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USER MANUAL

AMN PS-2A

Automatic Matching Network Power Supply Controller

5708577-A

April 17, 2002

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User Manual

AMN PS-2A
Automatic Matching Network Power Supply Controller

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ADVANCED ENERGY®

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WARNING:

Read this entire manual and all other publications pertaining to the work to be performed before you install, operate, or maintain this equipment. Practice all plant and product safety instructions and precautions. Failure to follow instructions can cause personal injury and/or property damage. All personnel who work with or who are exposed to this equipment must take precautions to protect themselves against serious or possibly fatal bodily injury.

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Introduction

READ THIS SECTION!

To ensure safe operation, you should read and understand this manual before you attempt to install or operate this unit. At a minimum, read and heed the “Safety” section in this chapter.

INTERPRETING THE MANUAL

The following sections describe the type conventions in the manual as well as the icons and symbols you may see in the manual.

Type Conventions

To help you quickly find what is being discussed, the manual presents certain words and phrases in type that is different from the rest of the text. We use the following type conventions:

- Pin and signal names appear in capitalized italics (*DUTY CYCLE.A*).
- Labels that are on the unit (switches, indicators, etc.) generally appear in boldface capital letters (**MODIFY**); however they appear as you see them on the unit. Exceptions are port names, which simply begin with a capital letter (User port).
- Commands (**162**) and command names (**setpoint**) appear in boldface lowercase letters.

Icons (Symbols)



This symbol represents important notes concerning potential harm to people, this unit, or associated equipment. It is found whenever needed in the manual.

We include this symbol in Danger, Warning, and Caution boxes to identify specific levels of hazard seriousness.



DANGER:

This box identifies hazards that could result in severe personal injury or death.

WARNING:
This box identifies hazards or unsafe practices that could result in personal injury.

CAUTION:
This box identifies hazards or unsafe practices that could result in product or property damage.

The following symbols could appear on labels on your unit.

Hazardous Voltage



1332

High voltage



1028

CE label



1020

Warning (refer to manual)



1027

SAFETY

Do not attempt to install or operate this equipment if you have not first acquired proper training.

- Ensure that this unit is properly grounded.
- Ensure that all cables are properly connected.
- Verify that input line voltage and current capacity are within specifications before turning on the power supplies.
- Use proper ESD precautions.
- BE CAREFUL AROUND THIS EQUIPMENT

PRODUCT SAFETY/COMPLIANCE

Certain options of this unit have been tested for and comply with the following:

Directives and Standards

The following tables list the Electromagnetic Compatibility (EMC) and Safety directives and standards.

Table 1-1. *Electromagnetic Compatibility (EMC)*

Directive or Standard	Description
89/336/EEC	EC Council directive on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Directive).
EN 61000-6-2	Electromagnetic Compatibility– Generic Standards— Immunity for Industrial Environment
EN 55011	Limits and Methods of Measurement of Radio Disturbance Characteristics of Industrial, Scientific, Medical (ISM) Radio Frequency Equipment (Class A, Group 2) (CISPR 11).

Table 1-2. *Safety*

Directive or Standard	Description
73/23/EEC	EC Council directive on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits (LVD - Low Voltage Directive).
EN61010-1	Safety requirements for electrical equipment for measurement, control, and laboratory use.

This device must be installed and used only in compliance with the standards listed and applicable requirements.

Certification

Certain options of this product are certified by:

- CE marking is self addressed by AE Compliance Engineering
- EMC measurements verified by UNISYS PCTC.

For more information, refer to the letter of conformance (US) or declaration of conformity (EU) accompanying the product.

Installation Requirements

WARNING:
Operating and maintenance personnel must receive proper training before installing, troubleshooting, or maintaining high-energy electrical equipment. Potentially lethal voltages could cause death, serious personal injury, or damage to the equipment. Ensure that all appropriate safety precautions are taken.

WARNING:
RISK OF DEATH OR BODILY INJURY. Disconnect all sources of input power before working on this unit or anything connected to it.

Conditions of Use

To be in compliance with the stated directives and standards, you must meet the following conditions of use.

- Install and operate this device in an overvoltage category II installation only.
- Install and operate this device only in a pollution degree 2 or better environment, which means an indoor location such as a computer room, office, or factory floor where only non-conductive pollution occurs during operation. Occasionally, a temporary conductivity caused by condensation occurs when the device is not operating.

- For units with captive line cord, you must install and operate this device with a disconnect switch that conforms to the applicable requirements. The switch must be easily accessible and near the device.
- Install this device so that the input power connection is inaccessible to the user
- Terminate the ac line cord according to the applicable requirements.
- Use only shielded cables on the remote interface and matching network interface connectors.

Theory

The following sections provide a general description of the Automatic Matching Network Power Supply 2A (AMN PS-2A) controller and a theory of how the controller operates.

GENERAL DESCRIPTION

The AMN PS-2A controller monitors and controls the positions of the load and tune capacitors within the AM family of matching network products, including the AM5, AM10, AM20, AM30, AM50, AM100, AM150, and AM250.

The AMN PS-2A is completely self contained, and it provides all necessary circuitry for controlling the servomotor system in matching networks without internal controllers.

The AMN PS-2A controller can be purchased in versions that use either 115 Vac or 230 Vac source power. These versions are also available with a 12 Vdc external fan option. The external fan option provides +12 Vdc for an external fan, which is mounted onto and provides additional cooling for the matching network. This voltage is provided through pins 14 (+12 Vdc) and 15 (ground) of the matching network connector (J1).

The indicators and meters on the front panel of the AMN PS-2A allow the user to monitor controller status information, including:

- Power on/off
- Failure status
- Tune and load capacitor positions
- Tune and load capacitor minimum limits
- Tune and load capacitor maximum limits

The AMN PS-2A provides flexibility by offering three modes with which the user can operate the matching network load and tune servomotors:

- In *automatic mode*, the matching network's phase and magnitude detectors actively control the servomotor speed and direction of travel.
- In *manual mode*, the user manually controls the servomotors through the momentary switches (labeled "**-**" and "**+**") on the AMN PS-2A front panel.
- In *remote mode*, a user-supplied external 0 to 5 Vdc signal controls the position of the servomotors (through the remote interface on the AMN PS-2A).

The back panel of the AMN PS-2A controller contains a filtered IEC ac line connector, a 25-pin, subminiature-D remote interface connector (**J2**), a 15-pin, subminiature-D matching network connector (**J1**), a BNC phase error signal connector (**J3**), a BNC magnitude error signal connector (**J4**), and phase/magnitude gain adjust potentiometers. These interfaces and connections are discussed in more detail in Chapter 4.

THEORY OF OPERATION

The diagram and the paragraphs that follow outline the theory of operation for the AMN PS-2A.

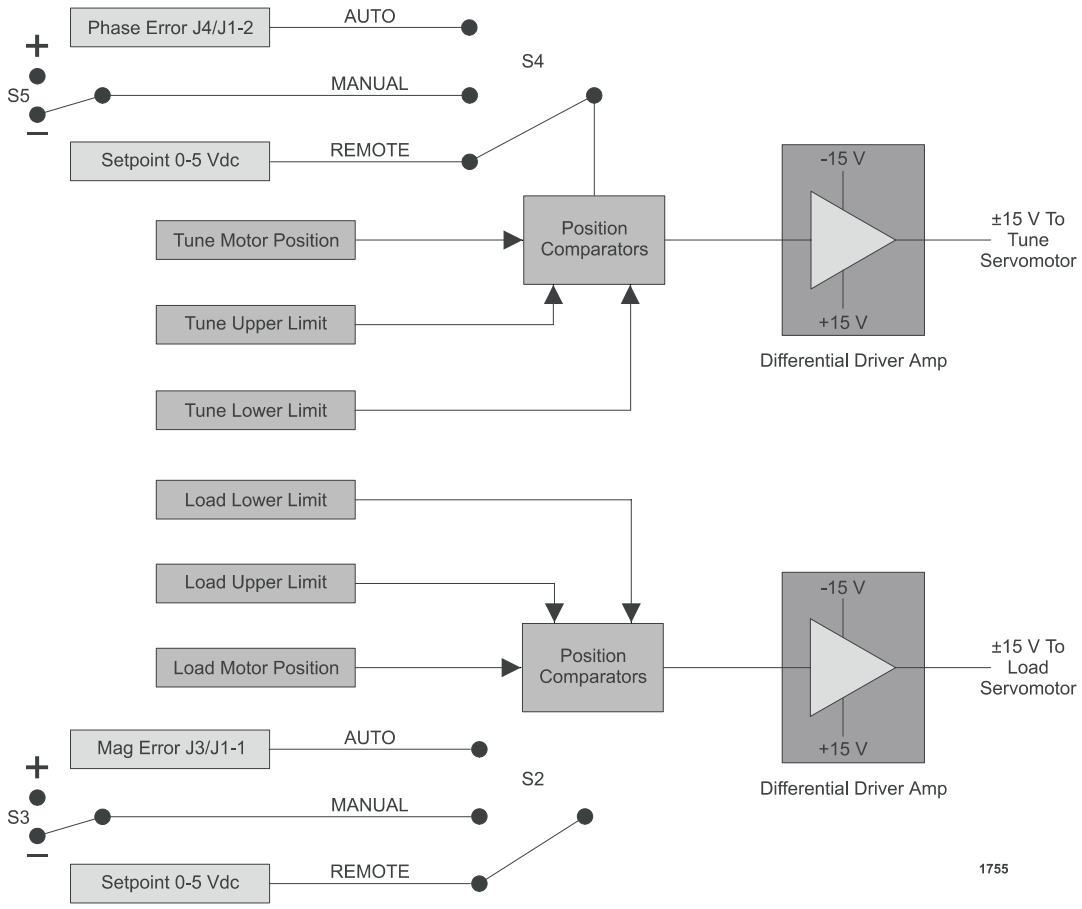


Figure 2-1. *Theory of Operation Block Diagram*

The phase/magnitude detector in the matching network samples the transmission line at 50 Ω and generates error signals, which are then sent to the AMN PS-2A. These signals cause the servomotors to turn the series and shunt capacitors. The direction of change depends on the polarity of the error signals.

In the AMN PS-2A, the phase and magnitude error signals are amplified with operational amplifiers that have a variable gain for adjusting the sensitivity of the feedback loop (the phase and magnitude gain adjustments are on the rear panel of the AMN PS-2A). These gain adjustments have a critical function in suppressing plasma oscillation: At low gain, mismatches are not rapidly compensated and thereby increase the reflected power. At high gain, plasma oscillations occur, and stable plasma operation is not feasible.

The amplified error signals are directed from the amplifiers into the AMN PS-2A mode selector, which allows you to select between automatic, manual, and remote operation modes.

A control signal is generated through the selected mode of operation, and this control signal is routed to a series of motor position comparators within the AMN PS-2A controller. The comparators also receive signals from the position fail detector. These position fail detector signals are processed from the motor position sensors, and they indicate motor position and provide information on the capacitance of the series capacitor. If the comparators receive no signals from these sensors, the **FAIL** LED on the front panel of the AMN PS-2A controller lights. To prevent damage to the series and shunt capacitors, the position fail detector also feeds the limit detector, which activates the brake that stops the servomotors when a limit is exceeded.

The comparators use these signals to compare the current servomotor position to that requested by the control signal and to its upper and lower mechanical limits. If the comparators detect a difference between the control signal and the current servomotor position, and if the motor is within its physical limits, this difference is forwarded to the differential motor drivers. (If it is not within the limits, the comparator does not forward a signal to the servomotor drive.)

The motor drivers provide ±15 Vdc to the servomotor to produce clockwise or counterclockwise rotation, allowing for adjustment of the servomotor speed. This adjustment keeps the servomotors from driving the series and shunt capacitors beyond the match point.

Specifications

The sections in this chapter describe the specifications of this unit, including physical, electrical, and environmental specifications.

PHYSICAL SPECIFICATIONS

Table 3-1 describes the physical specifications of the AMN PS-2A controller.

Table 3-1. *Physical Specifications*

Size	4.45 cm (H) x 21.59 cm (48.26 cm rack mount) (W) x 25.40 cm (D) 1.75 in. (H) x 8.50 in. (19 in. rack mount) (W) x 10.00 in. (D)
Weight	2.86 kg (6.3 lb)
Clearance	5 in. (12.7 cm) clearance from rear of unit for cable connections
Mounting	Mount to 19 in. rack using four #10 screws.
Connector/Cable specifications	
AC input power	Power cord with IEC 320 Connector (provided)
Matching network interface	15-pin, female, subminiature-D connector
Remote interface	25-pin, male, subminiature-D connector
Phase error voltage input	Type BNC coaxial, female
Magnitude error voltage input	Type BNC coaxial, female
Grounding	Equipment earth ground provided via IEC 320 ac input power connector.

ELECTRICAL SPECIFICATIONS

Table 3-2 describes the electrical specifications of the AMN PS-2A controller.

Table 3-2. *Electrical Specifications*

Input power specifications	
Line voltage	115 Vac or 230 Vac ±10%, single phase
Line frequency	50 to 60 Hz

Table 3-2. *Electrical Specifications (Continued)*

Line current	1A (115 Vac) maximum, 0.5A (230 Vac)
Over-current protection (non-user accessible)	• 115 Vac operation: two 0.75 A, 250 V, Slow-blow fuses (see Figure 3-1 on page 3-2) • 230 Vac operation: two 0.375 A, 250 V, Slow-blow fuse (see Figure 3-2 on page 3-3)
Power consumption	45 W maximum

Figure 3-1 and Figure 3-2 illustrates the wiring for the 115 Vac and 230 Vac transformers.

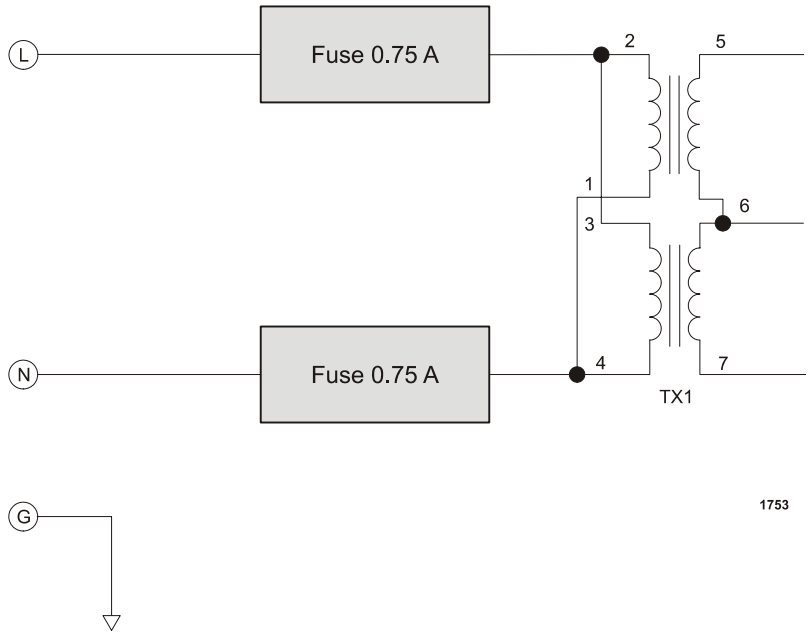


Figure 3-1. *Wiring for 115 Vac transformer*

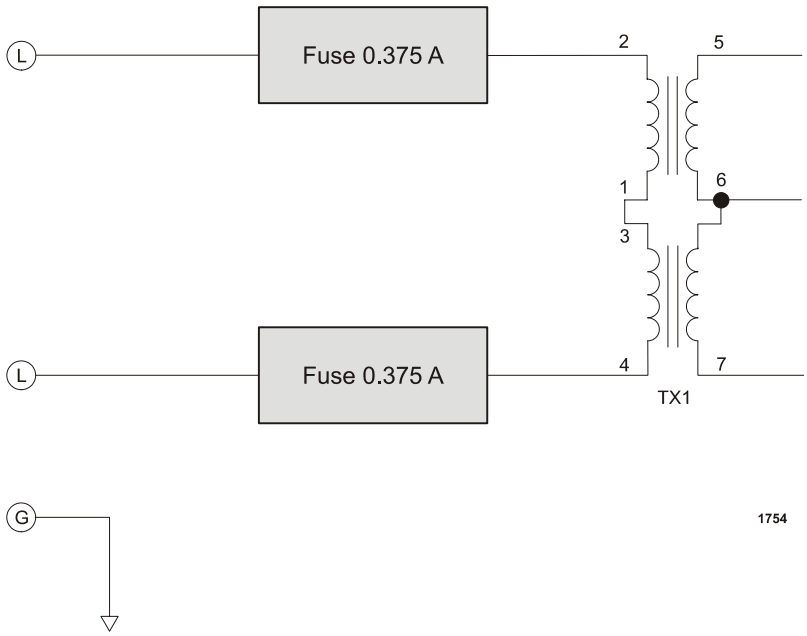


Figure 3-2. *Wiring for 230 Vac Transformer*

ENVIRONMENTAL SPECIFICATIONS

Table 3-3 and Table 3-4 describe the environmental specifications of the AMN PS-2A controller.

Table 3-3. *Climatic Specifications per EN 50178 and EN 60721*

	Temperature	Relative Humidity	Air Pressure
Operating	Class 3K3 0°C to +40°C +32°F to +104°F	Class 3K2 10% to 85% Note 1 +2 g/m^3 to +25 g/m^3	Class 3K3 80 kPa to 106 kPa 800 mbar to 1060 mbar (approximately 2000 m above sea level)
Storage	Class 1K4 -25°C to +55°C -13°F to +131°F	Class 1K3 5% to 95% +1 g/m^3 to +29 g/m^3	Class 1K4 80 kPa to 106 kPa 800 mbar to 1060 mbar (approximately 2000 m above sea level)
Transportation	Class 2K3 -25°C to +70°C -13°F to +158°F	Class 2K3 95% Note 2 +60 g/m^3 Note 3	Class 2K3 66 kPa to 106 kPa 660 mbar to 1060 mbar (approximately 3265 m above sea level)

Note 1 Non-condensing

Note 2 Maximum relative humidity when the unit temperature slowly increases, or when the unit temperature directly increases from -25°C to +30°C

Note 3 Maximum absolute humidity when the unit temperature directly decreases from +70°C to +15°C

Table 3-4. *Environmental Specifications*

Overvoltage	Category II
Pollution Degree	2

Controls, Indicators, and Interfaces

This chapter details the interfaces, indicators, and controls available on the front and rear panels of the AMN PS-2A controller.

REMOTE INTERFACE CONNECTOR (J2)

The remote interface connector (**J2**) on the rear panel of the AMN PS-2A controller supplies analog interface signals for system level operation. The AMN PS-2A operates on these signals when the unit is in remote mode. For more information on remote mode operation, see “Remote Mode” on page 5-5. To see the location of the remote interface connector (**J2**) on the rear panel, see Figure 4-7 on page 4-9.

Remote Interface Connector (J2) Electrical Characteristics

Table 4-1 describes the signals used in the AMN PS-2A remote interface connector.

Table 4-1. *Remote Interface Connector Signal Types*

Signal Type	Description
Analog Inputs	The setpoint signals from pins 12 and 13 are 0 to 5 V signals scaled to represent the desired tune and load capacitor positions as a percentage of maximum.
Analog outputs	The setpoint signals from pins 11 and 23 are 0 to 5 V signals scaled to represent the actual tune and load capacitor positions as a percentage of maximum.
Digital outputs	Ground path is provided when pin is low. When high, open collectors are present.
Grounds	All ground lines are to chassis ground.

Interface Cabling Requirements

The cable used to connect the AMN PS-2A controller’s 25-pin remote interface connector to the system must be a shielded, 25-wire I/O cable. Signal losses should be minimized by keeping the cable length as short as possible. The maximum

recommended cable length is 10 meters (33 ft.). To minimize interference from adjacent electrical equipment, the EMI shield in the cable must be terminated to the metal shells of the cable's connectors.

Remote Interface Connector (J2)

Figure 4-1 shows the remote interface connector (J2).

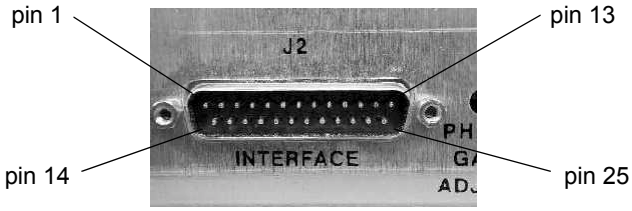


Figure 4-1. *Remote Interface Connector (J2)*

The remote interface connector (J2) uses a 25-pin, shielded, female, subminiature-D connector.

Table 4-2 describes the connector pin signals for the remote interface connector.

Table 4-2. *Remote Interface Connector (J2) Pin Descriptions*

Signal Pin	Name	Signal Type	Description
1	not used	n/a	n/a
2	*REMOTE ON/OFF (LOAD)*	Ground input	This pin enables remote operation of the load servomotor when grounded.
3	*REMOTE ON (TUNE)*	Digital output	This pin is low when the controller is in remote mode.
4	*REMOTE ON (LOAD)*	Digital output	This pin is low when the controller is in remote mode.
5	*REMOTE ON/OFF (TUNE)*	Ground input	This pin enables remote operation of the tune servomotor when grounded.
6	*- TUNE LIMIT*	Digital output	This pin is low when the negative tune limit is exceeded.
7	*+ TUNE LIMIT*	Digital output	This pin is low when the positive tune limit is exceeded.
8	*FAILURE OUTPUT*	Digital output	This pin is low in normal operation, high if there is a failure.
9	*-LOAD LIMIT*	Digital output	This pin is low when the negative load limit is exceeded.

Table 4-2. *Remote Interface Connector (J2) Pin Descriptions (Continued)*

Signal Pin	Name	Signal Type	Description
10	*+LOAD LIMIT*	Digital output	This pin is low when the positive load limit is exceeded.
11	*LOAD METER OUTPUT*	Analog output	This pin's 0 to 5 Vdc output is proportional to the front panel load meter.
12	*SETPOINT INPUT (TUNE)*	Analog input	In remote mode, this 0 to 5 Vdc input positions the Tune capacitor.
13	*SETPOINT INPUT (LOAD)*	Analog input	In remote mode, this 0 to 5 Vdc input positions the Load capacitor.
14	not used	n/a	n/a
15	*+15 V DC*	n/a	n/a
16	*-15 VDC*	n/a	n/a
17-22	not used	n/a	n/a
23	*TUNE METER OUTPUT*	Analog output	This pin's 0 to 5 Vdc output is proportional to the front panel tune meter.
24	ground	Ground	Ground
25	ground	Ground	Ground

Note: Pins 3, 4, 6, 7, 8, 9 and 10 are open collector. Requires pull-up resistor of 10K ohm to (+5V to +15VDC) if "high" is open or floating state.

MATCHING NETWORK INTERFACE CONNECTOR (J1)

The matching network interface connector (J1) on the rear panel of the AMN PS-2A controller provides the communication connection to the matching network. To see the location of the matching network interface connector (J1) on the rear panel, see Figure 4-7 on page 4-9.

Matching Network Interface Connector (J1) Electrical Characteristics

Table 4-3 describes the signals used in the AMN PS-2A matching network interface connector.

Table 4-3. *Matching Network Interface Connector Signal Types*

Signal Type	Description
Analog Inputs	The phase/magnitude error signals from pins 1 and 2 are ± 0 to 2 V signals dependent on the degree of error and RF power levels applied to the matching network. The load and tune wiper signals from pins 5 and 6 are 0 to 5 V signals scaled to represent the actual tune and load capacitor positions as a percentage of maximum. Interlocks on pins 14 and 15 provide interlock loop path.
Supply voltages	The load and tune supply voltages from pins 3 and 4 are ±15 V drive voltage applied to the matching network servomotors. Reference voltages on pins 7 and 8 are used for minimum/maximum load and tune capacitor positions.
Grounds	All ground lines are to chassis ground.

Interface Cabling Requirements

The cable used to connect the AMN PS-2A controller's 15-pin matching network interface connector to the matching network must be a shielded, 15-wire I/O cable. Signal losses should be minimized by keeping the cable length as short as possible. The maximum recommended cable length is 10 meters (33 ft.). To minimize interference from adjacent electrical equipment, the EMI shield in the cable must be terminated to the metal shells of the cable's connectors.

Matching Network Interface Connector (J1)

Figure 4-2 shows the matching network interface connector (J1).

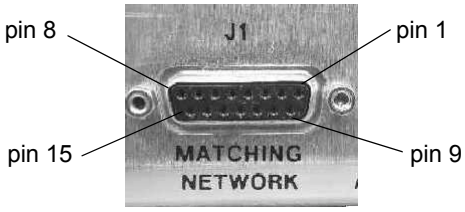


Figure 4-2. *Matching Network Interface Connector (J1)*

The matching network interface connector (J1) uses a 15-pin, shielded, female, subminiature-D connector.

Table 4-4 describes the connector pin signals for the matching network interface connector.

Table 4-4. *Matching Network Interface Connector (J1) Pin Descriptions*

Signal Pin	Name	Signal Type	Description
1	*MAGNITUDE ERROR VOLTAGE*	Analog input	This pin provides the magnitude error signal from the phase/magnitude detector in the matching network.
2	*PHASE ERROR VOLTAGE*	Analog input	This pin provides the phase error signal from the phase/magnitude detector in the matching network.
3	*LOAD MOTOR ±15 VDC DRIVE*	Power supply voltage	This signal controls clockwise and counterclockwise rotation in the load servomotor.
4	*TUNE MOTOR ±15 VDC DRIVE*	Power supply voltage	This signal controls clockwise and counterclockwise rotation in the tune servomotor.
5	*TUNE WIPER*	Analog input	This signal references the position of the tune capacitor potentiometer.
6	*LOAD WIPER*	Analog input	This signal references the position of the load capacitor potentiometer.
7	*5.2 VDC OUT*	Analog reference voltage output	This signal references the maximum voltage for load and tune capacitor position potentiometers.
8	*0.15 VDC OUT*	Analog reference voltage output	This signal references the minimum voltage for load and tune capacitor position potentiometers.
9	*COMMON*	Ground	This pin provides a common ground for shielding on the phase and magnitude error lines.
10	*GROUND*	Ground	This pin provides chassis ground.
11	*±15 VDC LOAD MOTOR RETURN*	Ground	This pin provides ground return for load motor drive voltage (pin 3).
12	*±15 VDC TUNE MOTOR RETURN*	Ground	This pin provides ground return for tune motor drive voltage (pin 3).
13	Ground	Ground	Chassis ground

Table 4-4. *Matching Network Interface Connector (J1) Pin Descriptions (Continued)*

Signal Pin	Name	Signal Type	Description
14	*+12 VDC or no connection*	Analog output	In units with the +12 Vdc external fan option, this pin provides +12Vdc at 100mA DC to run the external fan.
15	*ETERNAL FAN GROUND or no connection*	Analog output	In units with the +12 Vdc external fan option, this pin provides the ground return for the external fan (pin 14).

PHASE (J3) AND MAGNITUDE (J4) ERROR VOLTAGE INPUT PORTS

The phase and magnitude error voltage input ports are both BNC-type coaxial, female connectors. Phase and magnitude error signals can be supplied at J3 and J4 or on pins 2 and 1 of the matching network interface connector (J1), respectively. The signal feed scheme will depend on the specific matching network being used with the AMN PS-2A controller. Please see the manual that came with your matching network for more information about the connection requirements for your system.

Phase Error Voltage Input Port (J3)

Figure 4-3 shows the phase error voltage input port (J3)



Figure 4-3. *Phase Error Voltage Input Port (J3)*

Magnitude Error Voltage Input Port (J4)

Figure 4-4 shows the magnitude error voltage input port (J4).



Figure 4-4. *Magnitude Error Voltage Input Port (J4)*

PHASE/MAGNITUDE GAIN ADJUSTORS

The phase and magnitude gain adjustment potentiometers are accessed from the AMN PS-2A rear panel, as shown in Figure 4-5. To decrease the gain, turn the potentiometers clockwise. To increase the gain, turn the potentiometers counterclockwise.

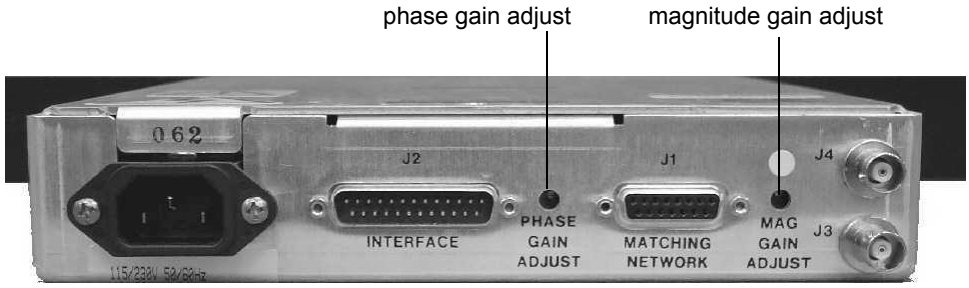


Figure 4-5. *Phase and Magnitude Gain Adjustments on Rear Panel*

FRONT PANEL SWITCHES AND INDICATORS

Figure 4-6 identifies the switches and indicators on the front panel of the AMN PS-2A controller. Table 4-5 defines each of the numbered switches and indicators.

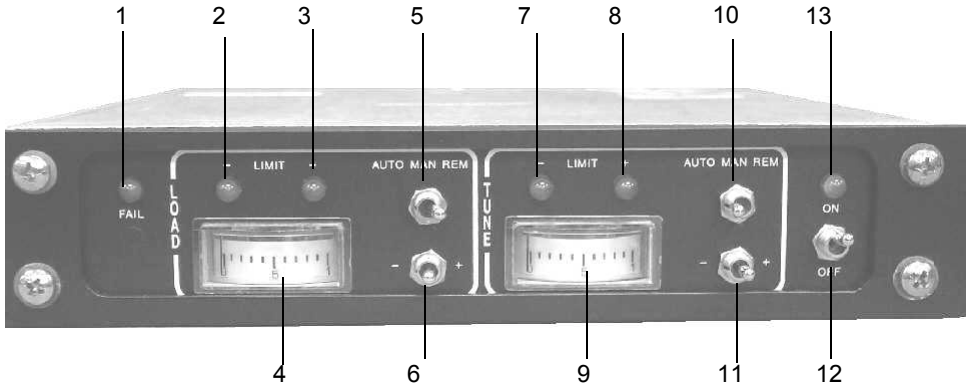


Figure 4-6. *AMN PS-2A Controller Front Panel*

Table 4-5. *Front Panel Controls and Indicators*

Number	Control/ Indicator	Description
1	**FAIL** LED	When lit, this LED indicates a loss of reference voltage from the AMN PS-2A controller to the matching network.
2	LOAD **- LIMIT** (minimum) LED	When lit, this LED indicates that the load capacitor motor has reached its minimum limit.
3	LOAD **+ LIMIT** (maximum) LED	When lit, this LED indicates that the load capacitor motor has reached its maximum limit.
4	**LOAD** meter	This meter indicates the present position of the load capacitor.
5	Load **AUTO/ MAN/REM** switch	This mode switch places motor control in one of three operation modes: automatic, manual, or remote.
6	Load **-/+** switch	When the controller is in manual mode, this switch adjusts the load capacitor. Putting the switch in the "**+**" position adjusts the capacitor in the positive direction. Putting the switch in the "**-**" position adjusts the capacitor in the negative direction.

Table 4-5. *Front Panel Controls and Indicators (Continued)*

Number	Control/ Indicator	Description
7	Tune **- LIMIT** (minimum) LED	When lit, this LED indicates that the tune capacitor motor has reached its minimum limit.
8	Tune **+ LIMIT** (maximum) LED	When lit, this LED indicates that the tune capacitor motor has reached its maximum limit.
9	**TUNE** meter	This meter indicates the present position of the tune capacitor.
10	Tune **AUTO/ MAN/REM** switch	This switch places tune motor control in one of three operation modes: automatic, manual, or remote.
11	Tune **±** switch	When the controller is in manual mode, this switch adjusts the tune capacitor. Putting the switch in the "+" position adjusts the capacitor in the positive direction. Putting the switch in the "-" position adjusts the capacitor in the negative direction.
12	**ON/OFF** switch	This switch applies power to the AMN PS-2A controller.
13	Power LED	When lit, this LED indicates that power is being applied to the controller.

REAR VIEW ILLUSTRATION

Figure 4-7 shows the rear panel of the AMN PS-2A controller.

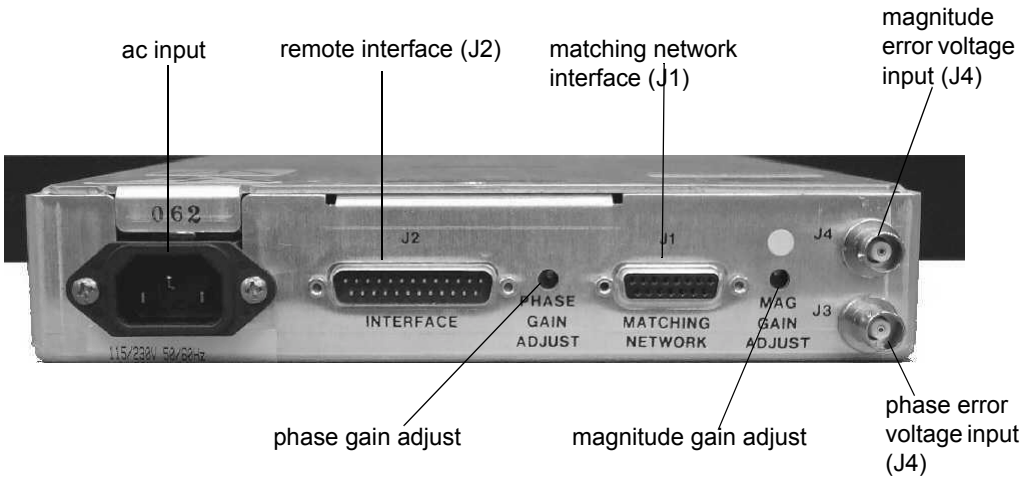


Figure 4-7. *Rear View*

Chapter 5

Installation, Setup, and Operation

INSTALLING

The following sections describe how to install the AMN PS-2A matching network controller.

Unpacking

Unpack and inspect your controller carefully. Check for obvious physical damage. If no damage is apparent, proceed with the unit connections. If you do see signs of shipping damage, contact Advanced Energy Industries, Inc., and the carrier immediately. Save the shipping container for submitting necessary claims to the carrier.

Grounding

Equipment earth ground provided via IEC 320 ac input power connector.

Spacing Requirements

The following dimensional drawing illustrates the spacing requirements of the AMN PS-2A controller.

DIMENSIONAL DRAWING

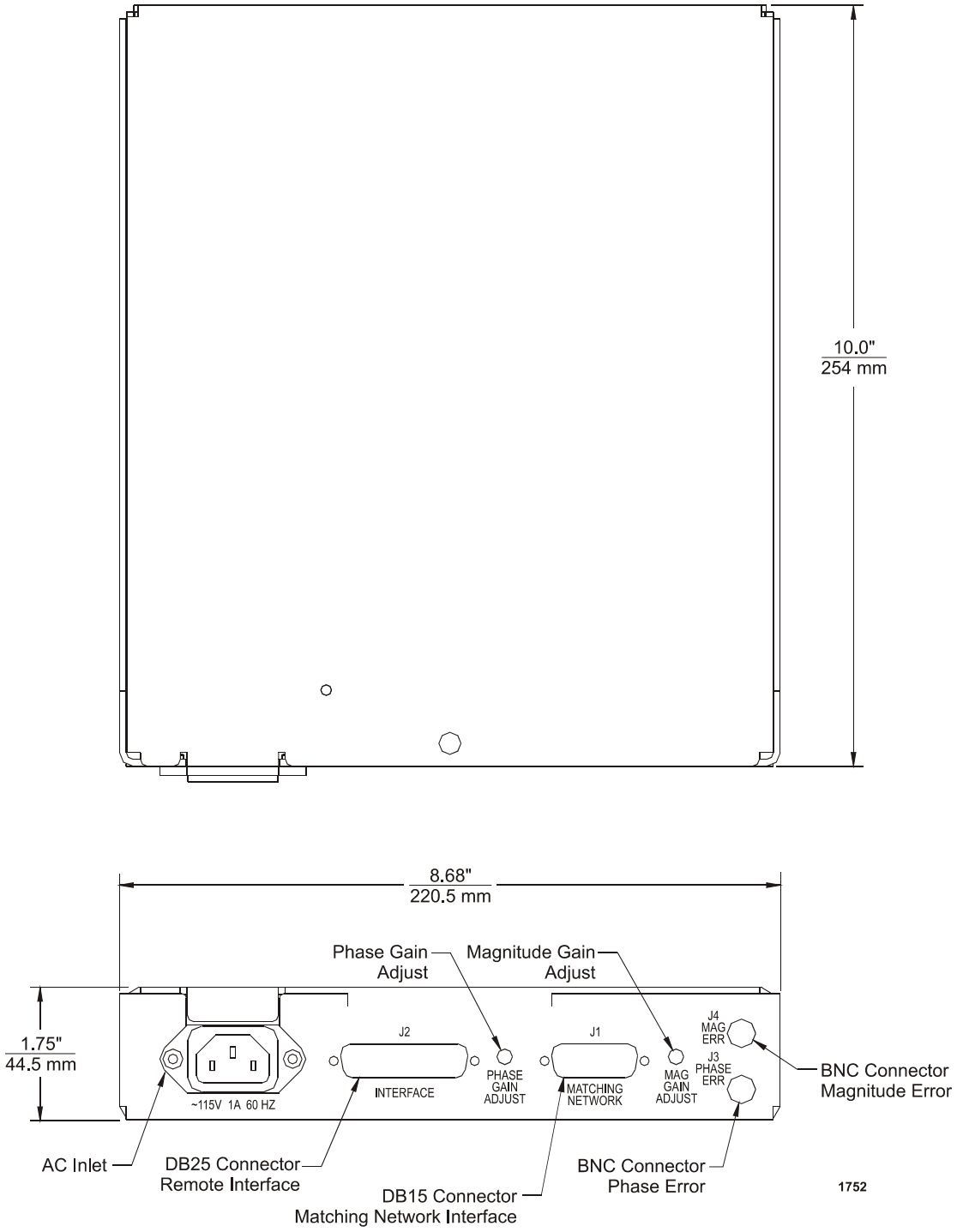


Figure 5-1. *Dimensions*

Mounting the Controller and Making Connections

Mount the AMN PS-2A controller in a convenient rack panel and connect the ac power cable.

Note: When mounting the controller, ensure that the ac power connector is user accessible as it serves as the main power disconnect for the unit.

After the controller is mounted and ac power is connected, make the following connections:

1. Connect the interconnect cable from the 15-pin, subminiature-D matching network interface connector (**J1**) on the controller to the 15-pin, subminiature-D controller interface connector on the matching network. For a more detailed description of matching network interface connector (**J1**), see Chapter 4.

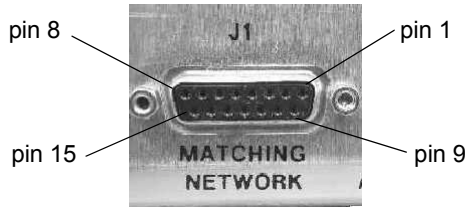


Figure 5-2. *Matching Network Interface Connector (J1)*

2. If you are using the remote mode of operation, connect to the remote interface connector (**J2**). Refer to the system installation guide for instructions on connecting this cable. (This connector supplies analog and digital interface signals for remote system level operation.) For a more detailed description of this connector, see Chapter 4.

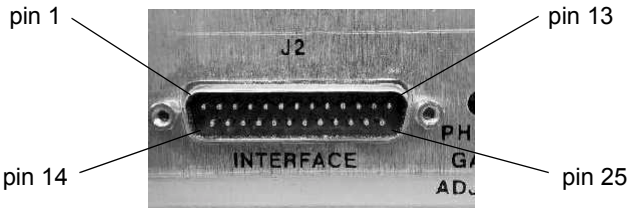


Figure 5-3. *Remote Interface Connector (J2)*

3. If necessary, make the magnitude and phase error input voltage connections through J3 and J4.



Figure 5-4. *BNC-Type Connector (J3 and J4)*

Electrical Verification

Once the AMN PS-2A controller is installed, use the following steps to verify that the unit is properly installed and connected:

1. Turn on the AMN PS-2A control using the **ON/OFF** switch on the front panel. For an illustration showing the location of this switch on the front panel, see Figure 4-6 on page 4-8.
2. Move the **AUTO/MAN/REV** switch to the **MAN** position on both the **LOAD** and the **TUNE** side.
3. Operate the ± on both sides to ensure that the motors turn smoothly, that the **LIMIT** LEDs on both sides operate, and that the **LOAD** and **TUNE** meters move properly.
4. Use the **ON/OFF** switch to turn the AMN PS-2A controller off.

OPERATION

The AMN PS-2A has three modes of operation: automatic, manual, and remote. The operational mode depends on the settings of the **AUTO/MAN/REM** switches.

The AMN PS-2A controller is typically used in automatic mode. However, you may want to use the remote mode in instances where the plasma impedance at initial strike point differs significantly from the post-ignition plasma impedance. In this situation, load and tune position remote presets can be set to provide the required impedance at initial plasma strike. Once the plasma is ignited, you can shift the servomotor control to the automatic mode.

Use the manual mode of operation to manually set the load and tune servomotors when determining required remote preset positions. The manual mode can also be used when troubleshooting the unit.

Note: In order to operate in one of these modes, both **AUTO/MAN/REM** switches must be in the same position.

Automatic Mode

In automatic mode, the AMN PS-2A controller drives the matching network's capacitor servomotors based on the phase/magnitude detector error signals generated by the matching network.

When RF is enabled in the system, a matching network mismatch causes the phase magnitude detector to generate phase and magnitude error signals. These error signals are supplied to the AMN PS-2A controller through the magnitude error voltage input connector (**J4**) and the phase error voltage input connector (**J3**). In response to these signals, the controller drives the matching networks capacitor servomotors. As the network comes closer to an impedance match, the phase and magnitude error voltages reach a null value, and the controller no longer drives the servomotors.

To operate the AMN PS-2A controller in automatic mode, place both the load and the tune **AUTO/MAN/REM** switches in **AUTO** position.

Manual Mode

In manual mode, the AMN PS-2A controller drives the matching network's capacitor servomotors based on the position of the ± switches on the AMN PS-2A front panel. For an illustration showing the location of this switch on the front panel, see Figure 4-6 on page 4-8

To operate the AMN PS-2A controller in manual mode, place both the load and the tune **AUTO/MAN/REM** switches in **MAN** position.

Remote Mode

In remote mode, the AMN PS-2A drives the matching network's capacitor servomotors based on 0 to 5 Vdc signals received through the remote interface connector (J2). For more information on this connector, see "Remote Interface Connector (J2)" on page 4-1.

To operate the AMN PS-2A controller in remote mode, place both the load and the tune **AUTO/MAN/REM** switches in **REM** position.

Troubleshooting and Global Support

Use the following sections to troubleshoot the AMN PS-2A or to find Global Support contact information.

BEFORE CALLING AE GLOBAL SUPPORT

Before calling AE Global Support, perform the following steps or procedures.

> **WARNING:**
> **RISK OF DEATH OR BODILY INJURY. Disconnect all sources of input power before working on this unit or anything connected to it.**

Troubleshooting With the Power Off

1. Ensure that power to the unit is off.
2. Check for visible damage to the unit, cables, and connectors.
3. Ensure that all unit connectors are installed correctly and are fastened tightly.
4. Check to determine whether any system-related circuit breakers have been tripped.
5. Ensure there is input power to the unit, and ensure the input power meets specifications.

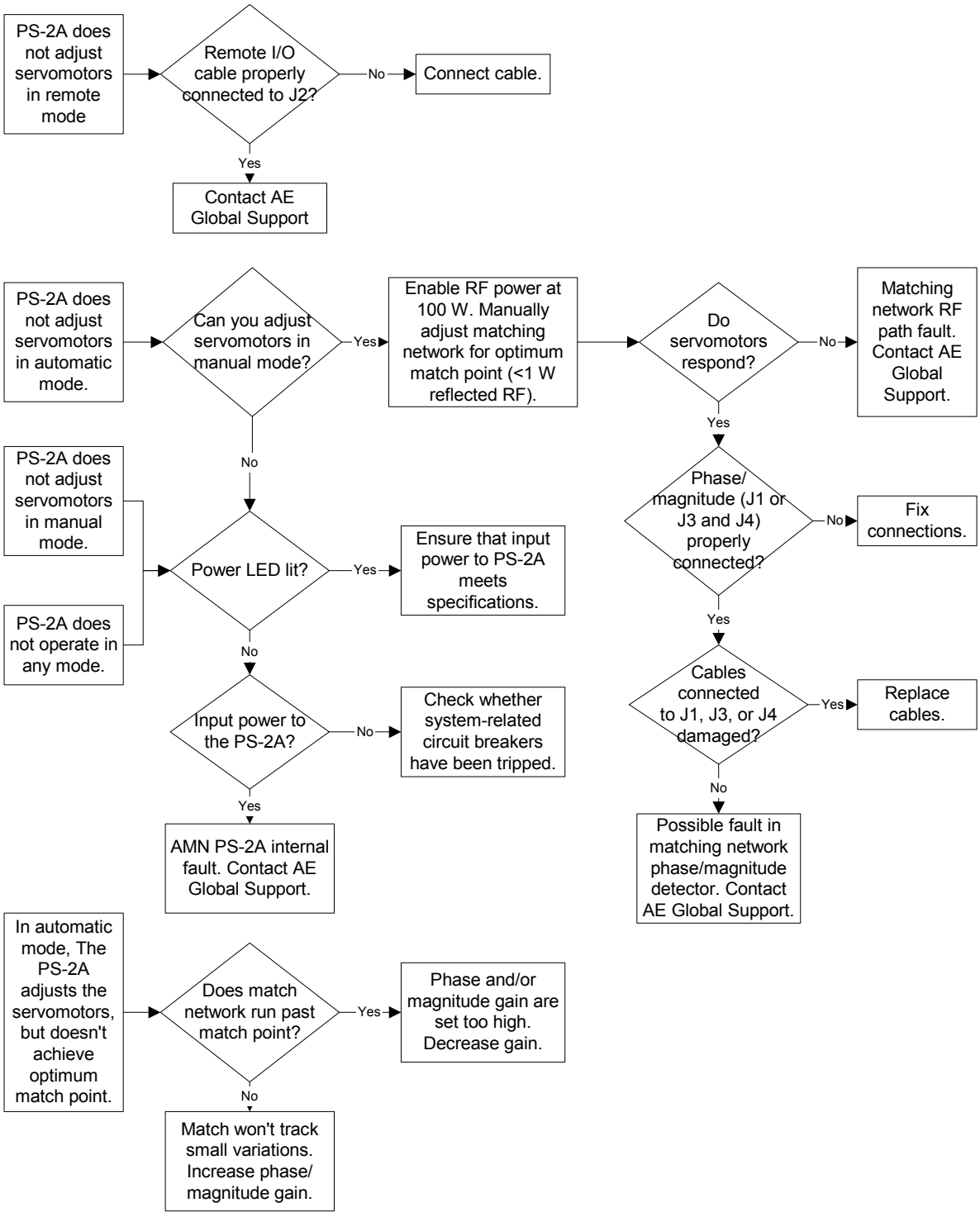
Troubleshooting With the Power On

1. Check the unit's input and remote power connections to ensure that proper power is being supplied to the unit.
2. Check the LEDs on all units to determine that the proper ones are lit.
3. In manual mode, run both capacitors to positive and negative limits. Verify that the proper LEDs light when limits are reached.
4. If the matching network runs past the optimum match point, the phase and/or magnitude gain may be set too high. To adjust, turn the phase and/or magnitude gain adjust potentiometers clockwise to decrease the gain level. For an illustration of the gain adjustments on the rear panel, see "Phase/Magnitude Gain Adjustors" on page 4-7.

5. If the matching network is not tracking small variations in the system, the phase and/or magnitude gain may be set too low. To adjust, turn the phase and/or magnitude gain adjust potentiometers counterclockwise to increase the gain level. For an illustration of the gain adjustments on the rear panel, see “Phase/Magnitude Gain Adjustors” on page 4-7.

Troubleshooting Flow Chart

Use this chart to troubleshoot the AMN PS-2A controller. To begin, select the problem you are experiencing from the boxes on the left side of the diagram.



AE GLOBAL SUPPORT

Please contact one of the following offices if you have questions.

Table 6-1. *Global Support*

Office	Contact
AE, World Headquarters 1625 Sharp Point Drive Fort Collins, CO 80525 USA *Note:* For returns and repairs, please call Global Support to get the correct shipping address.	Phone (24 hrs/day, 7 days/week): 800.446.9167 or 970.221.0108 Fax (M–F, 7:00 am – 5:30 pm MST): 970.407.5981 Email: technical.support@aei.com (We will respond to email by the next business day.) *Note:* For customers outside the US, please contact your local AE office.
AE, Voorhees, NJ 1007 Laurel Oak Road Voorhees, NJ 08043 USA	Phone: 800.275.6971 or 856.627.6100 Fax: 856.627.6159
AE, GmbH Raiffeisenstrasse 32 70794 Filderstadt (Bonlanden) Germany	Phone: 49.711.77927.0 Fax: 49.711.7778700
AE, Japan KK TOWA Edogawabashi Bldg. 347 Yamabuki-cho Shinjuku-ku, Tokyo Japan	Phone: 81.3.32351511 Fax: 81.3.32353580
AE, Korea Ltd. Gongduk Building, 4th floor 272-6 Seohyun-Dong, Bundang-Gu, Sungam Si Kyunggi, 463-050 Korea	Phone: 82.342.705.2100 Fax: 82.342.705.2766
AE, United Kingdom Unit 5, Minton Place, Market Court, Victoria Road Bicester, Oxon OX26 6QB UK	Phone: 44.1869.320022 Fax: 44.1869.325004

Office	Contact
AE, Taiwan, Ltd. 10F-6, No. 110, Chung Shan Rd. Sec. 3, Chungho City, Taipei Hsien Taiwan 235	Phone: 886-2-82215599 Fax: 886-2-82215050
AE, China Rm. 910 Anhui Building, No. 6007 Shennan Road, Shenzhen, China 518040	Phone: 86-755-3867986 Fax: 86-755-3867984

RETURNING UNITS FOR REPAIR

Before returning any product for repair and/or adjustment, ***first follow all troubleshooting procedures***. If, after following these procedures, you still have a problem or if the procedure instructs you to, call AE Global Support and discuss the problem with a representative. Be prepared to give the model number and serial number of the unit as well as the reason for the proposed return. This consultation call allows Global Support to determine whether the problem can be corrected in the field or if the unit needs to be returned. Such technical consultation is always available at no charge.

If you return a unit without first getting authorization from Global Support and that unit is found to be functional, you will be charged a re-test and calibration fee plus shipping charges.

To ensure years of dependable service, Advanced Energy® products are thoroughly tested and designed to be among the most reliable and highest quality systems available worldwide.

WARRANTY

Advanced Energy® (AE) products are warranted to be free from failures due to defects in material and workmanship for 12 months after they are shipped from the factory (please see warranty statement below, for details).

In order to claim shipping or handling damage, you must inspect the delivered goods and report such damage to AE within 30 days of your receipt of the goods. Please note that failing to report any damage within this period is the same as acknowledging that the goods were received undamaged.

For a warranty claim to be valid, it must:

- Be made within the applicable warranty period

- Include the product serial number and a full description of the circumstances giving rise to the claim
- Have been assigned a return material authorization number (see below) by AE Global Support

All warranty work will be performed at an authorized AE service center (see list of contacts at the beginning of this chapter). You are responsible for obtaining authorization (see details below) to return any defective units, prepaying the freight costs, and ensuring that the units are returned to an authorized AE service center. AE will return the repaired unit (freight prepaid) to you by second-day air shipment (or ground carrier for local returns); repair parts and labor will be provided free of charge. Whoever ships the unit (either you or AE) is responsible for properly packaging and adequately insuring the unit.

Authorized Returns

Before returning any product for repair and/or adjustment, call AE Global Support and discuss the problem with them. Be prepared to give them the model number and serial number of the unit as well as the reason for the proposed return. This consultation call will allow Global Support to determine if the unit must actually be returned for the problem to be corrected. Such technical consultation is always available at no charge.

Units that are returned without authorization from AE Global Support and that are found to be functional will not be covered under the warranty (see warranty statement, below). That is, you will have to pay a retest and calibration fee, and all shipping charges.

Warranty Statement

The seller makes no express or implied warranty that the goods are merchantable or fit for any particular purpose except as specifically stated in printed AE specifications. The sole responsibility of the Seller shall be that it will manufacture the goods in accordance with its published specifications and that the goods will be free from defects in material and workmanship. The seller's liability for breach of an expressed warranty shall exist only if the goods are installed, started in operation, and tested in conformity with the seller's published instructions. The seller expressly excludes any warranty whatsoever concerning goods that have been subject to misuse, negligence, or accident, or that have been altered or repaired by anyone other than the seller or the seller's duly authorized agent. This warranty is expressly made in lieu of any and all other warranties, express or implied, unless otherwise agreed to in writing. The warranty period is 12 months after the date the goods are shipped from AE. In all cases, the seller has sole responsibility for determining the cause and nature of the failure, and the seller's determination with regard thereto shall be final.

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