The Superior Performance of the BriPower ZGX Series in Low-Frequency AC Testing

Analysis of Low-Frequency AC Power Supply Application Requirements

In the field of power electronics research and development, particularly in the testing of transformers, sensors, and motor drives, low-frequency AC power supplies play an absolutely crucial role.

Taking transformer testing as an example, according to the principle of electromagnetic induction, when the primary side of a transformer is excited at low frequencies, the iron core is more likely to enter saturation. This helps in detecting its volt-ampere characteristics, ratio error, and phase displacement. For such tests, the power supply is typically required to output a stable, pure, and highprecision sinusoidal waveform in the ultra-low frequency range, from 0.05Hz up to several Hz.

If the power supply's output precision is poor or the waveform distortion is significant at low frequencies, it will directly invalidate the test results, making it impossible to accurately assess the true performance of the Device Under Test (DUT).

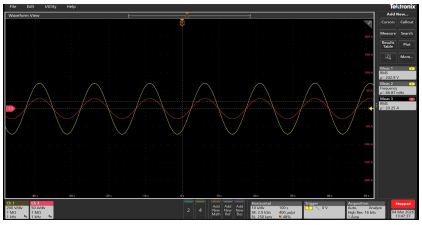
Addressing such demanding low-frequency testing requirements, the BriPower ZGX Series, leveraging its SiC-based high-frequency topology and dual-DSP control architecture, demonstrates exceptional low-frequency output capabilities.

ZGX Low-Frequency Output Accuracy Verification Analysis

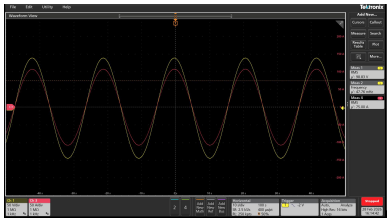
To validate the actual performance of the ZGX series in the low-frequency, a comprehensive test was conducted under various output voltages and load conditions. Test setup: connecting the ZGX input to the grid, ensuring the input voltage is within the operating range, and connecting the output to a purely resistive load. Set three-phase parallel output AC 100V, 200V, and 400V, adjust the output frequency within 0.05~1Hz, and also including a 50Hz point for reference. Read and record the measurements on the power analyzer and the waveforms on oscilloscope.

- **Test Data Overview**

The test data, recorded under different resistive loads (1.3Ω for 100V, 10Ω for 200V, and 20Ω for 400V), are shown in the tables below. Voltage error is calculated relative to the set value.



100V/0.05Hz Output Waveform



200V/0.07Hz Output Waveform

400V/0.1Hz Output Waveform

Table 1: Test Results at 100V / 1.3Ω Load

Setting Frequency (Hz)	Measured Voltage (Vrms)	Measured Frequency (Hz)	Voltage Error (%)
0.05	100.38	0.04776	0.38%
0.06	100.43	0.06686	0.43%
0.07	100.34	0.07642	0.34%
0.08	100.34	0.08597	0.34%
0.09	100.35	0.09550	0.35%
0.1	99.22	0.9982	0.78%
0.2	99.13	1.958	0.87%
0.3	99.22	2.961	0.78%
0.5	99.19	4.967	0.81%
1.0	99.19	9.982	0.81%

Table 2: Test Results at 200V / 10Ω Load

Setting Frequency (Hz)	Measured Voltage (Vrms)	Measured Frequency (Hz)	Voltage Error (%)
0.07	200.40	0.066	0.20%
0.09	200.38	0.085	0.19%
0.1	200.38	0.095	0.19%
0.3	200.39	0.296	0.195%
0.5	200.39	0.496	0.195%
1.0	200.39	0.998	0.195%
50	200.41	49.99	0.205%

Table 3: Test Results at 400V / 20Ω Load

Setting Frequency (Hz)	Measured Voltage (Vrms)	Measured Frequency (Hz)	Voltage Error (%)
0.1	401.24	0.095	0.31%
0.3	401.22	0.296	0.305%
0.5	401.22	0.496	0.305%
1.0	401.22	0.998	0.305%
50	400.87	49.99	0.2175%

- **Data Analysis and Conclusion**

The extended test data under multiple voltage and load conditions consistently demonstrate the exceptional low-frequency performance of the ZGX series:

High Precision Across Voltage and Load Variations:

- At 100V, output voltage remains within ±0.9% of the set value across 0.05Hz to 1Hz.
- At 200V, the error is exceptionally low, within +0.2% across all tested frequencies.
- At 400V, the error is within +0.31%, still well below typical industry requirements.This shows that the ZGX maintains its high accuracy regardless of the operating point, making it suitable for a wide range of test scenarios.

Stable Frequency Accuracy:

Measured frequencies closely track the set values, with deviations less than 0.01Hz at low frequencies and excellent tracking at 50Hz (e.g., 49.99Hz measured). This precision is critical for applications requiring exact synchronization, such as transformer phase angle measurement.

Waveform Purity:

The captured oscilloscope waveforms (see Appendix) show clean sinusoidal shapes with no visible distortion or DC offset, even at frequencies as low as 0.03Hz. This low distortion is essential for accurate characterization of devices like current transformers, where harmonic content can skew results.

ZGX Series Core Functionality Overview

Building on the excellent performance highlighted above, the BriPower ZGX Series represents a truly integrated all-in-one test solution. Beyond functioning as a high-precision AC source, its core features include:

Four-Quadrant Operation & Regenerative Load:

It functions not only as a power source but also as a regenerative electronic load. It can simulate various load characteristics like CC, CV, CP, CR in AC/DC modes and cleanly regenerate energy back to the grid, offering energy efficiency.

RLC/RCD Pure Analog Load:

Eliminating the need for bulky external inductor and capacitor cabinets, the ZGX features powerful built-in RLC/RCD load simulation, supporting up to 16 topologies for precise emulation of complex non-linear or resonant conditions.

High Voltage & Flexible Output Modes:

- High Voltage Mode: Utilizing phase reversal, it can achieve output up to 900V L-N (AC) or 1272V (DC).
- BiPolar DC Supply: Supports two-port or three-port modes for use as a positive and negative bipolar DC source, meeting specialized DC testing needs.

Powerful Waveform Generation & Analysis Capabilities:

- Harmonic Synthesis: Supports superposition and injection of harmonics up to the 100th order.
- User-Defined Waveforms: Supports importing arbitrary waveforms with 1024 to 4096 points.
- Real-Time Harmonic Analysis: Built-in FFT analysis for real-time monitoring of voltage and current THD and individual harmonic content.

PHIL (Power Hardware-in-the-Loop):

When paired with the EXDA expansion box (signal delay <20μs), it can function as a power amplifier for constructing real-time simulation test platforms.

Low Leakage Current:

<10mA leakage current, compliant with safety standards for electric vehicle OBC and other highly sensitive equipment testing.

Summary

The BriPower ZGX series demonstrates exceptional output stability in the ultra-low frequency range (0.05Hz~1Hz), making it an ideal solution for low-frequency excitation testing of transformers, sensors, and similar devices. Combined with its powerful integrated features like regenerative load, RLC simulation, harmonic synthesis, and PHIL capability, the ZGX is more than just an AC/DC power source; it is an indispensable, high-precision, multi-functional power electronics test platform for your laboratory.