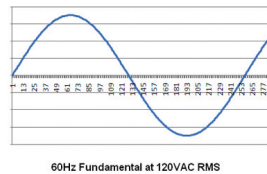
Waveform Analysis

A waveform can be described using one of two basic methods, a time domain method or a frequency domain method.

A waveform can be described in a time domain method by recording an amplitude level for given time intervals. The waveform can be reproduced if the amplitude values are known for given time intervals.

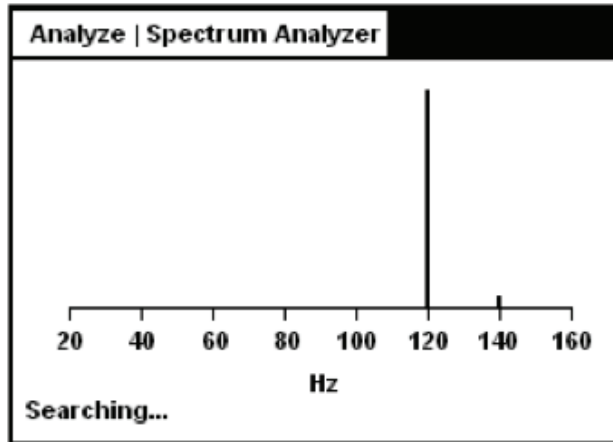


Another way to describe a waveform is using a frequency domain. A waveform can be described as a set of frequencies added together.



By using a mathematical process known as a Fourier Transform it is possible to convert waveform data from the time domain to the frequency domain.

The BITE3 measures the charge current in a time domain. The BITE3 measures the amplitude of the current periodically. The BITE3 then uses a Fourier Transform to convert the time domain information to a frequency domain. The different frequencies that make up the charge current can then be displayed in a bar chart.



By knowing what pulse rectifier is used in the charger it can be determined at what frequency the ripple should be. If the majority of the ripple frequency is not at the correct frequency then it can be determined that there is a problem in the rectifier circuit of the charger, such as an open diode. In this manner the BITE3 with its Spectrum Analyzer not only will test the health of the battery string but can verify the health of the battery charger as well.

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