Wilcoxon Research® PA8HF power amplifier
Operating guide

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Contents

WARNING: OPERATION OF THIS AMPLIFIER IS SAFE WHEN THE INSTRUCTIONS IN THIS MANUAL ARE READ THOROUGHLY BEFORE THIS SYSTEM IS CONNECTED TO ELECTRICAL POWER. PARTICULAR ATTENTION MUST BE PAID TO THE SAFETY SECTION OF THIS MANUAL. IT IS THE ULTIMATE RESPONSIBILITY OF THE USER TO SAFELY SET UP, OPERATE AND MAINTAIN THE SYSTEM. REPLACE FUSES ONLY WITH THE SAME TYPE AND RATING AS INDICATEDIN THIS OPERATING GUIDE.

WARNING: TO PREVENT FIRE OR SHOCK HAZARD, DO NOT EXPOSE THIS EQUIPMENT TO RAIN OR MOISTURE.

WARNING: LETHAL VOLTAGES ARE PRESENT IN THE AMPLIFIER AND MATCHING NETWORKS. THE AMPLIFIER CONTAINS ENERGY STORING DEVICES. THEY MUST BE ALLOWED TO DISSIPATE ENERGY BEFORE OPENING THE AMPLIFIER ENCLOSURE.

Safety section

The power amplifier can be safely operated when the instructions in this manual are carefully followed.

This section summarizes the safety considerations. Reminders, in the form described below, will appear in the detailed instructions to assure operator awareness of these safety considerations. Qualified personnel should operate and maintain this power amplifier only after becoming thoroughly familiar with this manual.

WARNING: This symbol is used in the instruction manual where operator safety must be considered. The instruction manual should be consulted and read carefully.

CAUTION: This symbol is used when caution is needed to prevent damage to equipment. It is used where careful attention to certain procedures described in the instruction manual is needed. This symbol is also used to emphasize procedures other than normal operating procedures.

Safety summary

1. Make sure that the power amplifier is properly grounded to a good earth ground.
2. Make sure that any piezoelectric shaker being driven is properly grounded to a good earth ground.
3. Disconnect the power cord at its source before connecting or removing power amplifier cables.
4. To reduce the risk of electric shock, do not remove the power amplifier cover. No user-serviceable parts are inside. Refer all servicing issues to Meggitt Sensing Systems.
5. Do not attempt to operate a power amplifier without the protective covers secured.
6. All cables must be connected between the power amplifier, matching network and shaker before electrical power is connected. Inspect for frayed or cut cables prior to operation.
7. Hearing protection devices are highly recommended in the vicinity of a piezoelectric shaker whenever the shaker is being driven at high output levels.
8. Do not expose this equipment to rain or moisture.
9. Lethal high voltage may be present at the power amplifier output connector.
10. When using the D125L piezoelectric shaker, it requires pressurization (minimum 1800 PSI) from a source of dry, inert gas. The D125L shaker must be electrically connected to the matching network and power amplifier, or the shaker terminals should be shorted together, prior to pressurization or de-pressurization. Pressure must be applied or released slowly (1 minute) to prevent excessive voltages at the shaker connecting terminals. Use extreme caution when handling pressurized cylinders.
11. Use common sense and avoid haste!

1.0 Product description

The PA8HF is a single-channel, rack-mountable power amplifier designed to high performance standards. The PA8HF develops a maximum of 800 watts of power into a 4 Ohm load. The amplifier will drive the full range of Wilcoxon Research shakers, with the ability to drive the larger shakers to the full performance limits of the shakers.

The PA8HF combines the latest power amplifier technology with uniquely simple circuit technology to reduce distortion of all types, and at all power levels, over the full frequency range. In addition to performance achievements, the power amplifier is designed for long-term reliability and exceptional resistance to abusive operating conditions.

The power amplifier has circuit breaker protection for AC power input and fuse protection for the output of the power amplifier.

Specifications	PA8HF
Power output	800 Watts, maximum, into 4Ω load
Power bandwidth	0.5 Hz to 100,000 Hz
Output fusing	12 Ampere, type 3AG or AGC, fast-blow
Input sensitivity	2.5 Volt peak, for full output
Input impedance	50 kΩ, nominal
Dimensions	19” wide, 17.5” deep, 5.25” high
Weight	50 lb
Power requirements	2,000 Watts, maximum

1.1 Front panel

1.1.1 Power switch: The power switch is located on the lower center of the front panel and serves to energize the power amplifier from the AC power line. The switch is a membrane type and latches the power when depressed to place the power in the “ON” or the “OFF” condition.

1.1.2 Power indicator: The PA8HF has an LED indicator above the power switch to monitor the following conditions:

- Unlit - indicates the amplifier has no power.
- Red - indicates the amplifier is muted (power-up)
- Green - indicates the amplifier operation is normal.
- Flashing red - indicates the amplifier clipping.
- Orange - indicates channel thermal shutdown.

1.1.3 Output fuse: One output power amplifier fuse is located in the upper right corner of the front panel. This fuse is connected in the power amplifier output circuit to aid in protecting the power amplifier or shaker from excessive current. The PA8HF power amplifier is supplied with a 12 Ampere fuse. The recommended fuse type is 3AG or AGC. Manual section 2.1 lists other values of fuses that may be used when driving electromagnetic shakers.

CAUTION: To prevent damage to equipment, NEVER replace a fuse with anything other than the type and value specified. Using values other than those specified will void the equipment warranty and may cause fire or injury to personnel.

1.2 Rear Panel

1.2.1 Line cord socket: The power amplifier is powered from the AC line using a standard power cord terminating in an IEC320 socket in the power amplifier chassis.

1.2.2 Power/circuit breaker (mains): The PA8HF amplifier uses a magnetic-trip circuit breaker to protect the amplifier. This switch should be 'OFF' during the time the shaker test system is being connected. When switched 'OFF', all A/C power is removed from the amplifier, including standby power. The circuit breaker is not the power switch and should be switched to and left 'ON' after all test connections are complete. Use the power switch or an external control voltage to power-up or power-down the amplifier.

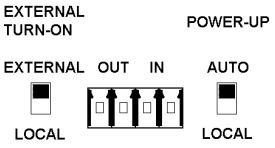
1.2.3 Output connector: There is a four-pin SPEAKON connector providing output to drive the shaker or matching network.

1.2.4 Input connector: A BNC coaxial connector located on the rear panel provides the input connection for the power amplifier.

1.2.5 Piezo filter switch: This is a toggle switch located on the rear panel. This switch allows the user to enable the 500 Hz (-3 dB point) high pass filter required when driving piezoshakers using matching networks. When the switch is in the "IN" position, the 500 Hz high pass filter is selected. When the switch is in the "OUT" position, the 0.5 Hz high pass filter is selected.

Note: The piezo filter should be set to the "OUT" position when driving electromagnetic shakers (such as the F3, F4, F5B, or the F10). Check the position of this switch if you have low output from your electromagnetic shaker.

1.2.6 Auto/local switch: In "local" position either the front panel power switch or an external voltage controls the power-up of the amplifier. "Auto" is used when the amplifier is powered from a switched power outlet. The 'POWER' switch and / or control voltage will function normally after the initial power up.



1.2.7 External/local switch: To power-up the amplifier using an external control voltage, supply a 4V to 12V AC or DC control voltage to the 'IN' terminals of the control voltage connector. By selecting the switch to the "external" position, the amplifier will power-up only when the control voltage is present (on). Immediately following power up, the control voltage will appear at the 'OUT' terminals of the control voltage connector for the control of other equipment. The removal of the control voltage (0v) causes the amplifier to turn 'off' and the control voltage at the 'OUT' terminals will be interrupted. In the "Local" setting, the amplifier will ignore the control voltage, and power up only by using the front panel power switch. If a control voltage is present at the 'IN' terminals it will still be available at the 'OUT' terminals after the power-up sequence.

1.2.8 Ground terminal: The ground terminal in the lower right corner is available to ensure proper ground of the test system components. Matching network ground connection can also be made to this terminal.

2.0 Operation of the power amplifier

Meggitt Sensing Systems manufactures a comprehensive line of vibration generating systems, including electromagnetic and piezoelectric shakers. Electromagnetic shakers are powered directly from the output of the power amplifier. However, piezoelectric shakers require a matching network between the power amplifier and the shaker. A signal source to drive the power amplifier is not part of the system and must be supplied by the user. This guide describes the operation of the PA8HF power amplifier. Other guides describe the operation of the matching networks and shakers. For all vibration generating systems a customer supplied signal generator is necessary to operate the vibration generating system. A piezoelectric accelerometer to monitor vibration output is strongly recommended.

2.1 Using the power amplifier with an electromagnetic shaker (models F3, F4, F5B, F10)

2.1.1 Piezo filter switch: The power amplifier drives electromagnetic shakers directly. The switch should be set to the “OUT” position.

2.1.2 Output fuse: The output fuse is used to protect the shakers and matching networks attached to the output of the amplifier. Users may wish to replace the 12 Amp fuse shipped with the amplifier with a smaller value to insure excessive current is not applied to the electrodynamic shakers. Use AGC or 3AG type fuses. The maximum safe current to each shaker is as follows:

Model	Current
F5B	0.1 Amp
F3	0.75 Amp
F4	1.5 Amp (no cooling unit)
	2.5 Amp (with cooling unit)
F10	4 Amp

2.2 Using the power amplifier with a piezoelectric shaker (models F7, F7-1, D60L, D60H, D125L)

The power amplifier will drive piezoelectric shakers, but must have a matching network between the power amplifier and the shaker. High pass filtering at 500 Hz (-3 dB point) is selected by setting the piezo filter switch to the “IN” position.

Note: The amplifier requires external fan cooling when operated at or near maximum power for extended periods. The fan aids the dissipation of heat from the heat sink cooling fins. Operating with no fan may allow the thermal shutdown of the amplifier to engage during testing.

CAUTION: In these modes of operation power amplifier must be used with a Wilcoxon matching network. Do not attempt to operate the power amplifier without the appropriate matching network.

CAUTION: The impedance matching transformers used in the matching networks are not designed for use at low frequencies. NEVER attempt to drive the matching

networks at frequencies less than 500 Hz. Piezoelectric shakers have little or no useful output at low frequencies.

2.3 Matching networks

The operating guide for the particular matching network used will provide detailed information for the proper use of matching networks. However, information in this section is presented to aid the user in understanding and applying matching networks.

While an electromagnetic shaker presents a low, relatively constant, largely resistive impedance, a piezoelectric shaker is essentially capacitive. This means that the impedance presented by the piezoshaker will decrease almost linearly with increasing frequency. A piezoshaker creates a displacement proportional to the voltage input for frequencies below its resonance. Therefore, in order to get maximum displacement and consequently maximum acceleration levels at low frequencies, the voltage must be stepped up significantly.

The impedance matching network normally consists of a step-up transformer and an output tap switching arrangement. A variety of output voltages are then available to maximize the voltage delivered to the piezoshaker at different frequencies. Due to the capacitive nature of the piezoelectric shaker, the output impedance of the power amp, and the impedance transformation of the matching network's transformer, the voltage at the piezoelectric shaker rolls off at 20dB per decade after the corner frequency (exactly like an RC filter). As the voltage switch setting on the matching network is switched from highest to lowest setting, the bandwidth of the system will increase. In general, piezoshakers can be operated at their lower frequencies with the matching network switch in its highest voltage position. The relatively low load (high impedance) of the piezoshaker at low frequencies is not demanding and the power amplifier can maintain the high voltage swing for maximum shaker output, however as the operating frequency increases, lower output voltage taps become more efficient. The greatest power requirements for the Power Amp will occur at the corner frequencies of the matching network and shaker system and at the resonant frequency of the shaker.

CAUTION: The piezoshakers can be damaged by internal heat build up when run at high levels for extended periods. This is due to the dielectric loss tangent of the piezoceramic material that generates heat. When driven at high power levels this heat buildup will raise the temperature of the piezoceramic to the Curie temperature where it will depolarize itself. Please contact Meggitt Sensing Systems for assistance when extended high output testing will be performed.

CAUTION: Do not change switch settings of the matching network when there is a signal present as this may cause the contacts to arc and destroy the switch.

3.0 Initial system setup

Note: All cables should be installed and connections should be completed before switching the power/circuit breaker switch to "ON."

3.1 AC line power

The power amplifier is wired at the factory for either 120 VAC or 230 VAC. This AC voltage power wiring is not changeable by the user. The AC power source should be capable of providing a minimum of 20amps at 120 VAC or 13 amps at 230VAC. A power cord terminating in an IEC320 plug should be connected from the power amplifier to the AC power line socket.

MAINS

3.2 Signal input

A laboratory grade low-noise oscillator should be used as a signal source. Use a coaxial cable to provide the input signal to the BNC connector on the rear panel of the power amplifier. To avoid hum and noise pickup, avoid running the signal cable parallel to power line cords. Any cabling near power line cords should be crossed at right angles. The driving signal amplitude is controlled by the signal generator amplitude control. It is recommended that the signal generating amplitude control be preset, considering the signal generator's capability, to eliminate the possibility of overdriving the power amplifier.

3.3 The power amplifier, matching network, and shaker cables

Electromagnetic shakers do not require a matching network and are connected directly to the power amplifier with the indicated cable type. Piezoelectric shakers require a matching network between the power amplifier and shaker, therefore two cables will be necessary to complete the connections. Table 1 describes the cable types required for completing all shaker system connections.

Table 1 – Interconnecting cables

Cable connecting to matching network	Matching network	Cable connecting to shaker	Shaker model
None	None	R1-22-J93-10F3	F3
None	None	R4M-22-J9B-10F4	F4
None	None	R2-22-J9C-10F5	F5B
None	None	R4M-22-J9B-10F10	F10
R22-22-J9B-5	N7FS	R4-4M-J9-10	F7
R22-22-J9B-5	N7FS	R7-7M-J59-12	D60L
R22-22-J9B-5	N7FS	R7-7M-J59-12	D60H
R22-22-J9B-5	N8FS	Integral Cable	D125L
R22-22-J9B-5	N8HFS	R4-4M-J9-10	F7-1

4.0 Operation

4.1 Applying power

Verify the AC voltage is correct and all necessary cables are securely attached.

Switch the power/circuit breaker switch to the "ON" position.

Push the front panel power switch and observe the LED turning from unlit to red (mute). When the power supply has stabilized the amplifier will come out of mute and the LED will change to green (normal operation).

Note: If the power indicator color remains red, a fault condition exists within the power amplifier or output circuit. Turn off the power, repeat the steps in the initial system setup (section 3.0) then re-apply power. If the fault persists, contact Meggitt Sensing Systems. The LED, when unlit, indicates no A/C mains power is present and the amplifier probably needs only to be powered on or the rear panel circuit breaker is switched off.

Clipping occurs when the channel output level no longer can follow the level increase at the input (overdriven input condition). When the PA8HF is driven into clipping the LED will change from green to red then back to green when the level is reduced (flashing red). Momentary clipping can be tolerated, however it indicates that maximum output power has been surpassed and potential amplifier or shaker damage may result if overload conditions persist. Any amplifier that is constantly operated into clipping indicates a more powerful amplifier is needed for that application.

The PA8HF has thermal shutdown circuitry to prevent damage due to overheating. Should thermal shutdown occur, the amplifier will mute and the LED will turn orange indicating this condition. When the amplifier has cooled to a safe operating condition the PA8HF will return to normal operation. Persistent thermal shutdown indicates a cooling fan may be necessary to increase airflow across the heat sink. The end user should investigate cooling fans for this.

4.2 Test operation

Follow the procedures below to test the operation of the power amplifier.

1. Verify the amplitude level of the signal source is set to its minimum position.
2. While monitoring the shaker force output level, or acceleration level, gradually increase the signal output level of the signal generating system.
3. Verify that the shaker force being applied to the test structure is adequate to continue testing.
4. If there is no force output from the shaker reduce the signal generating system output signal to its minimum, turn off all power, check all instrumentation components, check all system fuses, and check all cabling before re-applying power.
5. If it appears that there is a problem with the power amplifier, please refer to maintenance (section 5.0) for assistance. If the shaker is producing adequate force, the system is ready to use for testing.
6. At the completion of all testing operations, reduce the signal generating system output signal to its minimum and turn off power to all test system components.

5.0 Maintenance

WARNING: Lethal voltages are present within the chassis of the power amplifier whenever AC power is connected. Users should not attempt repair operations on components of the power amplifier.

A great deal of care has gone into every power amplifier to verify that it meets or exceeds all its specifications before it is shipped to you. If you are certain the problem lies in the power amplifier, check first to determine if the power indicator is illuminated. If it is not, the main AC mains breaker has likely tripped. Reset the breaker.

After resetting the AC mains breaker, the amplifier may immediately cause another breaker trip. If this should occur, there could be an amplifier power supply problem and the power amplifier requires service.

CAUTION: To prevent damage to equipment, NEVER replace a fuse with anything other than the type specified. Using types other than those specified will void the warranty and may cause fire or injury to personnel.

The output fuse (located on the front panel) should only be replaced with AGC or 3AG types as supplied with your system. When removing this fuse, ensure that power is not applied to the power amplifier.

The output fuse, because of its construction, may interrupt the circuit before a circuit breaker on a matching network opens. DO NOT substitute a higher value or a different type of fuse. Decrease the matching network output voltage tap or decrease the level of the signal generator. Consult Meggitt Sensing Systems for more information about inductive tuning or other special application assistance.

For piezoelectric shaker systems employing matching networks, there may be another current-limiting device (such as a fuse, circuit breaker, or thermal cutout) to the amplifier's output within the matching network. Consult the matching network's manual for details.

CAUTION: The power amplifier contains no user serviceable components. Service or repair of the power amplifier should not be attempted by anyone other than Meggitt Sensing Systems employees or designated representatives.

6.0 Technical assistance

6.1 Technical assistance

For technical assistance, please contact Meggitt Sensing Systems customer service at 301-330-8811 or email techasst@meggitt.com.

6.2 Customer service

To obtain a return materials authorization number, please contact customer service at 301-330-8811, or fax to 301-330-8873.