BriPower EXDA & ZGX System Configuration Guide: Optimizing High-Precision Power Amplification

Executive Overview: The ZGX-EXDA Ecosystem

The EXDA (Analog & Digital IO Extension Box) is a transformative interface that evolves the BriPower ZGX Series from a standard programmable power source into a high-speed linear signal amplifier. By serving as the high-fidelity link between digital control environments and physical power delivery, the EXDA allows the ZGX system to operate as a sophisticated Power Hardware-in-the-Loop (PHIL) interface.



Figure 1 EXDA Front Panel



Figure 2 EXDA Rear Panel

Crucially, this integration unlocks the ZGX's four-quadrant operation capabilities, allowing the system to dynamically source and sink power with the precision required for grid simulation and motor drive emulation. The EXDA-ZGX ecosystem is defined by three core value propositions:

- **Ultra-Low Latency:**

A 20μs end-to-end signal transmission delay (in PHIL mode) ensures the simulation stability required for high-bandwidth closed-loop testing.

- **Fixed-Gain Precision:**

The system utilizes hard-coded physical conversion ratios rather than variable percentage-based mapping, ensuring consistent control logic across all power ranges.

- **Customizable Control Logic:**

Reserved digital and communication pathways provide a "private customization" hub for researchers to implement bespoke interlocking and synchronization protocols.

The physical integration of these units creates a robust, industrial-grade "Signal Conditioning Layer" capable of handling the most demanding high-precision power applications.

Hardware Integration and Physical Connectivity

Proper physical setup is paramount to maintaining signal integrity and electrical isolation between high-power ZGX outputs and sensitive control electronics. The EXDA acts as the bridge, isolating the host unit while providing the high-speed connectivity required for real-time simulation.

Connectivity Requirements

The following hardware specifications must be adhered to for optimal system performance:

- Auxiliary Power Supply:

The EXDA requires an independent single-phase 220V AC power supply, separate from the ZGX main power input.

- Host Communication:

A dedicated fiber optic link provides high-speed data transfer and total electrical isolation from the ZGX host. BriPower provides the necessary fiber optic and input cables by default.

- **Signal Conditioning Layer (SMA):**

All analog signal paths utilize SMA female connectors. These include an integrated locking mechanism (anti-detachment design) to ensure reliable connectivity in high-vibration environments or long-term automated testing where cable creep could lead to failure.

- **Standard Cabling:**

BriPower provides 1m coaxial cables for all SMA connections, ensuring users have the necessary shielded leads for standard laboratory setups.

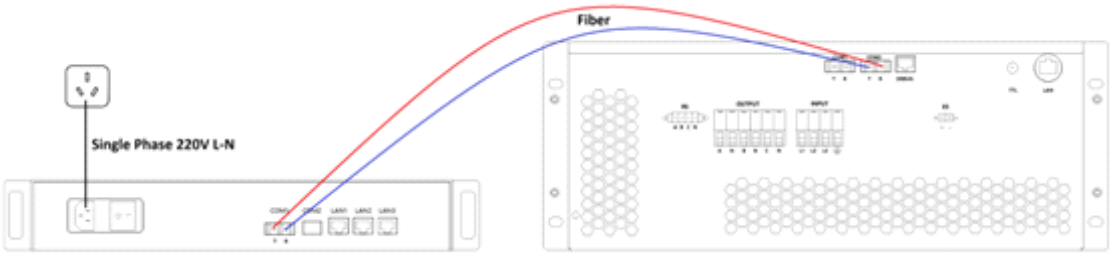


Figure 3 Input and Connection to ZGX

Hot Plugging Prohibited:

To prevent permanent damage to the EXDA or the Device Under Test (DUT), SMA connectors must never be connected or disconnected while the system is energized. Always follow a strict power-down sequence before modifying any physical signal connections.

High-Precision Analog Input (AI) Configuration

The EXDA utilizes a "Fixed Gain" philosophy for its 8 analog input channels. Unlike traditional systems that map signals based on a percentage of full-scale range, the EXDA uses hard-coded conversion ratios. This ensures that 1V of input always carries a specific physical meaning in Volts or Amps, regardless of the power range selected, simplifying external control model development.



Figure 4 Analog Input Connectors

Phase Mapping and Control Ratios

For three-phase systems, the input mapping is strictly defined: AI1, AI2, and AI3 are mapped to Phases A, B, and C respectively. The system accepts ±10V peak signals with a 500kHz sampling rate.

Parameter	Conversion Ratio (Gain)	Application Note
Voltage Output (CV)	66.5 V/V	1V input command = 66.5V ZGX output
Current Output (CC)	10 A/V	1V input command = 10A ZGX output

⚠ Important — ±10V Is Not the Usable Control Range:

The ±10V specification refers only to the maximum voltage tolerance of the SMA interface hardware—it is not a valid operating range for control purposes. Because the EXDA operates with fixed-gain conversion, a ±10V input signal would translate to an output well beyond the ZGX's rated capacity (e.g., 10V × 66.5 V/V = 665V, exceeding the 636V peak voltage range) and will trigger an Over Voltage or Over Current protection fault.
Therefore, users must always derive the valid analog input range from the actual output calculation (desired output value ÷ fixed gain), rather than assuming the full ±10V window is usable. Refer to the protection examples below for per-model calculation methods.

- **Voltage Protection Example:**

For a ZGX unit with a peak Line-to-Neutral (L-N) voltage of 450V (636V peak), the corresponding analog threshold is 9.5V. If the input analog signal exceeds 9.5V, the power supply will report an Over Voltage fault.
Calculation: 636V / 66.5 (V/V) ≈ 9.5V.

- **Current Protection Example:**

For the ZGX15 model with a rated current of 30A/ph and a peak current capability of 90A, the maximum allowable analog input for arbitrary waveforms is 9V. Exceeding this will trigger a Current Limit protection.
Calculation: 90A / 10 (A/V) = 9V.

Parallel Operation Considerations

In configurations where multiple ZGX units are connected in parallel, the EXDA controls the ZGX Master unit directly. The fixed gain ratio applies to the output of the Master unit. Consequently, the total system output current will be the sum of the Master unit's output multiplied by the number of paralleled units. Users must calculate the analog input based on the Master unit's share of the total current to avoid triggering protection on the individual units.

High Voltage Mode (Reverse Phase Output)

The EXDA + ZGX combination acts as a true linear amplifier, faithfully reproducing the input analog signals—both amplitude and phase—at the ZGX output. Consequently, the ZGX High Voltage Mode can be activated purely through the analog inputs: by setting a 180-degree phase angle difference between two input channels (e.g., AI1 and AI2), the corresponding output phases shift 180 degrees, doubling the output voltage range. In AC mode, this delivers 900V L-N from the standard 450V L-N range; when frequency is set to 0 (DC mode), it provides 1272Vdc based on the 636Vdc range. Note that the fixed-gain ratio (66.5 V/V) still applies to each individual phase, so users must verify that per-phase analog input does not trigger OVP.

PHIL Performance Dynamics

The system's PHIL capability is anchored by a 20μs end-to-end latency and a 10kHz small-signal bandwidth. This allows the ZGX-EXDA ecosystem to replicate high-frequency transients and complex harmonic distortions with industrial-grade fidelity, enabling the power supply to reproduce voltage or current waveforms in real-time based on external simulator commands.

Real-Time Monitoring via Analog Output (AO)

Real-time waveform monitoring is critical for data acquisition (DAQ) and deep-dive analysis via oscilloscopes. The EXDA provides 4 analog output channels capable of mirroring phase voltages or currents.

Configuration Note

The user must specify the four desired parameters (e.g., Phase A Voltage, Phase B Voltage, Phase C Voltage, and Phase A Current) to BriPower at the time of order to ensure the hardware is mapped correctly for the intended application.



Figure 5 Analog Output Connectors

Monitor Scaling Ratios

The feedback signals are attenuated according to the following fixed ratios:

- Voltage Monitor: 0.0149 V/V (1V ZGX Output = 0.0149V AO signal)
- Current Monitor: 0.1 V/A (1A ZGX Output = 0.1V AO signal)

The Open Integration Hub: Customizable Digital & Comm Resources

The EXDA features several "Reserved" interfaces rebranded as Open Customizable Resources, offering a hub for specialized system integration.

User-Defined Digital I/O (4 In / 4 Out)

These 0-5V interfaces support bespoke logic for specialized testing, such as External Emergency Stop (Interlock) integration, PLC handshaking for automated lines, or synchronization pulses for measurement hardware.

Extensible Communication Center

The unit separates host communication from user-available ports to ensure system stability:

- COM Ports: COM1 is dedicated to the ZGX host communication; COM2 is a reserved resource for custom serial protocols.
- LAN Ports: LAN1 is utilized for the primary host connection, while LAN2 and LAN3 remain reserved for custom Modbus variants or TCP/UDP-based remote control.

To unlock the full potential of these reserved resources, users should engage with BriPower engineering for firmware-level logic development tailored to specific project requirements.

Comprehensive Technical Specification Summary

Ensuring long-term reliability requires strict adherence to the electrical and mechanical limits of the EXDA interface.

Parameter	Specification
ADC / DAC Resolution	16-bit
Sampling Rate	1 MSPS
Small-Signal Bandwidth	10kHz
End-to-End Latency	~20μs (PHIL Mode)
Analog Signal Range	±10V Peak
Digital I/O Range	0-5V
Interface Type	SMA Female with locking mechanism
Isolation	Fully isolated from ZGX output and chassis ground
Auxiliary Power Supply	Independent 220V AC (Single Phase)
Physical Dimensions	440 * 670 * 178 mm (W * D * H)
Operating Temperature	0°C to 40°C

By combining the robust, four-quadrant power capabilities of the ZGX Series with the high-speed signal conditioning (16-bit, 1 MSPS) of the EXDA, BriPower provides an industrial-grade solution for the most advanced frontiers of power electronics research.