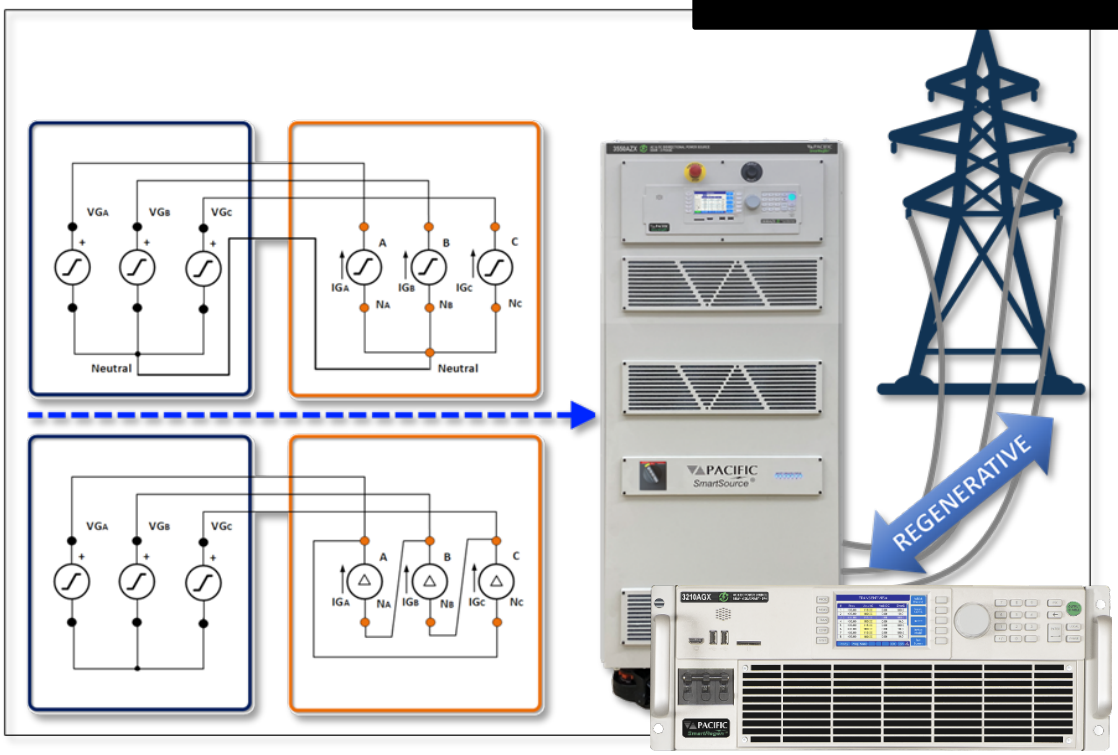
PACIFIC POWER SOURCE
2802 Kelvin Ave, Suite 100, Irvine, CA, 92614 USA

Delta & Wye Load Configurations

AGX / RGS / RLS SERIES
AZX / GSZ / ELZ SERIES



1 Supported Output / Input Configurations

The AGX, RGS, RLS, AZX, GSZ and ELZ Series Regenerative AC & DC power source & Electronic Load models supports a total of six source output or load input configurations depending on model and or options in either Source and or Load modes. These configurations are:

Mode	Phase Mode	Applications
FORM 1	Single Phase Mode	Used for DC applications or Single-phase AC loads
FORM 2	Split Phase Mode	Used for Split Phase or Single-phase loads that require higher AC voltages
FORM 3	Three Phase Mode	Used for all three phase WYE/STAR or DELTA AC Loads. This mode simulates standard power grids.
FORM 4	Dual Outputs or Inputs	Provides two separate outputs (Source Mode) or separate inputs (AC Load Mode option). Independent Frequency.
FORM 5	Tripple Outputs or Inputs	Provides two separate outputs (Source Mode) or separate inputs (AC Load Mode option). Independent Frequencies.



Mode	Phase Mode	Applications
FORM 6	Split Phase & Single Phase Outputs or Inputs	Provides one set of split phase outputs and one single phase output (Source Mode) or split phase inputs and one single phase input (AC Load Mode option). Independent Frequencies.

These five output configuration modes are illustrated in the diagram shown in Figure 1-1.

By selecting FORM4 through FORM6, the user can set different frequency values for each of the two or three outputs. In source mode, this allows the unit to function as two or three independent AC power sources, each having its own voltage, current limit, frequency, and phase setting.

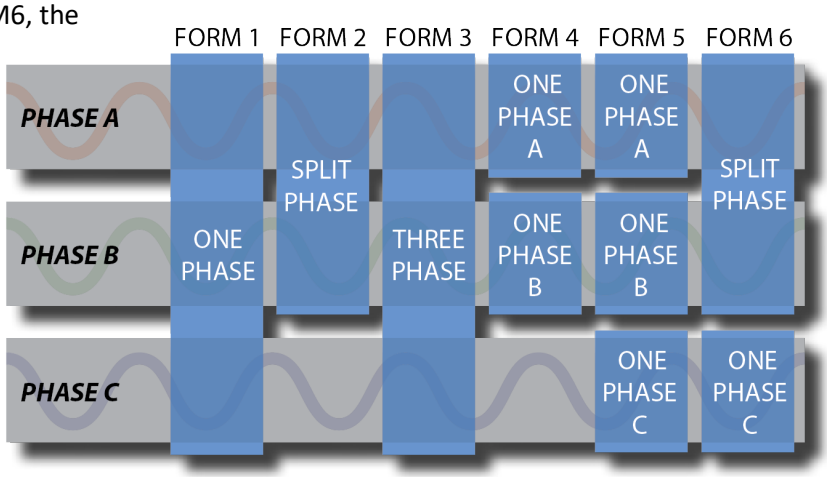


Figure 1-1: Illustration of FORM's 1 through 6

In Electronic Load mode, FORM4 through FORM6 allows the load to be set to different Load modes such as Constant Current (CC), Constant Power (CP), Constant Impedance (CR) or Constant Voltage (CV) for each individual input.

These additional output or input configurations in combination with isolated neutral connections allow for additional EUT support in both AC or DC Source mode as well as AC or DC Load mode of operation. This application note explains the various EUT configurations that can be tested using these power source & electronic load models.

2 Isolated Neutral AZX Option W and AGX-4U models

The available “W” option (Alternate Output Wiring) removes the internal connection between the three output neutral terminals. This renders them galvanically isolated from each other. As a result, the neutrals for phases A, B and C can be at different voltage potentials with respect to chassis ground at all times. The same is true for AGX and RGS models with the ‘-4U’ designation in the model number which have a user removable Neutral shorting bar on the rear panel. Note that ELZ and RLS electronic load only models always ship with isolated neutrals.

This has some important application specific benefits as explained in subsequent paragraphs of this application note.

3 Load Mode connection to a WYE/STAR AC Source

AC sources that have a WYE/STAR output configuration will have three phase connections and a neutral connection. These source configurations can be directly connected to the Electronic Load inputs, A, B, C and the Neutrals (N_A, N_B and N_C as long as these are shorted together. If the “W” Isolated Neutrals

Option is configured on the electronic load, the neutrals are isolated so the user must connect the three Neutral terminals on the load input N_A, N_B and N_C together.

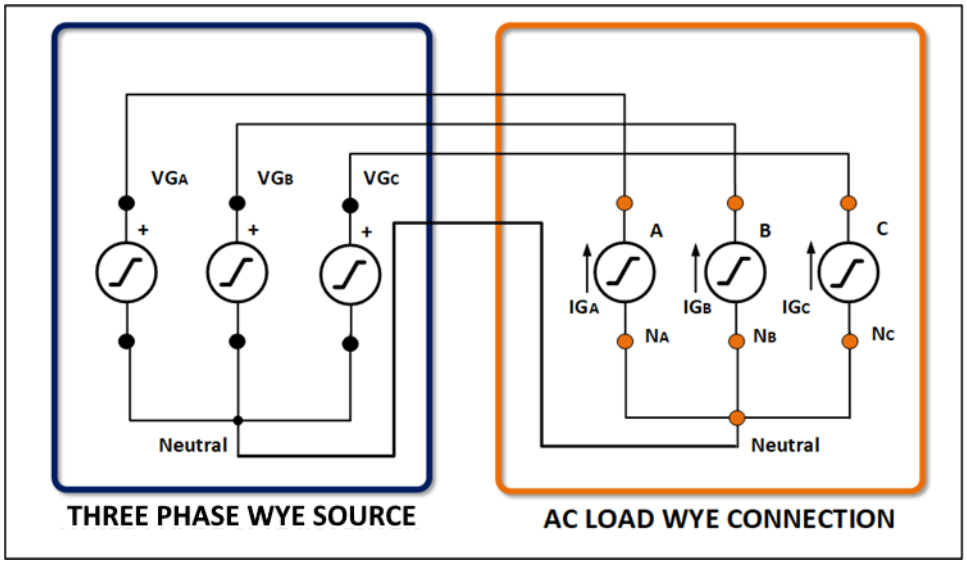
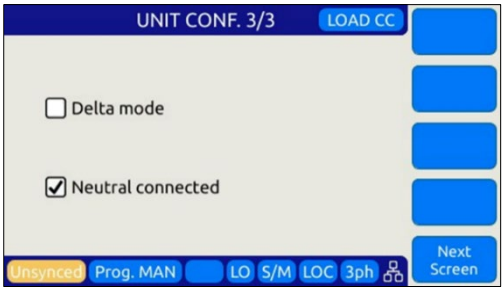


Figure 3-1: Load Connection to AC Source with WYE/STAR Output

This applies to three phases and the split phase without neutral connection in all the load modes.

Note that this AC Load setup is supported on all models- with or without the "W" Option - as only a common neutral input is required.

Typically supported WYE/STAR 3 Phase WYE/STAR Source output voltages for this configuration are:



Grid Voltage	Regions	Supported AGX, RGS, RLS	Supported AZX, GSZ, ELZ
120 V_{LN} / 208 V_{LL}	US, Canada	✓	✓
220 V_{LN} / 380 V_{LL}	Asia	✓	✓
230 V_{LN} / 400 V_{LL}	Europe	✓	✓
254 V_{LN} / 440 V_{LL}	---	✓	✓
277 V_{LN} / 480 V_{LL}	US	✓	✓
346 V_{LN} / 600 V_{LL}	Canada	✓	✓

© 2025, Pacific Power Source, Inc., Irvine, CA All rights reserved

4 AZX Load Mode connection to a No Neutral Delta AC Source

When testing three phase AC sources with a DELTA output configuration on the other hand, there is no output neutral available to connect to the AZX, GSZ or ELZ Load neutral input(s). Connecting such a unit under test to only phases A, B and C of the electronic load would leave the input neutral floating, allowing it to float to any voltage level. This condition may result in an over voltage protection fault as the load input voltage sense circuits are neutral referenced and thus the Line to Neutral input voltage measurement results may be off. If that happens, the load will be unable to load the AC voltage source and will trip an over voltage error. This setup is reflected in the Figure below.

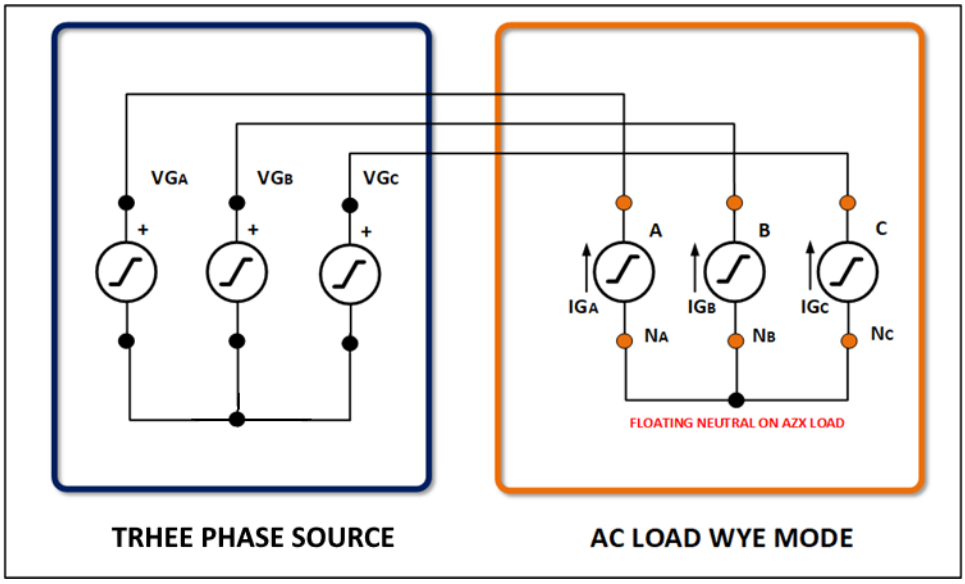
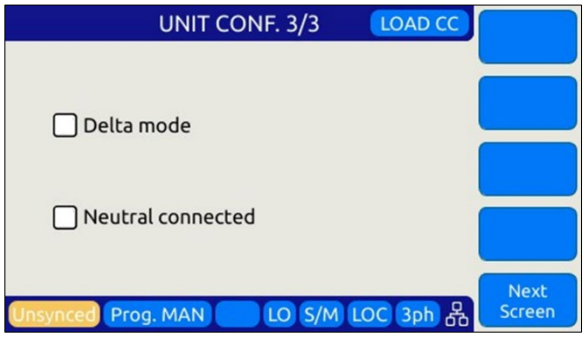


Figure 4-1: No Neutral Load Connection to a 3 Phase AC Source

4.1 For AZX, GSZ, ELZ Models Only

When there is no neutral, disable the Neutral connected option in the System Configuration 3/3 screen so that the load can control the neutral point to 0 and avoid an OVP error. See the 3rd UNIT CONFIGURATION screen shown to the right. The same setting can be made using the web browser interface, CONFIGURATION menu.



If there is no neutral connection (Neutral connected = unchecked), the Load will compensate for the L-N voltage measurements to maintain a zero (virtual) neutral using a neutral balancing control loop. This applies for both CC and CR load modes and only supported on AZX, GSZ source with load mode option and on the ELZ electronic load models.

4.2 For AGX, RSG, RLS Models

For AGX, RGS and RLS models, this No Neutral application only works with the load in Constant Resistance mode (CR Mode). Constant Current (CC) mode is **not** supported in this situation and there is no neutral balancing control loop.

© 2025, Pacific Power Source, Inc., Irvine, CA All rights reserved

5 Delta AC Source Load Application

To directly support these types of Delta only AC sources, the Load's Neutrals must be isolated from each other as they will be at different potentials. In AC Load mode with isolated neutrals, the load can support testing of a Delta source. This connection method is shown in the image below.

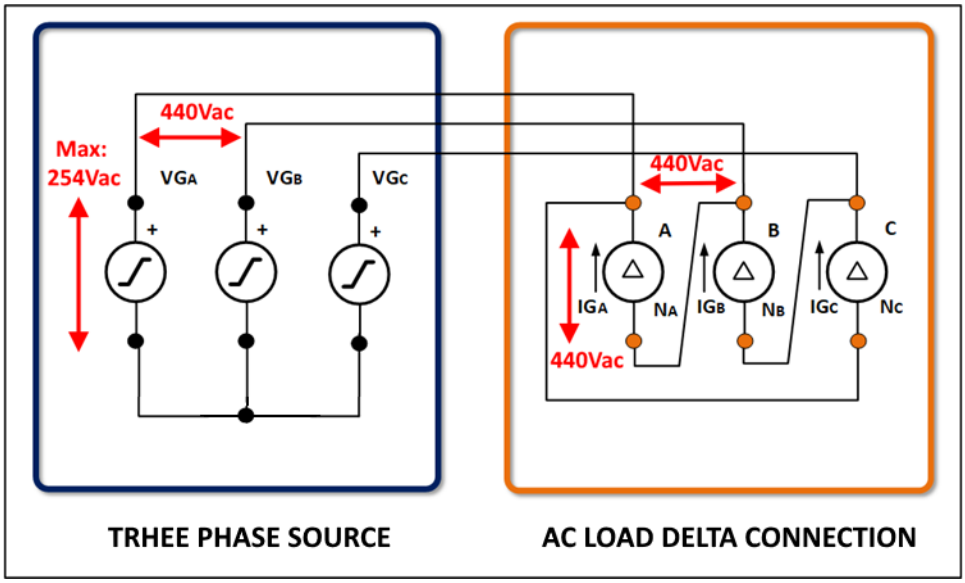
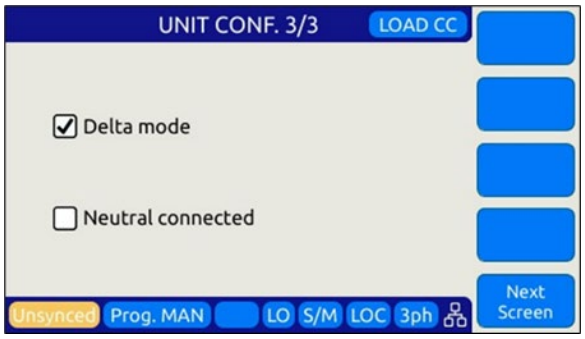


Figure 5-1: Alternative Load with W option Connection to a DELTA AC Source

In this situation, the maximum supported input voltage is determined by the equivalent Line to Neutral voltage. Thus, the AC load maximum supported AC input voltage is reduced from 480Vac to 277Vac. This restriction is caused by the fact that the voltage across each of the load power stages will be √3 * VG (Generator Voltage). Since the maximum AC voltage for an AZX, GSZ and ELZ is 440Vac, the highest output voltage of the connected three phase inverter must be no more than 440 / √3 = 254Vac. For the AGX, RGS and RLS, this voltage is 350 / √3 = 202Vac.



Typical supported DELTA Inverter output voltages for this configuration are:

Grid Voltage	Regions	Supported AGX, RGS, RLS	Supported AZX, GSZ, ELZ
120 VLN / 208 VLL	US, Canada	✓	✓
200 VLN / 346 VLL	---	**Max**	✓
220 VLN / 380 VLL	Asia	**No**	✓
230 VLN / 400 VLL	Europe	**No**	✓
254 VLN / 440 VLL	---	**No**	**Max.**

© 2025, Pacific Power Source, Inc., Irvine, CA All rights reserved

Grid Voltage	Regions	Supported AGX, RGS, RLS	Supported AZX, GSZ, ELZ
277 VLN / 480 VLL	US	No	No.
346 VLN / 600 VLL	Canada	No	No

6 Phase Angle Settings in AC Load Mode

Note that phase angle programming in AC load mode in CC, CR or CP Modes is based on current phase angles, not voltage. As such, if the **SYNC** setting is enabled, the phase angle setting controls the shift between the voltage and the current for each phase, A, B and C.

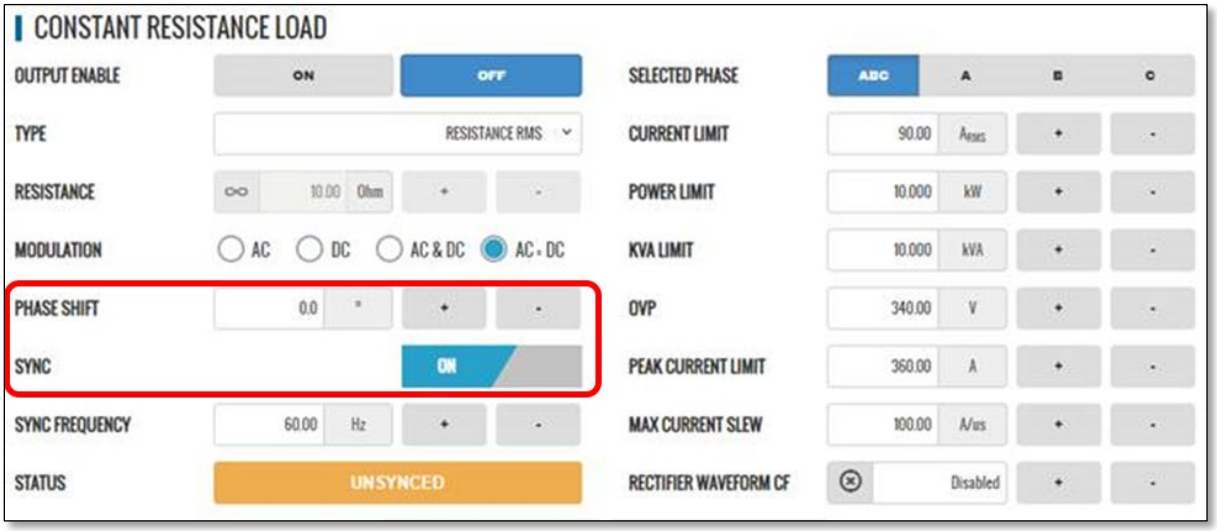


Figure 6-1: AC Load Mode Phase Shift set to SYNC ON in web browser interface.

For example, in the AC load mode and constant resistance mode with SYNC set to **ON**, setting the phase angels to:

Phase A= 0°
Phase B= 120°
Phase C=240°

Programming phase shift to the load current of phases B and C will introduce additional phase on top of the voltage phase shift. Thus, the load will not be balanced. This is because the input voltages from the unit under test are likely 120 degrees apart.

To fix this, set all current phase angle settings to 0°. At that setting, all three phases will be loaded correctly. A zero on all phases produces voltages and current that are in sync for each phase.

For a balanced three phase voltage it will produce current at 0 / 120 / 240 and will end up in a unity power factor load.

© 2025, Pacific Power Source, Inc., Irvine, CA All rights reserved

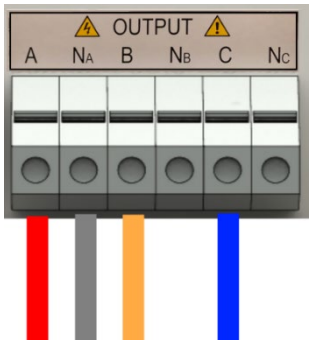
7 Operating modes and Output Connections

Standard units have 3 inverters (phases) in a wye/star connection, i.e. all neutrals are shorted together with an internal shorting busbar. In voltage mode they function as three **voltage sources**, in current or load mode they function as three **current sources**.

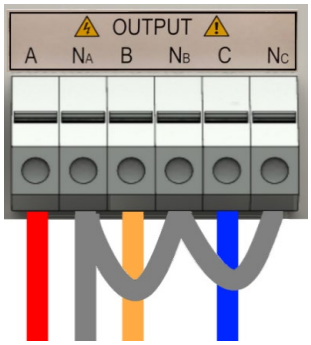
The W Option means this internal (AZX/GSZ/ELZ) or external (AGX-4U /RGS-4U /RLS-4U) shorting busbar has been removed, so it converts the unit to three independent (and thus floating) voltage or current sources, similar to having three batteries, which can be externally connected in a wye/star, delta, or even in series.

7.1 AZX / GSZ / ELZ Output Terminal Configurations

Thus, a standard AZX is identical to an AZX -W with its three Neutral terminals shorted externally. A standard AGX-4U has a removable external neutral shorting bar so can be configured easily for isolated neutrals or a common neutral.



Standard Output



W Option Output

7.2 AGX / RGS / RLS Output Terminal Configurations

The rear panel output terminals for AGX, RGS and RLS Rackmount models may be different, depending on the production date. Early models have a common neutral unless they were ordered with the -W option as well. If not, they will have three shorted neutral terminals on the output located next to each other. This is shown in the figure below on the left. Newer built units will have a similar output terminal pin orientation as the AZX series and a user removable neutral shorting bar above the output terminal. This is shown below on the right. These newer versions have a "U" identifier in the serial tag model number immediately following the dash four voltage input designator as in "-4U".

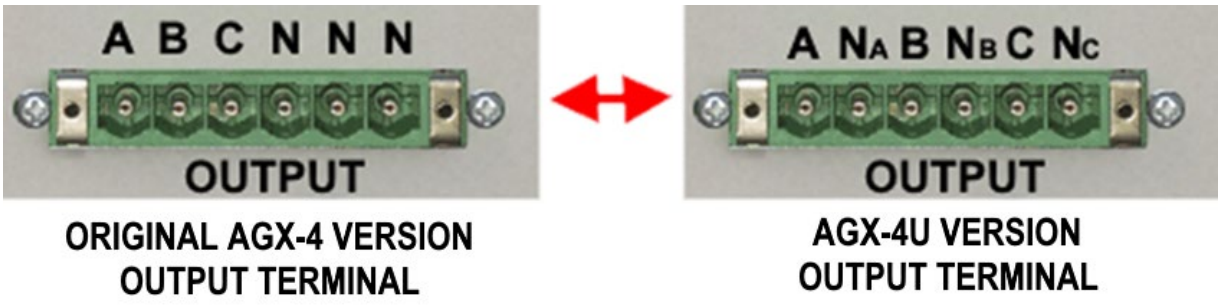


Figure 7-1: AGX-4 vs AGX-4U Version Output Terminal Pin Assignments

© 2025, Pacific Power Source, Inc., Irvine, CA All rights reserved

Thus, a 3120AGX-4 is an original version with common neutrals, whereas a 3120AGX-4U is a newer version with isolated neutrals that can be shorted if needed by installed in the included shorting bar. Note that "-4U" models are default shipped with this shorting bar installed unless the "W" option is specified at the time of ordering. The removable Neutral shorting bar on AGX-4U models is shown in figure.

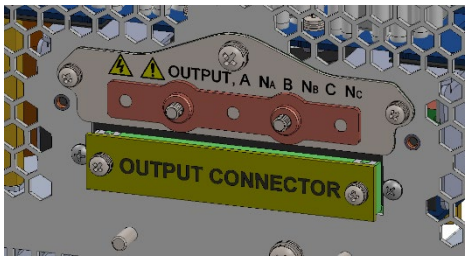


Figure 7-2: Neutral Shorting Bar

7.3 Additional Considerations

With the unit working in voltage mode, if the outputs are connected in delta mode it is equivalent to connecting three voltage sources in parallel, which is a problem since voltage sources that are connected in parallel will "fight" to control the voltage. This results in at least one of them tripping an overcurrent protection.

Delta connection of the output is mostly meant to be used in load and current source mode. In general, voltage mode should be used with a wye/star connection of the outputs.

Something similar happens with a standard unit(with wye/star connection) in load (or current mode) with the neutral terminals **not** connected to the voltage source (unit under test). It´s equivalent to have current sources in parallel, which is not permissible as one phase will saturate its output trying to control the current.

8 Summary

• AZX/AGX in three phase voltage mode, the output amplifiers "should" be connected in star (Y), with 3 neutrals shorted together, as the standard AZX (GSZ, ELZ) / AGX (RGS, RLS):

• AZX/AGX in three phase (or split-phase) mode and current or load operating mode, can be used in 3 different configurations:

- Voltage source neutral connected to the AZX/AGX neutral
- No neutral connection to voltage source, but AZX/AGX output amplifiers in true delta connection
- No neutral connection to voltage source and AZX/AGX output amplifiers in star connection:
  - AZX works in any load mode by unchecking the "Neutral connected" option. This enables a voltage control loop that automatically balances the neutral potential.
  - AGX works only in constant resistance mode."

9 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.

PACIFIC POWER SOURCE
2802 Kelvin Ave, Suite 100
Irvine, CA 92614 USA
Phone: +1 949.251.1800
Fax: +1 949.756.0756
Toll Free: 800.854.2433
E-mail: sales@pacificpower.com
www.pacificpower.com

© 2025, Pacific Power Source, Inc., Irvine, CA All rights reserved