



WFCO Converters - Theory of Operation

Introduction

WFCO Converters of every style have become the favored brand for power conversion and electric distribution in the RV industry. They provide RV owners an efficient and cost-effective method to use an AC power source and provide power to DC components inside the RV, while charging accessory batteries at the same time. This document explains how these products are designed to operate.

Basic Operation

RVs are frequently sold with at least one 12 VDC accessory battery installed. This battery is normally a deep-cycle battery that has the ability to sustain a slower drain of power. RV owners find this useful when powering loads such as lights, radios and refrigerators without being connected to AC power or running the motorhome engine. As soon as the RV is connected to AC power, the converter begins charging the battery as needed, while, at the same time, providing 12 VDC power to loads such as lights, radios and refrigerators.

When the RV is connected to AC power, users frequently use the lights, refrigerators, fans and other electronics as they would in their home. RV users also expect the battery to be fully charged when they want to disconnect from power and move the RV, or when they are dry camping and turn off their generator.

WFCO Converters are designed to fulfill these needs and expectations by providing three stages of charging, commonly referred to as Absorption, Bulk and Float Modes.

Absorption Mode is the default or normal operation, providing an output of 13.6 volts DC. Because RVs today are designed with converters sized to provide ample DC output power for all DC loads in normal usage, an RV will rarely require anything other than Absorption Mode.

When a WFCO converter is connected to a battery in Absorption Mode, power is available for charging that battery whenever the converter output is greater than the voltage level of the battery. If the battery is at or near fully charged, the current draw from the converter to the battery may be very small. On the other hand, if the battery were to be fully discharged, the current draw from the converter to the battery may be quite high.

If you have any questions, please contact the WFCO Power Pros at 877.294.8997. Please be sure to check out the WFCO website at www.wfcoelectronics.com





Testing has shown that a completely discharged battery (11.9 VDC) connected to a WFCO Converter in Absorption Mode with an output of 13.6 VDC and having a 20 amp lighting load connected to the converter will charge the battery to its fully charged level of 12.7 VDC in fewer than three hours. Adding more DC loads will lessen the amount of current available and will lengthen the time required to charge the battery. Batteries with damaged cells will also require additional time to charge, and may never reach a full charge voltage.

Because of the relationship between voltage and amperage, once the converter reaches its maximum rated operating current level, any increase in the DC load will start to decrease the voltage output level. When the output from the converter reaches a preset level, the converter will go into Bulk Mode.

Bulk Mode is designed to charge a significantly discharged battery in a little less time than Absorption Mode. The microprocessor in WFCO Converters continuously monitors the DC line voltage. When the microprocessor detects the preset voltage level, it will boost the converter voltage to 14.4 VDC. The increased voltage will help the battery charge faster, while still providing power to the DC appliances in the RV.

In Bulk Mode, it may not be possible to observe the 14.4 VDC output because of the voltage-current relationship. To measure the 14.4 VDC, reduce some DC loads while monitoring the voltage at the converter output. As the DC loads are removed, the voltage will begin to climb until 14.4 VDC (nominal) is shown on the meter.

As the battery continues to charge, the current drawn by the battery will gradually decrease. WFCO Converters are designed to drop out of Bulk Mode when the total amperage-draw from the converter reaches a preset point, indicating the battery is charged. If the amperage-draw stays above the preset point, the converter will stay in Bulk Mode for a maximum of four hours. These features have been implemented to protect and extend the life of the battery.

Float Mode is the third stage of converter operation. This mode is designed to provide a trickle charge to the battery. If the converter observes no significant variations in current draw for approximately 44 continuous hours, it will drop the output of the converter from 13.6V to 13.2V. This lower voltage will keep the battery charged while the RV is not in use. This also helps preserve the life of the battery, while keeping it charged and ready for use. A change in DC current will cause the converter to exit Float Mode and return to the default, or normal, Absorption Mode.

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Safety Features

WFCO Converters are designed to keep the RV safe and, in some cases, prevent irreparable damage to the converter.

Automatic Cooling Fan: The microprocessor in the converter monitors the current drawn by the appliances and battery and increases the fan speed as the current draw increases. This cools the converter components as required by the load.

Over-Temperature Protection: If the internal temperature of the converter exceeds a critical point and the fan cannot cool the unit down, it will shut down. This protects the unit from excessive heat that may damage sensitive components. The unit will restart once the temperature inside the unit is again low enough.

Short-Circuit Protection: In the event of a short circuit in the RV, the WFCO Converter will drop the voltage output to zero volts. If the short-circuit condition is removed and no other fault conditions are detected, the converter will resume normal operation. However, short-circuit conditions are dangerous, and an RV will require inspection by a qualified service technician.

Reverse Battery and Overload Fuse Protection: WFCO Converters include replaceable fuses for protection from conditions that can permanently damage the converter. These fuses will blow and protect the converter if the battery is connected incorrectly, or if the converter experiences an overload condition. Before replacing the fuses, check to make sure that the polarity connection is correct, and turn off as many DC loads as possible. Disconnect from power, replace the fuses, and then reconnect to power.

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Measuring DC Output

Voltmeters or digital multi-meters are great tools for measuring the voltage at different points in the system. Here are a few simple steps to follow in testing a converter:

- If there is a battery installed, disconnect one of the cables so the battery is out of the circuit.
- Turn off all the DC loads in the coach (lights, etc.) so there is no load on the converter.
- Turn the converter OFF by throwing the converter breaker in the load center or unplugging the shore cord, and leave it OFF for at least one minute.
- Turn the converter back ON and measure the DC voltage at the NEG and VCC lugs on the DC fuse board in the power center or at the NEG and POS terminals on a deck mount converter. The reading should be approximately 13.6 VDC.
- One by one, start turning DC loads back ON and monitor the voltage at the lugs on the fuse board or the terminals on the deck mount. The voltage should remain stable, but may drop slightly as loads are applied.
- After completing the testing, reconnect the battery cable removed in the first step.

Tips for Charging Batteries

Batteries charge more quickly when there are no other connected loads competing for DC current. If the batteries are taking too long to charge, consider turning off as many DC loads as possible. More power will be available for the battery to charge.

The following styles of batteries are approved for all WFCO Converters and Power Centers:

- Sealed lead-acid batteries for automotive engine starting
- Flooded lead-acid batteries for deep-cycle applications
- Sealed AGM batteries for deep-cycle applications

Do not charge GEL-cell batteries unless you are using a WFCO WF-6800 Series power converter, and have selected the GEL switch position in the back of the unit. No other WFCO Converters are designed to charge GEL-cell batteries.

Do not charge any types of batteries other than those listed above with WFCO Converters. If you are unsure if the WFCO Converter is compatible with a particular type of battery, please call your RV dealer or the battery manufacturer for assistance.

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