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APPLICATION NOTE

DC TEST APPLICATIONS USING DC OUTPUT MODE

Abstract

Modern programmable AC power sources like Pacific Power's AFX Series offer AC, DC and AC+DC output modes. This makes these programmable sources potential candidates for DC test applications. Of course, there are some considerations when deciding to use an AC source for DC testing.

Considerations for using an AC Source for DC Tests

Some of the issues to consider when using a programmable AC source for DC testing are:

- AC sources typically have higher DC voltage ranges such as 212Vdc or 425Vdc. This makes them less suitable for low voltage DC test requirements like 24Vdc, 12Vdc or less as full power is not available at these low voltages.
- The lower of two available voltage ranges will offer higher DC Current output and is preferred if the test voltage is less than the low voltage DC range value. In the case of the AFX Series, there is only one voltage range and it has constant power mode so maximum power is available all the way from 425Vdc down to 170Vdc.
- AC power sources have no bulk output capacitor storage, unlike their DC power supply counterparts, so they may exhibit higher switching noise levels at their output. Also, because of this lack of capacitance, load transient response on an AC source will not be as good as on an equivalent voltage range DC power supply. However, bulk capacitance can be added at the output of the AC power source if needed when operating in DC only mode.

Faster Voltage Slew Rates

Despite the issues listed, AC sources in DC Mode have capabilities not supported by DC power supplies. In particular, AC Sources have fast slew rates, often in the tens of micro seconds range compared to 10's of milliseconds for DC power supplies. The lack of output capacitance makes this possible. Of course, the unit under test may have input capacitance which must be considered as this capacitance will affect DC voltage rise and fall times.

Both Bipolar or Unipolar DC

An AC source in DC mode is always bi-polar. Thus, both positive and negative DC voltages can be programmed. If the EUT is not designed for this, set the negative USER LIMIT for the DC mode to 0V so only positive output voltages can be programmed.

Number of DC Outputs

A single phase AC power source will only provide a single DC output when in DC mode. A three phase AC source like the AFX Series on the other can be used in three phase mode to provide three independent DC output voltages. Think of it as a multi-output DC supply.

For maximum DC current, use the single phase mode so all DC current is available for testing a single EUT. Figure 1 shows connection of a DC load in single phase mode. **Note** that wire size must be chosen to support max. DC current on both positive (L) and negative (N) terminals.

For situations where a dual rail DC bus is required, use either three phase or split phase mode. Three phase mode allows unbalanced DC voltages to be programmed on positive and negative DC rails of the EUT. In split phase mode, you can obtain twice the available DC output voltage if needed.

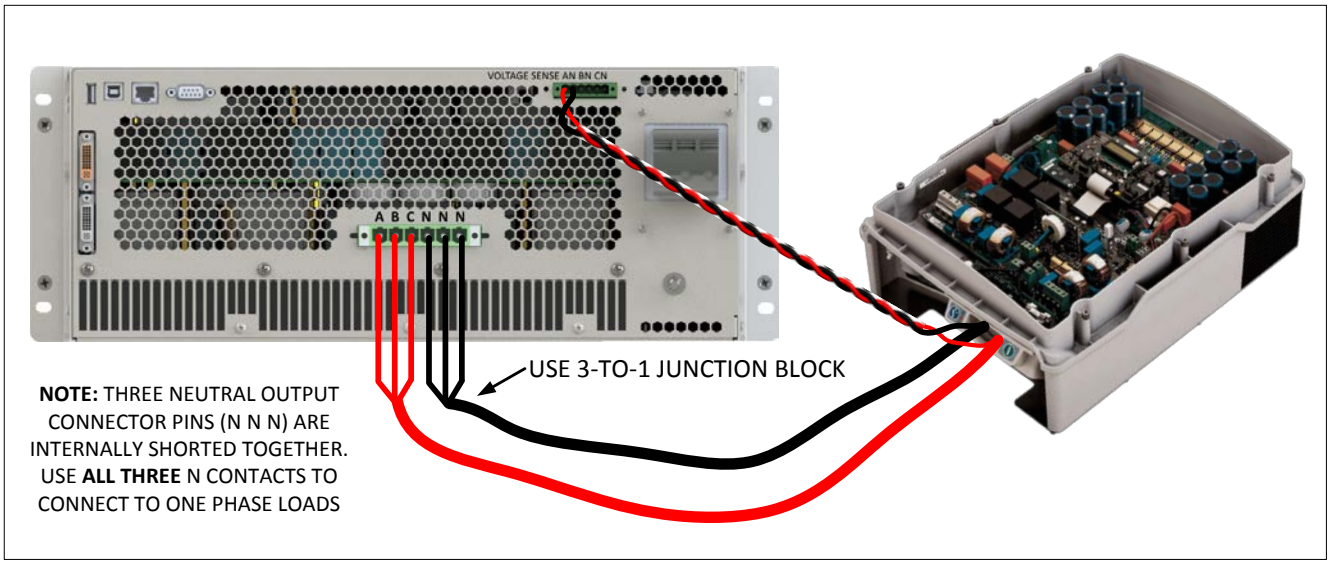

Figure 1: DC Load Connection with External Voltage Sense wiring

Easy to Program

The AFX Series has a modern and intuitive user interface so setting up for DC output is easy.

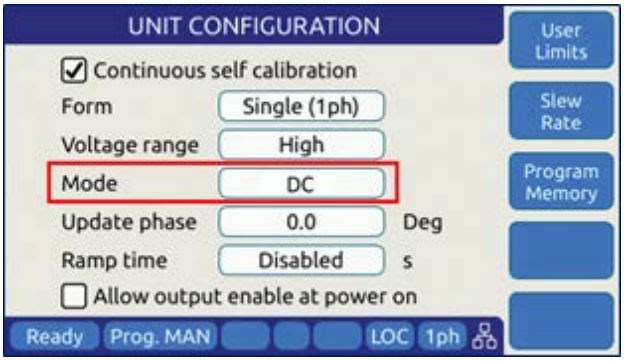

Figure 2: AFX Series Configuration Screen

Select DC mode in the UNIT CONFIGURATION screen. This now allows DC output levels to be programmed from the PROGRAM screen. Select High voltage range if more than 212 Vdc output is required for your testing. If not, select Low range to avoid damaging the EUT due to excessive voltage. Of course you can also set the DC High USER LIMIT value to a suitable upper value to prevent this.

Figure 3: AFX Series Program Screen

DC Test Fixture

To address some of the performance issues in DC mode, it is possible to add external low pass filtering, blocking diodes and bulk storage capacitance to improve the DC voltage quality. Such circuitry could be integrated in a test fixture as needed but must be bypassed when switching to AC mode or AC+DC mode. Refer to Figure 4.

The following circuits can be included:

Bridge Diode: Blocking diodes to prevent reverse polarity and current from the unit under test flowing back into the power source. In case of user error or where the User Limits on the power source are not set to prevent reverse polarity output, a

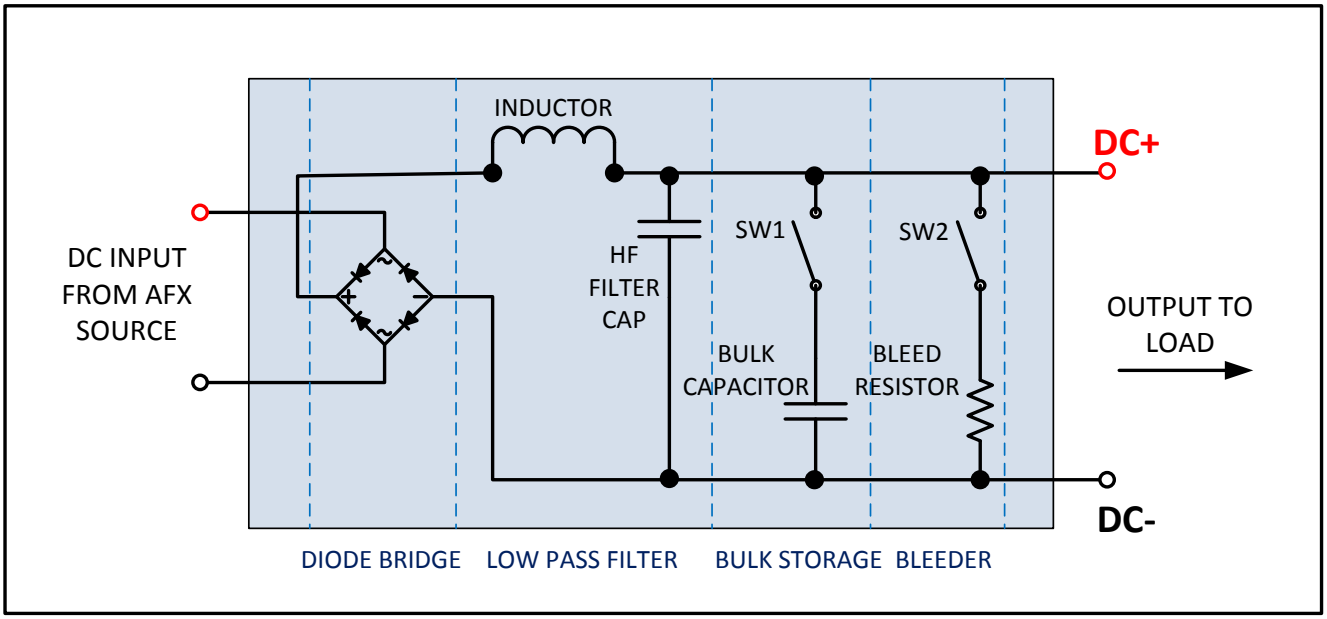

Figure 4: Optional DC Mode Test Fixture Circuits

bridge diode can be added to the output which will prevent reverse polarity as well as current back-feeding. This will cause about a 1.5Vdc voltage drop to the load however. Using external sense can compensate for this additional voltage drop or the user can increase the programmed DC voltage to compensate for this drop.

Low Pass Filter: Adding a low pass LC filter will reduce some of the high voltage switching noise if the EUT is sensitive to HF noise. An DC EMI filter can be used but the voltage rating should be sufficient to withstand maximum DC output voltage.

Capacitance: Bulk storage capacitance can be added to improve load transient performance. The amount of capacitance added must be determined under load to avoid any voltage regulation loop instability. Adding this capacitance will reduce voltage rise and fall time performance so add no more than needed to obtain stable and acceptable DC voltage quality. The capacitor voltage rating and ESR must be sufficient for the max DC voltage and AC ripple present at the output of the AC power source. If some EUT's have sufficient input capacitance already, this external capacitance can be disconnected using a switch (SW1) in series with the capacitor.

Bleeder Resistor: If the bulk storage capacitor is added, also add a bleeder resistor and series switch (SW2). When the AC source DC output is turned off, voltage across the capacitor in the text fixture remains unless the capacitor charge is dissipated by the load. With no load connected, the bleeder resistor can be used to discharge any remaining charge bringing the voltage down to a safe level. The bleeder resistor power rating must be sufficient for the application.

Note 1: For most applications, not all stages of this DC Test Fixture will be required.

Note 2: When switching back to AC mode, this test fixture must be removed.

Conclusion

The new AFX Series is one of the most versatile and compact programmable AC & DC power source on the market that should be part of every power design and test engineer's tools kit. To learn more, check out http://pacificpower.com/products/afx-series

Customer Support

For application support, contact Pacific Power Source's Customers Service - Toll Free US: +1 (800) 854-2433 / support@pacificpower.com or your local authorized Pacific Power Source distributor.

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