ALPHA 9500

MICROPROCESSOR CONTROLLED HF LINEAR AMPLIFIER

user manual

ALPHA AMPLIFIERS

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RF Concepts
Alpha 9500 Linear Amplifier

User Manual

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Alpha 9500 Linear Amplifier User Manual

Prepared for RF Concepts by MRH/JH/LJW.

To reach technical support or obtain copies of this document, go to **www.rfconcepts.com**.

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1 Introduction

Congratulations on your purchase of a professional-quality Alpha 9500 linear amplifier.

1.1 Product Description

The Alpha 9500 (see Figure 1-1) is an self-contained autotune HF linear power amplifier. It is capable of continuous operation at 1500 W peak power output on single sideband (SSB), keyed continuous wave (CW), slow-scan television (SSTV), radioteletype (RTTY), digital modes or FM, with no time limit.

⚠ CAUTION

CAUTION! Study this manual carefully before operating your amplifier for the first time. In particular, it is extremely important that you thoroughly review the installation and operation sections. Failure to do so could result in serious damage not covered under warranty.

Figure 1-1 Alpha 9500

1.2 Product Capabilities

Product capabilities include:

- Continuous RF output. The Alpha 9500 is capable of 1.5 kW continuous RF output on all commonly used modes and on any authorized amateur frequency from 1.8 to 29.7 MHz (other than the 60-meter band).
- Compatibility with popular amateur transceivers and exciters. The Alpha 9500 requires approximately 50-65 W peak RF drive for 1.5-kW output.
- Capable of full CW break-in, QSK, and all digital modes when used with any appropriate transceiver.
- Built-in protective functions. The control system incorporates protective functions that minimize the probability of accidental damage to the amplifier or its power tubes. In most cases, when one of the protective functions is tripped, the amplifier goes to standby.
- USB and serial interface allow for remote operations, diagnostics, and firmware upgrades.

1.3 Safety Considerations

- Locate the Alpha 9500 where there is good air circulation all around and on top of the cabinet. The unit may become hot during operation.

- Use proper lifting techniques and two people when moving the Alpha 9500. The Alpha 9500 weighs approximately 69 pounds when the transformer is installed.
- Although the Alpha 9500 meets international safety standards and FCC regulations, remember that the equipment works with high voltages that can be LETHAL!

This operating manual holds information, cautions, and warnings that you must follow to ensure safe installation and operation. Read Chapter 1 before attempting to unpack or operate the Alpha 9500. Failure to perform procedures properly may result in amplifier damage, fire hazard, or electric shock.

IMPORTANT

- **Never open the amplifier case without unplugging the unit from the wall outlet.**
- **Never stick objects into holes in the case.**
- **Never touch an antenna during transmission.**
- **Never attempt to turn on the amplifier without the cover securely in place (all attachment screws reinserted).**
- **Never turn the amplifier back on after a hard fault without waiting at least 20 seconds.**
- **Never press the ON (AMP) button after the amplifier faults to power off.**
- **Never allow liquids to enter the amplifier through the cover holes.**
- **Never cover or obscure the exhaust holes in the cover of the amp.**

1.4 Related Products

Other products available to enhance your use of the Alpha 9500 include:

- Alpha 2100 full-1500 W-rated 50-ohm dummy loads
- Alpha 4500 series SWR meters and wattmeters

For more information, go to **www.rfconcepts.com** or call **303-473-9232**.

1.5 Assistance

Technical assistance from RF Concepts is available from several sources.

- Go to our website at **www.rfconcepts.com** and click **Support**. On this site you can get the following assistance:
  - FAQs
  - Legacy equipment information
  - Manuals
  - Repair information
  - Software downloads
  - Tech tips
  - Technical support
- E-mail us at **service@rfconcepts.com**.
- Fax us at **303-473-9660**.
- Phone us at **303-473-9232**.

2 Amplifier Components and Specifications

The Alpha 9500 uses a single 3CX1500 (8877) high-mu external-anode triode ceramic tube for amplification. The main power supply is an unregulated transformer/rectifier/capacitor power supply for the high-voltage (HV) and heater circuits. All other power supplies are regulated.

The biasing and tank circuits are similar in most respects to those of the Alpha 9500's predecessor, the Alpha 77. The unit has thoroughly modern computer-controlled power supply and control circuitry. Extensive safety measures protect the amplifier against most off-nominal conditions. It has USB and RS-232 interfaces to aid in remote operation. All front-panel features are accessible via these interfaces.

There are six main circuit boards in the amplifier. Communications among these is via an I2C bus.

The amplifier front and back are shown below (see Figure 2-1 and Figure 2-2). Amplifier components are listed alphabetically and described below.

Figure 2-1 Amplifier front and interior

Figure 2-2 Amplifier back

2.1 Cathode (Input-Match) Board

The cathode board, housed in the tube deck, consists of a set of Pi filters controlled by a set of five relays that are enabled based on the band-switch setting.

2.2 Center-Partition Board

The center-partition board contains the RF decoupling circuit on the B+ line as well as the crowbar safety circuit. When you remove the top cover of the Alpha 9500, the spring metal of this safety device shorts out the B+ line.

2.3 Controls and Display

The Alpha 9500 controls enable you to adjust and monitor the amplifier as needed (see Figure 2-3).

IMPORTANT

Note that the front panel has, in the upper-right corner, a 7-segment LED display. The display contains 4 digits.

The buttons below the display control what kind of value is displayed: **FLT**, **Fwd**, **Ig**, **Ip**, **SWR**, or **Vp**.

Figure 2-3 Amplifier controls

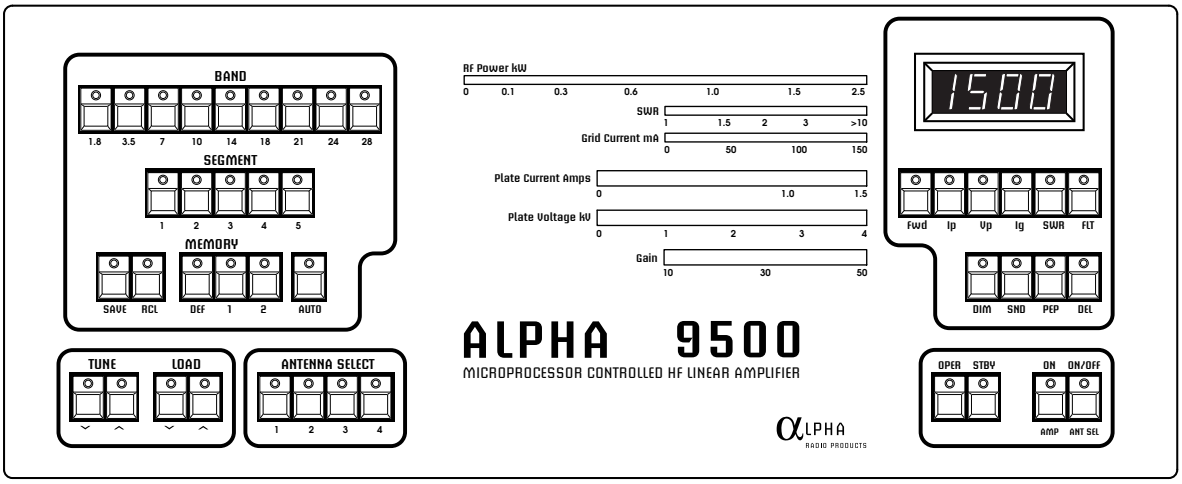


Table 2-1 Amplifier Buttons (listed alphabetically)

Button	Purpose
ANTENNA SELECT	Determines which one or two of the four antenna output ports to use.
BAND	Selects an amateur band, designated in megahertz (MHz).
DEL	Displays the delivered power from the amplifier to the selected antenna port in watts (W).
DIM	Controls the brightness of the display LEDs.

Table 2-1 Amplifier Buttons (listed alphabetically) (Continued)

Button	Purpose
FLT	Sets the 7-segment display to show the last fault. Also loads new firmware.
Fwd	Sets the 7-segment display to show forward power in W.
GAIN	Displays the gain in decibels (dB).
GRID CURRENT	Displays the grid current in milliamperes (mA).
Ig	Sets the 7-segment display to show grid current in mA.
Ip	Sets the 7-segment display to show plate current in mA.
LOAD	Controls the load capacitor.
MEMORY	Selects one of three sets of segment memories: • **DEF** — factory-default settings • **1**, **2** — User 1 and User 2 memories • **AUTO** — autotune
ON (AMP)	Turns the amplifier tube and voltage on.
ON/OFF (ANT SEL)	Turns antenna select on; the amplifier tube is not on.
OPER	Sets the amplifier to the operate position.
PEP	Toggles between peak power (PEP) and average power.
PLATE CURRENT meter	Displays the plate current in milliamperes (mA).
PLATE VOLTAGE meter	Displays the plate voltage in volts (V).
RCL	(Currently nonfunctional)
RF POWER kW meter	Displays the forward power in W.
SAVE	Saves the current settings.
SEGMENT	Selects different frequencies within each band.
SND	Controls the sound volume (not yet implemented).
STBY	Sets the amplifier to standby (bypass).
SWR meter	Sets the 7-segment display to show SWR.
TUNE (UP or DOWN)	Controls the tune capacitor.
Vp	Sets the 7-segment display to show plate voltage in V.

2.4 Display Board

The display board is the largest board in the amplifier and spans the entire inside front panel. It has three microcontrollers, one each to control the stepper motors; the LEDs and 7-segment display and push buttons; and the sound controller.

2.5 Firmware

The Alpha 9500 firmware controls and implements most amplifier features and functions.

You can upgrade the master firmware via a serial or USB connection to a Microsoft Windows PC. For information, see Chapter 7, "Maintaining and Upgrading the Amplifier."

2.6 Master-Control Board

The master-control board monitors all critical voltages and currents in the amplifier, as well as the input power and output forward and reflected power. It uses these converted values to control the amplifier's operation and to send data to the front panel, so that the correct LEDs are lit and the stepper motors move to the correct positions. A standard 9-pin RS-232 serial port is provided for control and monitoring and is found on the back of the Alpha 9500. A USB port is also provided. Either port may be used, but only one may be active at any one time.

The amplifier automatically senses when a PC is attached to the USB port, and uses that port. If nothing is connected to the USB, the amplifier automatically switches back to the RS-232 serial port.

2.7 Output-Tank Circuit

The output-tank circuit provides reliable high-efficiency, low-distortion performance in a very compact volume. The basic topology is "pi-L", which provides harmonic attenuation adequate to meet the requirements of all countries globally that permit power outputs of 1500 W.

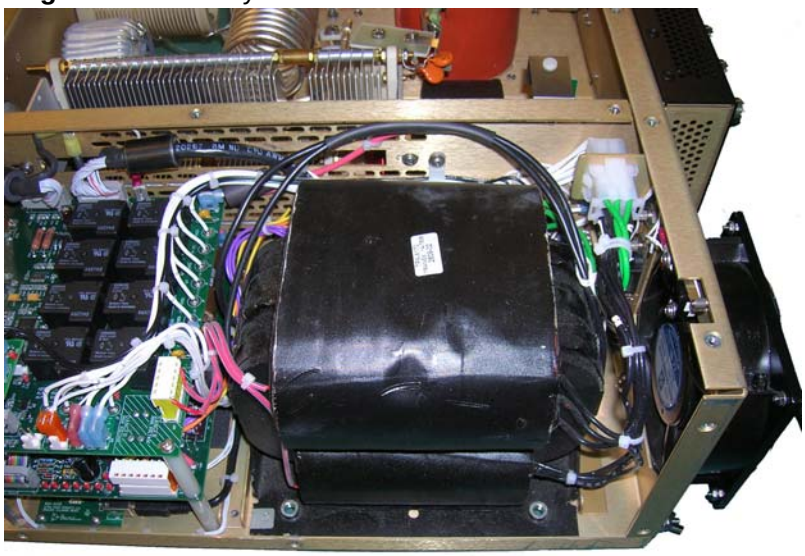
Band switching is under automatic control, accomplished by a 4-wafer band switch. These wafers are used as multifunction tap selectors, which simultaneously select band taps on the inductors and include varying amounts of capacitance to provide band spread on the tune and load capacitors. The wafers are in the RF tank area. The band-switch position is controlled by a stepper motor in the front subchassis.

2.8 Power Connections

When the Alpha 9500 is powered up, it measures the line voltage and chooses, then sets the appropriate tap setting for the transformer primary. After it is powered up, it does not reset the tap. The amplifier can be set

to override autotaps election and use any primary tap; it may be useful to do so if your line voltage is unsteady or on the edge of a tap setting. For more information, contact RF Concepts technical support.

Figure 2-4 Primary connections



2.9 Power Supply

The power supply has two major sections: a switch-mode supply for the logic circuitry and a conventional transformer supply for all other voltages.

When the amplifier is plugged into the AC line, the switch-mode supply is always on and all the microprocessors are active. It is usual for some of the front panel LEDs to blink momentarily when the unit is first plugged in.

The remaining voltages are produced by the mains and HV boards, described below.

Mains Board

Figure 2-5 Mains board

Power-supply functions are split between the mains board and the HV board. The mains board deals mostly with the primary side of the transformer. The various taps for the transformer primary are routed through this board and so is the AC line input. Relays on the mains board connect the AC line to the appropriate taps on the transformer primary.

When the **ON (AMP)** button is pressed, the microprocessor on the mains board samples the line voltage and determines which tap to select. That voltage tap remains selected until the amplifier is turned off, and does not change even if the line voltage fluctuates.

If you install your amplifier in a location where the line voltage is not steady, you can force the tap selection via the serial or USB port. For information on how to force tap selection, contact RF Concepts technical support.

Also on the mains board is a step-start circuit. This circuit consists of a relay and a resistor, which are time-sequenced to limit the inrush current into the amplifier when it is first turned on.

HV Board

The main high voltage for the amplifier is created on the HV board using a full-wave bridge rectifier and a bank of capacitors. This power supply has two 10-ohm resistors, one in the positive (B+) lead and one in the negative return to the tube cathode. This combination of resistors limits the surge current in the case of a B+ arc.

When the power-supply current exceeds about 2.5 amps, a latching relay opens the coil circuit of the mains tap relays on the mains board, causing the amplifier to go to the power-off state. This hard-fault circuit operates independently of microprocessor control.

All power-supply filter capacitors on this board have bleeder resistors that discharge the capacitors in less than 60 seconds. If you must work on this board, confirm the discharged condition with a voltmeter, due to the remote possibility of bleeder resistor failure.

2.10 Tube and Tube Deck

The Alpha 9500 uses a single 8877 triode tube. The tube operates well within its published ratings. It is operated in Class AB1, with a plate voltage of 3300 V (nominal, full output, key down) and a cathode voltage of 9.4 V.

The tube deck is a mechanical assembly that houses the tube socket and the cathode (or input match) printed circuit board (PCB).

A temperature sensor mounted on the cathode PCB measures the temperature of the air immediately below the tube socket. This temperature measurement is used by the master controller as part of the fault-detection software.

2.11 Specifications

The Alpha 9500 linear amplifier specifications are as follows.

Table 2-2 Alpha 9500 linear amplifier specifications

Parameter	Value
Frequency coverage	All amateur frequencies in the range 1.8–29.7 MHz
Power output	1500 Watts minimum
3rd Order IM	<–30 dBc
SWR tolerance	3:1
Drive power	65 Watts nominal
Tube	3CX1500/8877

Table 2-2 Alpha 9500 linear amplifier specifications (Continued)

Parameter	Value
Cooling	Forced air
Antenna outputs	4xSO-239 connectors
Antenna selection	1 or 2 outputs per band/segment
Input	SO-239 connector
Tuning/Band switching	Automatic; manual override possible
Power	100, 120, 200, 220, 240V AC, 50/60 Hz
Power tap selection	Automatic
Interface	Serial port with full remote-control capability
Protection	Protected against all common faults
Display	Bar graphs as well as digital panel meter
T/R switching	Vacuum relays; QSK (full break-in)
Bypass capability	1500 Watts Wattmeter and antenna selector active in ON1 to allow use with exciter. HV and tube come on in ON2 for linear use.
Width	17.5 inches
Height	7.5 inches
Depth	19.75 inches
Weight	76 pounds

3 Preparing Your Station

3.1 Prepare Your Station

The Alpha 9500 is capable of dramatically improving the performance of your amateur station. It is important that you observe good engineering practices to achieve all the benefits of such a station in a safe and reliable manner.

This chapter provides a few important operational considerations. We recommend that you also consult a good source of general information such as the latest Amateur Radio Relay League (ARRL) Handbook for Radio Amateurs, especially if this is the first high-power amplifier that you have used.

Procedure 3-1 Prepare your station

Step 1 Provide 220 VAC power.

The amplifier runs best when powered by a 200–240 VAC circuit. If you do not have a 220 VAC outlet in your station, have a licensed electrical contractor install one. A minimum of a 20 A capacity is required. A 20-A breaker on your 220-V circuit is sufficient.

When you size the circuit, be sure to include the current drawn by other equipment that may be on the same circuit.

Select a location for the outlet as close as possible to where you expect to operate the amplifier. If you are not sure or contemplate moving the amplifier, consider installing two outlets.

There are many styles of power plugs, some of which are country-specific. For this reason, the amplifier is not shipped with a plug. Ask your contractor for two or three matching plugs during installation.

Ask the contractor to measure the voltage and record it for reference.

Although the amplifier can run when connected to a 110 VAC outlet, you WILL NOT achieve full-legal-limit output in this case. Rather, you should not expect more than 1000 W output. For more information on the limitations of operation when connected to a 110 VAC outlet, see Section 3.2, "Limitations of Operation at 90–130 VAC," page 3–3.

Note that, when the amplifier is plugged in and turned on, it is normal to hear the capacitors and band-switch zero themselves and a slight "clunk" as the transformer comes up to full load.

Step 2 Provide proper airflow.

It is critical that airflow around the amplifier remain unimpeded at all times and that the top of the amplifier remain clear of any restrictions.

Maintain at least 3 inches of clearance around the amplifier to allow for unobstructed airflow.

If you are mounting the amplifier in a console, ensure that the exhaust air is properly and fully removed from the console. If outlet air is drawn back into the amplifier air intake and recirculated, the amplifier gets hotter and hotter, resulting in degraded performance or even failure. If you are designing your own console, consider putting in additional fans and/or ducting to deal with waste heat.

Minimize the possibility of dust or other contamination getting drawn into or falling on the amplifier. Periodically (at least annually) clean the dust out of the amplifier, paying particular attention to the tube fins. We recommend the use of compressed air for dust removal.

Step 3 Ready your antenna for 1500 W.

Ensure that all antennas are rated for 1500 W and that they are carefully tuned and installed for minimum voltage SWR.

Many antennas that are suitable for general use are unsuited for operation with a full 1500 W of power. At this power level in a 50-ohm circuit, the RMS current is 5.5 A and the peak RF voltage is 387 V. For SWR = 2:1, these values double to 11 A and 775 V. The actual voltage and current at various points in or on your antenna may actually be many times these values.

Step 4 Provide adequate RF cabling.

The importance of a well-constructed feed-line system cannot be overstated.

Use good-quality low-loss coaxial cable of size RG/8 or larger. The Alpha 9500 is intended for a nominal 50-ohm load. With proper matching (50 ohms) between amplifier and feedline, open-wire feeders or lines of other than 50 ohms may be used.

Use new, clean connectors and install them according to manufacturer recommendations. Clean the connectors after soldering them and before mating them with the amplifier.

Install system feedlines following good engineering practice and according to manufacture recommendations.

NOTE: The FCC requires users to check their installations for compliance with published values for allowable exposure to RF fields. This information is available in ARRL publications, FCC printed rules, and on the web. We strongly recommend that you do this for any installation, both fixed and at an expedition or contest site.

If you have any questions regarding engineering your amplifier into your amateur radio station, go to **www.rfconcepts.com** and click **Support**.

Step 5 Provide surge protection.

Induced energy from nearby electrical storms or other power transients may damage components. Such damage is not covered under warranty. It is therefore important to use a good lightning arrestor. However the only lightning-proof solution available is to disconnect antenna feedlines and AC power when the equipment is not in use.

NOTE: Whenever the amplifier is online — either off, in standby (STBY), or in warm-up with the WAIT LED lighted — the amplifier is bypassed and the exciter is connected directly to the antenna. The throughput limit in all cases is 1500 W.

3.2 Limitations of Operation at 90–130 VAC

Electrical-power equipment draws twice as much primary current from 120 V mains as from 240-V mains. Therefore, if you operate the Alpha 9500 on typical 120 V/20 A household circuit without exceeding the 20-A circuit rating, you limit maximum peak power output to about 600–1000 W.

If your line voltage is below 110 V *under load*, do not expect to be able to get 1500 W output (see Table 3-1).

Table 3-1 Amplifier behavior with nonstandard line voltages

Line voltage	Expected behavior
Low: 90–110 V	Power outputs above 1000 W are not expected.
Normal: 110–130 V	1500 W PEP operation (CW or SSB) may be possible if your AC line service has sufficient current capacity (30-A circuit recommended). However, 1500 W continuous should not be expected.
High: >250 V	Lifetime of the tubes may be reduced. Ask your utility company if they can reduce your line voltage. If this is not possible, consider placing your own step-down transformer in line between the AC outlet and the amplifier. A transformer with at least 4-kVA rating is required, due to the nature of the current waveform in the primary. Another choice for voltage control, a ferroresonant voltage regulator, is an expensive solution, but is a good way to stabilize primary voltage.

NOTE

If you intend to operate the amplifier at ~120 V or if other equipment draws current from the same circuit as the amplifier, the following apply:

1. If you replace the factory-shipped 20 A/250 V fuses with 25 A/250 V “slo-blo” fuses (for line voltages of less than 100 V), be aware that the higher current at the lower voltage significantly warms the amplifier’s power cord. The cord (as well as fuse holders and some internal connectors) are operating near their maximum ratings due to the current demand at lower voltages.
2. Ensure that the AC cord is not coiled too tightly or placed where normal air flow is restricted, causing it to overheat.
3. You must change the two lower 2A fuses on the rear panel to 5A fuses to allow for the increased in-rush current.

4 Setting Up the Amplifier

IMPORTANT

The Alpha 9500 is easy to set up, tune, operate, and maintain. However, failure to carry out each procedure exactly as described in this manual is likely to lead to amplifier damage, which is not covered under warranty. Damage to other station equipment may also result.

Proceed slowly throughout these procedures to avoid bumping and damaging adjacent wires, connectors, and components.

4.1 Unpack the Amplifier and Transformer

Procedure 4-1 Unpack the amplifier and transformer

Step 1 Remove the amplifier and transformer from their cartons.

The Alpha 9500 ships in two heavy-duty cardboard cartons, each mounted on a wooden pallet and strapped down for secure shipping. The amplifier weighs 39 lb (18 kg); the transformer weighs 43 lb (20 kg).

1a Remove the strap securing the two boxes to the pallet.

1b Inspect the boxes for shipping damage.

1c Unpack the cartons.

1d Retain the pallet and cartons in case you need to ship the unit later.

Step 2 Inspect the amplifier and transformer for shipping damage.

If you find damage, call RF Concepts at **303-473-9232**.

Step 3 Remove the blower screw from the bottom of the amplifier.

3a Place the amplifier on the bench or desk where it is to be used.

3b Remove the cover screws (Figure 4-1) and the cover.

Figure 4-1 Cover screws

3c Rotate the amplifier onto its right hand side.

3d While looking at the bottom, locate and remove the screw (labeled **BLOWER SCREW,** Figure 4-2) that holds the blower in place during shipping.

Figure 4-2 Blower screw

NOTE: Before shipping, reinsert the screw to prevent damage to the blower.

3e With the cover off, remove the Delrin rod holding the tube in place. Retain the rod in case you need to ship the unit later.

4.2 Install the Transformer

NOTE

- The transformer is very heavy. When moving it, use due caution and handle only by the lifting handle.
- The extra piece of wood shipped with the amplifier is the transformer shim, which was cut to specific dimensions to aid in this installation.
- Do not over-tighten the screws that hold the transformer in place, as doing so may cause excessive vibrations or noise.
- If you move the amplifier, even if only from one site to another locally, remove the transformer first to avoid the possibility of damage.

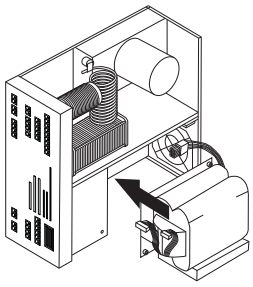
Procedure 4-2 Install the transformer

Step 1 Position the amplifier on a flat surface, at or near where it is to be used, with plenty of room for you to work.

Installing the amplifier on a tilt so far that the transformer is cantilevered or hangs out to any degree causes the chassis to distort, which may affect a number of things, from the alignment of screw holes on the top cover to the band-switch alignment and tension.

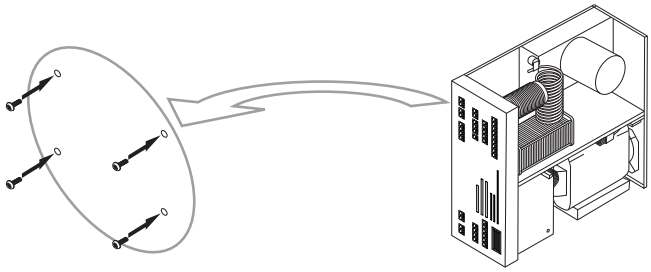
Step 2 Slowly move the amplifier and transformer together, aligning the nuts on the transformer with the screw holes on the bottom of the amplifier.

Figure 4-3 Moving amplifier and transformer together



Step 3 Secure the transformer into place from the bottom of the amplifier by inserting the supplied bolts (1/4/20 ½-inch hex bolts) with ¼-inch washers through the four clearance holes in the chassis and into the nuts in the transformer base.

Figure 4-4 Securing transformer



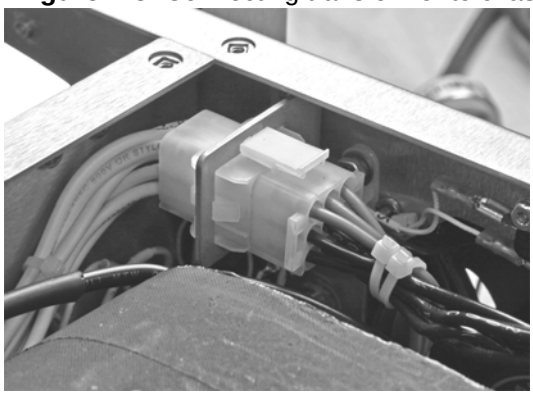
Step 4 Carefully rotate the amplifier back to its standard orientation.

4.3 Connect the Transformer

Procedure 4-3 Connect the transformer

Step 1 Connect the transformer to the chassis.

Figure 4-5 Connecting transformer to chassis



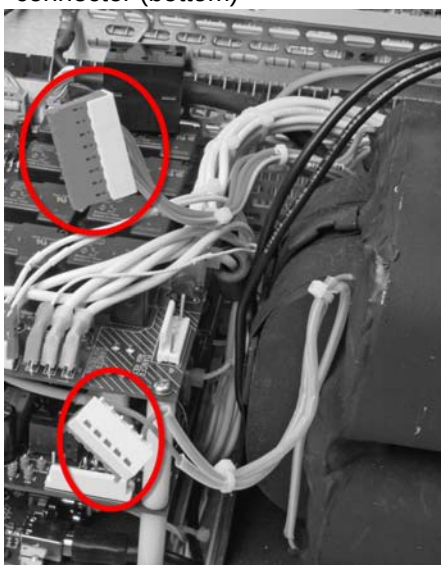
1a Align the transformer's Molex plug with the connector at the back of the amplifier.

1b Push to connect them so that they are fully mated.

Step 2 Connect the transformer to the amplifier's high-voltage (HV) board (the lower of the two boards).

2a Locate the transformer's 7-pin HV connector. Move the 2-pin mains connector out of the way as needed to do so.

Figure 4-6 Transformer's 7-pin HV connector (top) and 2-pin mains connector (bottom)

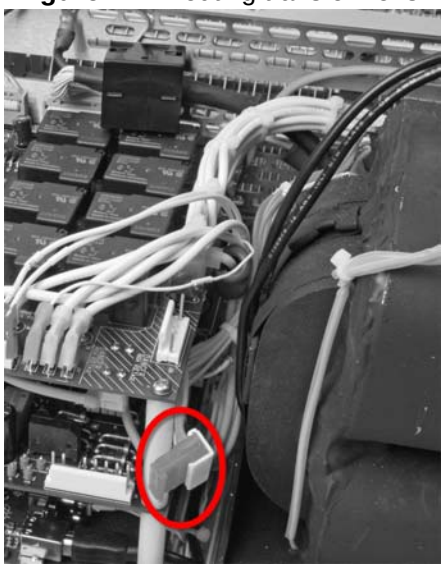


2b Carefully route the transformer's HV connector below all of the other bundled wires.

NOTE:

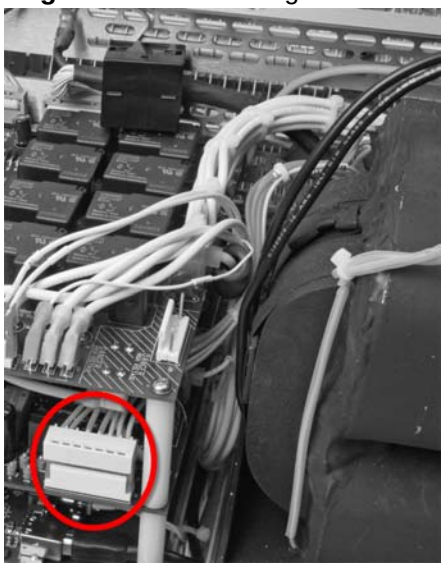
- Do not bump or bend components on either board.
- Do not allow the HV wiring to touch any of the upper circuit board.

Figure 4-7 Routing transformer's HV connector



2c Align the transformer's HV connector with the amplifier's HV board connector, with all pins in their appropriate slots, then gently but firmly push the connectors together so that they are fully mated.

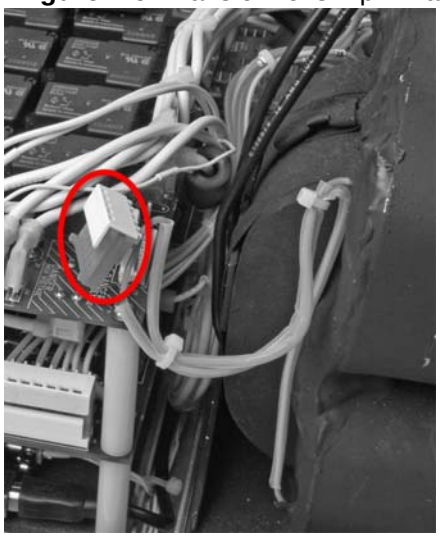
Figure 4-8 Connecting transformer to the HV board



Step 3 Connect the transformer to the amplifier's mains board (the upper of the two boards).

3a Locate the transformer's 2-pin mains-board connector.

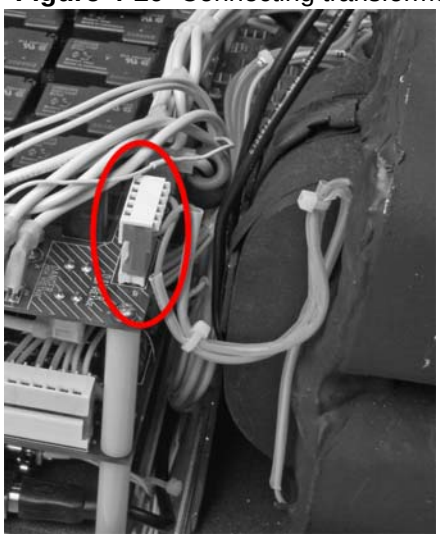
Figure 4-9 Transformer's 2-pin mains-board connector



3b Locate the respective 2-pin connector on the amplifier's mains board.

3c Align the connectors with both pins in their appropriate slots, then gently but firmly push the connectors together so that they are fully mated.

Figure 4-10 Connecting transformer to mains board



4.4 Connect the Cables

Procedure 4-4 Connect the cables

Step 1 Connect the power cord.

WARNING

WARNING! To avoid the hazard of a potentially fatal electric shock and/or severe damage to the Alpha 9500 and other equipment:

- NEVER operate the amplifier with the cover removed.
- ALWAYS use an AC plug that is appropriate for the primary mains voltage, current rating, and configuration.
- ALWAYS use grounding type AC connectors that conform to local codes.
- NEVER use 120-VAC plugs to connect to power receptacles for 190–250 V circuits.
- ALWAYS connect ALL station equipment to a good common ground. Failure to do so may allow RF feedback to leak into the transceiver and cause severe signal distortion.

⚠ CAUTION

CAUTION! We strongly recommend that you operate the amplifier on 240 VAC. If you choose not to heed this recommendation, see a discussion of the limitations of doing so in Section 3.2, "Limitations of Operation at 90–130 VAC," page 3–3.

1a Connect the green wire in the amplifier power cable only to the AC mains safety ground (or to neutral, as may be necessary with a 240-V circuit configured 120V-N-120V without a separate ground, commonly found in the US).

1b Connect the black-and-white power cord wires to the two hot wires of the AC source. Either wire may be connected to either side of the line. For best results, use a dedicated 200–240 V branch circuit of #10 AWG copper wire or equivalent, rated at 20 A, to feed the amplifier.

1c Connect the ground stud with wing nut on the rear of the chassis to a good RF earth ground, such as a copper water pipe or driven rod, via heavy copper braid or strap.

Step 2 Adjust the 8877 tube and exhaust chimney.

2a Ensure that the 8877 tube is firmly seated in its socket.

2b Ensure that the silicon-rubber exhaust chimney is straight and that it is fully and correctly installed so that the bottom of the chimney is firmly against the tube deck and completely covers the airflow opening in the deck. Tube cooling exhaust must exit only through the tube anode fins; it must not be allowed to escape outside them. Failure to ensure proper cooling airflow may result in tube damage or destruction, which is not covered under warranty.

2c Ensure that the anode connector is tightly clamped to the 8877 tube.

Step 3 Replace the amplifier cover and all attachment screws.

Use only the 6-32 screws supplied with the amplifier and do not tighten any of the screws until all are started.

⚠ WARNING

WARNING! Do not attempt to operate the amplifier with the cover removed or placed on the unit without the attachment screws. Doing so damages the Alpha 9500 and may also cause injury or death to the operator.

Step 4 Place the amplifier in its operating position on a stable surface with sufficient space to the rear, sides, and top to allow good air flow and safe placement of cables.

Step 5 Connect the amplifier RF INPUT to the transceiver RF OUTPUT.

Use 50-ohm coaxial cable-RG-58C/U or equivalent.

Step 6 Connect the amplifier RF OUTPUT to the antenna or appropriate matching device.

Use RG-8A/U, RG-213/U, or equivalent high-quality cable with a PL-259 UHF-type plug on the amplifier end. Do not use RG8X cable, because it is not rated for 1500 W.

Step 7 Connect the transceiver (T/R) control cable to the amplifier's KEY IN input.

The amplifier has a full break-in vacuum relay QSK system that requires only the normal interconnection when used with a modern QSK transceiver. The amplifier requires a contact closure (short circuit) on transmit from the transceiver's RELAY jack center pin to the chassis. This function is supplied by the transceiver, usually from a dedicated relay that is normally open in receive and closed in transmit.

7a Use shielded wire for the T/R control cable. Fit the amplifier end with a common phono (RCA-type) plug and the transceiver end with a suitable connector.

7b Ensure that the T/R relay contact closes. Protection circuitry prevents hot-switching when RF drive is applied. Modern transceivers have the proper time delay between key-up and the start of the transmitted signal to allow the amplifier to follow the CW keying.

If you suspect a T/R timing problem:

1. Connect the CW keyer to the amplifier's KEY IN input.
2. Connect a cable from KEY OUT on the amplifier to the keying input of the transmitter.
3. Ground the key cable (they should key up).
4. Apply power from the transmitter. The amplifier should respond with power out to the antenna.

NOTE: The amplifier does not generate or use Automatic Level Control (ALC) voltages to control an exciter.

4.5 Set the Input Drive

You must set the transceiver output power properly. Virtually all damage to date has resulted directly from severe overdrive. The amplifier requires 50-W drive for full rated output.

Damage caused by applying several-times-rated drive power to the amplifier is not covered under warranty. Fortunately, most modern transceivers maintain quite consistent output from band-to-band and mode-to-mode when set up properly.

Some transceivers may produce RF spikes upon keying during SSB operations. Do not operate the amplifier with transceiver power controls set at full power output. Do not rely on the mic gain control to set power. Rather, set up the transceiver with proper mic gain and processor levels at normal power level to drive the amplifier (typically 50 W).

⚠ CAUTION

CAUTION! Some transceivers may experience RF spikes during keying for SSB operations. To avoid these spikes, do not operate the amplifier with transceiver power controls set at full power output and do not rely on the mic gain control to set power. Rather, set up the transceiver with proper mic gain and set processor levels at normal power level sufficient to drive the amplifier (normally 50 W).

4.6 Connect the Transceiver Keying Line

Procedure 4-5 Connect the transceiver keying line

Step 1 Connect the transceiver keying line.

The following is a list of popular transceivers and considerations for their connection to the amplifier. For advice on other transceivers, contact RF Concepts as described in Chapter 1, “Introduction.”

Table 4-1 Popular transceivers

Transceiver	Connection and keying information
Icom	RF —
	T/R — Connection with the “Send” jack. For information, see the transceiver user manual.
Kenwood	RF —
	T/R — For information on connecting to external amplifiers, see the transceiver user manual.

Table 4-1 Popular transceivers (Continued)

Transceiver	Connection and keying information
Yaesu	RF —
	T/R — Connection with the RCA "TX GND" connector and/or DIN "Band Data" connector. For information, see the transceiver user manual.
Older transceivers	For information on connecting to external amplifiers, see the transceiver user manual.

Step 2 (Optional) Enable the transceiver automatic antenna tuner.

Many popular transceivers have built-in antenna tuners. Although a tuner is not usually needed when driving your amplifier, you may use it with care through the amplifier.

For instructions, see the transceiver user manual.

5 Operating the Amplifier

5.1 Principles of Operation

Once your Alpha 9500 linear amplifier is set up as described in the previous chapters, before first use you must tune it for peak RF output and lowest current for the selected antenna port over the range of band segment frequencies to be used. At that point it is ready for use.

The Alpha 9500 can be operated in autotune mode (using factory-default values stored in default memory) or tuned using values that you store in user memory.

Basic operation

The amplifier is initially tuned at the factory with default tuning values in default memory and two user memories, designated User 1 and User 2. These values are appropriate for a pure 50-ohm load but should work for any band segment with voltage standing-wave ratios of SWR ≤ 1.5:1.

For normal use, do the following:

- For SWR ≤ 1.5:1, tune using the default values.
- For SWR > 1.5:1 or if you do not achieve good results with the default values, tune manually or using autotune and save the new tuning values for each band segment in User 1 or User 2 memory for future use.

  NOTE: For SWR between 2.0:1 and 3.0:1, manual tuning using the load and tune controls may be required and full output may not be achieved.

You can select different antenna ports for use with different band segments. The next time you use the amplifier, when you select a band segment, the amplifier returns automatically to the last port used for that segment. If you ever use other than the default port, then, each time you use the amplifier you should check the port setting and change it if necessary to the correct port.

When powered on, the amplifier tunes to the last-used band segment using memory values. You can select a different band segment manually or apply low input power to select a new band segment.

After you have set up your user memories, during normal operation, you need only select the desired tuning mode (Default, User 1, or User 2) and band and band segment, or key the amplifier (10–20 watts) to select the band and band segment, then increase input power to achieve full output. You are now ready to operate. If you must manually tune or autotune, something has probably changed in the antenna system and you may need to reprogram a user memory. It is generally safest to program and operate from user memories. If you have not saved to the user memories, they still contain factory default values.

Operational states

The Alpha 9500 can be in one of seven operational states, listed in Table 5-1.

Table 5-1 Operational states

State	Description
Off	Plugged in but OFF. **To enter this state:** Plug the amplifier into the AC line supply. **In this state:** The front panel lights briefly illuminate, then turns off and the entire front panel goes dark. (If the lights stay on, unplug the AC connector for a few seconds and plug in again. the amplifier has an internal auxiliary 5V power supply that is on.) All microprocessors are powered up and communicating with one another. The USB and RS232 ports are active.
On 1	Operating with the exciter only, without tube heater or HV. **To enter this state:** Press the **ON/OFF (ANT SEL)** button or send a command from the serial interface. **In this state:** The internal frequency counter is active and automatically switches antennas when you transmit. Forward power and SWR are indicated on the digital meter and the bar graphs. Use this state when you need to access the antenna switch function but you are using only exciter input power. The portions of the front panel display that are appropriate in this mode are enabled and others are disabled.

Table 5-1 Operational states (Continued)

State	Description
On 2 (warmup)	Tube is warming up and HV is present. **To enter this state:** Press the **ON AMP** button or send a command from the serial interface. **In this state:** The AC line is connected to the primary of the transformer and all amplifier voltages are present (including the high voltage for the tube plate). The stepper motors may turn briefly; they sound like a low growl. A 3-minute warmup countdown begins. The amplifier cannot move to a higher state until the countdown timer reaches 0. To see the number of seconds remaining, tap the **FLT** button and watch the digital meter. During warmup, we recommend that you check the plate voltage by tapping the **Vp** button. The digital meter should read in the range 3400–3650.
Standby	Tube is ready and amplifier is in bypass mode (exciter only). **To enter this state:** Wait for the amplifier to complete its 3-minute warmup. **In this state:** The exciter can use the antenna, but the amplifier does not amplify the signal. Certain faults cause the amplifier to return to this mode.
Unkeyed	Key-in has not been asserted. **To enter this state:** Wait for the amplifier to complete its 3-minute warmup and press the **OPER** button. Or issue the command for the OPER mode from the serial interface. **In this state:** The amplifier is fully warmed up, but the key-in line has not been activated. The tube is biased to a very low current and the exciter is still connected to the antenna.
Keyed, no RF	Key-in has been asserted, but no RF is sensed. **To enter this state:** Wait for the exciter to short the key-in line to ground. **In this state:** The input and output relays are activated and the exciter is connected to the tube input.
Power	Amplifier is keyed, RF has been sensed, and the amplifier delivers power. **To enter this state:** Wait for the amplifier to sense RF. **In this state:** The tube is biased to its operational condition. The amplifier measures the RF frequency and attempts to match its operational condition to the drive frequency and power that it senses. If the frequency of the input signal indicates that a band change is needed, the amplifier briefly unkeys to avoid damage to the bandswitch. Antenna-select features are disabled to avoid hot-switching of relays. The amplifier is now fully operational and delivering power to the load.

Tuning modes

You can tune the amplifier in one of three tuning modes—Default, User 1, or User 2—and from any of these proceed to autotune mode..

Table 5-2 Tuning modes

Mode	Description
Default	By default, when the amplifier is first powered on or QSYed, it retunes using factory-supplied tuning values. These values are derived for a load with voltage standing-wave ratio SWR = 1.0:1, so the amplifier will be tuned with a different tuning value from default memory for each segment of each band. For SWR ≤ 1.5:1, the default tuning values are usually appropriate. For SWR > 1.5:1, some manual tuning may be required using the tune and load controls. The antenna port last used in Default mode for a particular band and band segment is used.
User 1/User 2	In User 1 or User 2 mode, the amplifier tunes (autoselects) from values stored in User 1 or User 2 memory. As in Default mode, the amplifier retunes at powerup or when it is QSYed to a different band segment. Initially (from factory), the user memories are programmed with factory-default values, which are retained until they are overwritten by new tuning values saved to a band segment. The antenna port is the last one used for that user memory on that band and segment. If for some reason the amplifier is not correctly tuned, you can tune it manually using tune and load controls, and the new value is then stored in user memory. When you switch among Default and User 1/User 2 modes, the amplifier tunes to the values stored in the newly selected memory. Programming a user memory overwrites any previous values, and default values are lost from user memory for a specific band segment. You can view the default values through the computer connection to the amplifier. If you have two antennas that operate on the same band, store separate values in User 1 and User 2 memories. The antenna port selection is determined by the last used antenna on that band segment.

Table 5-2 Tuning modes (Continued)

Mode	Description
Auto	In autotune mode, which you select when the amplifier is in User 1 or User 2 mode, the amplifier initially tunes from stored values and then automatically tweaks the tuning when power is applied. The amplifier tunes on the fly and hunts for an optimum tuning point as you change frequency. However, depending on load conditions, you may need to turn off autotune mode and tweak the tuning yourself with the load and tune controls. The currently selected antenna port is used. Be sure to save the results of autotuning into the user memory by pressing the **SAVE** button. When you switch out of autotune mode, the amplifier holds the tuning unless you press Default or User 1/User 2, in which case it returns to the memory values for those modes. Note that *autotuning* the amplifier is different from *autoselecting* a band and band segment. In normal operation, when the amplifier is keyed, it autoselects the correct band and segment without your intervention, although you can overrule it by manually selecting a band segment. Autotuning, on the other hand, is initiated only when you press the **Auto** button to put the amplifier in autotune mode.

Faults

In the event of a fault, the tube biases off, the relays are placed in bypass mode, and RF from the amplifier goes directly to the antenna. The **FLT** (Fault) switch lights and the 7-segment display shows the number of the last recorded fault.

IMPORTANT

Do not turn the amplifier off. To clear a fault:

- For a gain fault, wait for the amplifier to reset itself.
- For all other faults, resolve the fault as described in Section 8.2, "Fault Codes and Resolutions." Then press the left ON button to release the fault and press the OPER button to continue.

5.2 Start Up the Amplifier

Procedure 5-1 Start up the amplifier

Step 1 Install and set up the amplifier as described in the preceding chapters.

Step 2 Power up the amplifier by pressing one of the two **ON** buttons:

- **ON/OFF (ANT SEL)** button

  This provides initial power to the metering, band, and segment-selection circuits, which turns on the wattmeter and antenna-selection functionality (ON1 setting). When you then pass RF through and key

the amplifier, the amplifier autoselects a band and segment. You can pass up to 1500 W through the amplifier in bypass or the ON1 setting.

- **ON (AMP)** button

  This duplicates the functions described above, and also applies high voltage to the tube. The amplifier begins its warmup countdown sequence and the 7-segment display shows the seconds remaining in the countdown. The STBY switch light blinks.

Step 3 Monitor amplifier parameters:

- Display amplifier parameters by pressing the associated button that controls the 7-segment display. For information on these buttons, see Section 2.3, “Controls and Display,” page 2–3.
- Display the plate voltage by pressing the **Vp** button. The value should be about 3545 V. If the value is....
  - <3300 V: Check your outlet, plug wiring, and equipment grounding in your shack. If power is variable or unstable, you can force the amplifier to always choose a particular tap setting. For information on how to do so, contact RF Concepts technical support.
  - >3800 V: Ensure that the correct primary tap is being selected. If autotap-selection is disabled, try enabling it. If the highest tap is being used, your line voltage is likely >250V; talk to your power company about reducing it.

To return to the countdown display, press the **FLT** (Fault) button.

Step 4 Proceed to Section 5.3, “Tune the Amplifier,” page 5–7.

NOTE

During warmup and operation, do not press the **MEMORY/AUTO** button. The amplifier performs automatic frequency detection, band-tuning, and antenna selection independently of this button. Rather, use this button to assist with initial tune and load settings as described in Section 5.3, “Tune the Amplifier,” page 5–7.

5.3 Tune the Amplifier

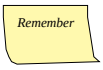
IMPORTANT

- Do not attempt to tune the amplifier until you read this entire section. Then follow instructions carefully.
- During any tuning operation, it is important that you monitor grid current and gain. Even at SWR >2:0:1, where full output may not be achieved, you must still keep grid current and gain within limits. You normally should not need over ~60 W input to drive the amplifier to full output.

The Alpha 9500 has an autotune feature for tuning to the desired frequency. You can use this feature or turn it off and manually tune the amplifier.

Your goal in tuning the amplifier is to maximize output power for a given input power. At SWR > 2.0:1, this normally becomes difficult. You can load a high SWR, but keep in mind as you approach full output that there is great stress on the transmission line, connectors, and antennas. If you use an antenna tuner, also keep in mind that high voltages and circulating currents may exist between the tuner (also inside the tuner) and the antenna even though the amplifier sees a good load.

REMEMBER



A properly tuned amplifier has the following properties:

- Full legal power output. For voltage SWR <2.0:1 this is 1500 W (with 40–60 W drive). For SWR > 2.0.1, full power may not be possible but the other tuning indications are the same.
- Grid current in green zone (normally 40 mA; at >100 mA, the system alarms)
- Gain indication in green zone
- Plate current in green zone (1 A at 1500 W; at >1.2 A, the system alarms)

(Optional) Changing antenna settings

You can optionally change to other than the default antenna or use two antennas simultaneously.

Procedure 5-2 (Optional) Change the antenna settings

Step 1 Start up the amplifier as described in "Start Up the Amplifier," page 5–5.

Step 2 To change the default antenna to a different port for all User 1/User 2 memory bank settings:

2a Press User 1 or User 2 so that the memory light is on.

2b Press the desired antenna port twice.

2c While the antenna light is blinking, press the **SAVE** button.

The new antenna port value is now spread across all bands and segments on User 1 or User *2*.

Step 3 To listen (and transmit) on two antennas simultaneously:

3a Press the **ANTENNA SELECT** button for the first desired antenna twice.

3b While the light is blinking, press the button for the second desired antenna.

Both antenna lights should now be on and both antennas open for listening and transmitting. The SWR is determined by the parallel combination of the two antennas.

Step 4 Proceed to either "Autotuning," page 5–8 or "Manual tuning," page 5–9.

Autotuning

Use autotune during initial setup to find correct tuning values.

NOTE

- We recommend that you use user memories rather than autotuning for normal operation.
- If you use autotuning for normal operation, hunting behavior usually indicates instability in the antenna or feed system. Repair the antenna or feed system so that you can operate from fixed tuning.
- Autotuning may give slightly different tuning values when the amplifier is retuned due to the existence of a small tuning dead zone.

Procedure 5-3 Autotune the amplifier

Step 1 Start up the amplifier as described in "Start Up the Amplifier," page 5–5.

Step 2 If necessary, select the antenna port for the desired band.

NOTE: If you operate on other than the default antenna port (port 4) for one or more bands, you must manually select the port before keying the amplifier on that band. To select the port, press the **ANTENNA SELECT** button for the desired antenna port. The amplifier stays on that port until you change the band segment. If you wish to return to the same tuning settings, save the settings into memory. When you return, the antenna port goes to the one last used for that segment.

Step 3 Set the transceiver to the desired band/segment frequency.

Step 4 Select User 1 or User 2 mode (so that you can save the settings).

Step 5 Press the **MEMORY/AUTO** button to turn on autotune.

Step 6 Key the transceiver by applying input power of 10–20 W.

The amplifier selects the specified band and autotunes.

Step 7 With the amplifier keyed, slowly advance the transceiver power.

As you increase the power, the amplifier continues to tune.

Step 8 (For initial amplifier setup) When you reach the desired output power level, unkey the amplifier and press the **SAVE** button once.

The Save LED blinks on and off once. The tuning settings are now associated with the indicated band/segment. From now on, each time you are in User 1/User 2 memory, when you key the amplifier and apply RF in that range of frequencies, the amplifier autoselects these saved settings.

Step 9 Repeat the previous steps for all band segments.

Step 10 Press the **MEMORY/AUTO** button again to turn off autotune.

Step 11 (Optional) Verify the saved settings by returning to each frequency and confirming the power output. Make any necessary adjustments and save as before.

Step 12 Proceed to "Program the Amplifier Memory," page 5–10.

NOTE

After you set up your amplifier with reasonable tune and load settings, do not press the **MEMORY/AUTO** button. Small changes in frequency and antenna performance are handled easily within the amplifier tuning range.

Manual tuning

Use manual tuning as necessary to optimize amplifier performance.

Procedure 5-4 Manually tune the amplifier

Step 1 Start up the amplifier as described in "Start Up the Amplifier," page 5–5.

Step 2 Select a band segment either with autoselect or manually.

Step 3 If necessary, select an antenna port.

If you operate on other than the default antenna port (port 4), you must manually select the port. The port that was last used is saved.

Step 4 Key the amplifier by applying input power of 10–20 W.

Step 5 Move the tune and load controls carefully, in small steps, until you maximize (that is, achieve full rated) output power.

As you do so, monitor grid current and gain to keep them in the proper ranges.

Step 6 Save the tuning values in one of the user memories.

Step 7 Continue the process for all band segments of interest.

Step 8 Proceed to "Program the Amplifier Memory," page 5–10.

5.4 Program the Amplifier Memory

The Alpha 9500 has 5 memory settings per band per user (Default, User 1, and User 2). Each memory setting holds 3 values: frequency, tune, and load.

These capacitor settings are made at the factory by tuning into a 50-ohm load, saving the settings, and migrating them to the appropriate memory bank. The amplifier is thus set up at the factory so that the memory-bank tune and load settings across all bands and band segments are appropriate for 1500-W output into a 50-ohm load on antenna port 4 for User 1 and User 2.

Antenna port 4 is the default output port for all memories on initialization. We recommend that you choose antenna port 4 for your primary antenna on User 1. If no antenna is connected or the wrong port is selected, you get a voltage SWR fault (Fault 12).

The default memory settings are the only ones that cannot be changed (except at the factory). They are listed in Table 5-3.

Table 5-3 Factory-set memory settings by band and segment

Band	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5
28	28.20	28.60	29.00	29.40	29.80
24	24.55	24.65	24.75	24.85	24.95
21	21.05	21.15	21.25	21.35	21.45
18	18.05	18.15	18.25	18.35	18.45
14	14.05	14.15	14.25	14.35	14.45
10	10.05	10.15	10.25	10.35	10.45
7	7.05	7.15	7.25	7.35	7.45
3.5	3.55	3.65	3.75	3.85	3.95
1.8	1.82	1.84	1.90	1.94	1.98

You are expected to optimize the capacitor settings stored in User 1/User 2 memories during installation.

Procedure 5-5 Program the amplifier memory

Step 1 Start up and tune the amplifier as described in "Start Up the Amplifier," page 5–5 and "Tune the Amplifier," page 5–7.

Step 2 Tune the amplifier to the desired frequency in the User 1/User 2 position and the correct antenna port. Remember that you cannot store in the default position.

Example: Tune to 14.025 MHz in User 1 segment 1.

Step 3 Press the **SAVE** button (to the left of the User 1/User 2 buttons).

Step 4 If you use more than one antenna for a band, repeat to store the additional antenna information.

Example: You have one antenna on port 4 (beam) and another on port 3 (vertical) and both are resonant at 14 MHz. Store the beam settings in User 1 antenna port 4 and the vertical settings in User 2 antenna port 3.

Step 5 Move off the band and ensure that the amplifier returns to the previous location by pressing any other band button and rekeying the amplifier on the just-programmed frequency. If necessary, save the value again.

Step 6 (Optional) To change the center frequency associated with a particular segment in User 1/User 2:

6a Go to the desired frequency and key the amplifier.

6b While the amplifier is producing power, press the desired segment button to save.

The current frequency from the transceiver is saved as the new center frequency for the segment.

NOTE: Center frequencies for each band must increase in order from 1 to 5 (segment 1 is the lowest and segment 5 is the highest).

Step 7 Proceed to "Operate the Amplifier," page 5–12.

5.5 Operate the Amplifier

Procedure 5-6 Operate the amplifier

Step 1 Start up and tune the amplifier and program memory as described in "Start Up the Amplifier," page 5–5, "Tune the Amplifier," page 5–7, and "Program the Amplifier Memory," page 5–10.

Step 2 Push the **OPER** button.

Although the amplifier tunes from memory when you key up with lower power in either standby or operate states, for autotuning to work properly you must be in one of the operate states.

Step 3 Select the correct antenna.

The amplifier starts initially with the default antenna port (port 4).

Step 4 Key the transceiver with the transceiver power output set as low as possible.

Step 5 Apply RF.

The amplifier requires only about 50 W for full output. When the amplifier is keyed and RF is applied, the following sequence occurs automatically:

1. The controller jumps to the correct bandswitch position and frequency segment (this is called autoselect).
2. The antenna setting changes to the last one used for that frequency on that memory bank (Default, User 1, or User 2).
3. The tune and load capacitor settings change to the saved values for that band segment.

This is the how the amplifier normally functions. If the amplifier has been set up properly, no other user intervention is required.

Step 6 Monitor the grid current.

The amplifier operates in Class AB2 when delivering maximum output power consistent with excellent linearity. A small amount of grid current flows, which you can monitor via the grid-current bar graph. As overdrive approaches, grid current increases rapidly and the red grid LEDs become illuminated.

At maximum output and efficiency, the red grid LEDs should not be illuminated. If they are illuminated before the desired value of plate current and/or power output is reached, readjust amplifier loading before continuing.

Step 7 Ensure that exhaust air is detectable from the exit vent holes above the tube. If exhaust air is not detectable:

7a TURN OFF the amplifier immediately.

7b Ensure that the exhaust chimney is properly positioned over the tube.

7c Power up the amplifier again.

NOTE

- If the amplifier faults, it usually resets itself after 4 seconds.
  - — To reset the amplifier manually if it fails to reset itself, push ON/AMP and then OPR. (You need not turn the amplifier off.)
  - — To display the last fault, press the **FLT** button and view the 7-segment display.
  - — To display the last 20 faults, open the AR9500 PC application that allows remote control over a serial interface and select the correct COM port. Select **Tools > Get fault log**.

  To see a complete list of possible faults, see Chapter 8, “Diagnosing Faults.”

- You can optionally control the Alpha 9500 completely from the Microsoft® Windows® AR9500 PC application rather than the front panel. For more information, see Chapter 6, “Operating the Amplifier from a PC.”

6 Operating the Amplifier from a PC

The Alpha Remote (AR) AR9500 PC application allows you to access all functions and features of the Alpha 9500 from your PC. From this application you can view and use:

- A simulated front panel with all the buttons replicated, so that you can click them just as if you were pushing the corresponding button on the front panel
- Windows that show:
  - The amplifier's normal operational RF parameters
  - All power supply voltages used in the amplifier
  - The amplifier ID and serial numbers for all resident firmware
  - The last 20 faults that the amplifier registered
  - The band edges used by the amplifier
  - The segment center frequencies

6.1 Set Up to Operate from a PC

Procedure 6-1 Set up to operate from a PC

NOTE

- You can also establish communications with the amplifier via any communications program such as hyperterminal. The communications parameters for most COM ports are:
  - 115,200 baud
  - 8 data bits, 1 stop bit, no parity bit
  - No flow control
  - Straight-through cable
- The Alpha 9500 has both a 9-pin serial port and a USB port on the back. Only one of these can be active at a time.

Step 1 Locate the amplifier's USB driver (filename *CDM-setup.exe*) from the RF Concepts website or the CD supplied with the amplifier.

Step 2 Determine which PC COM port is assigned to the Alpha 9500.

The amplifier is normally assigned to COM port 4 or 5. Confirm this by checking the computer properties and going to the PC's Device Manager to locate the COM ports.

Step 3 Download the AR9500 PC application (filename *9500_app.zip*) from the RF Concepts website and install it.

Step 4 When you first run the application, set up the correct COM port for the application.

We recommend that you use the active COM port on the PC rather than assigning a USB port as the COM port.

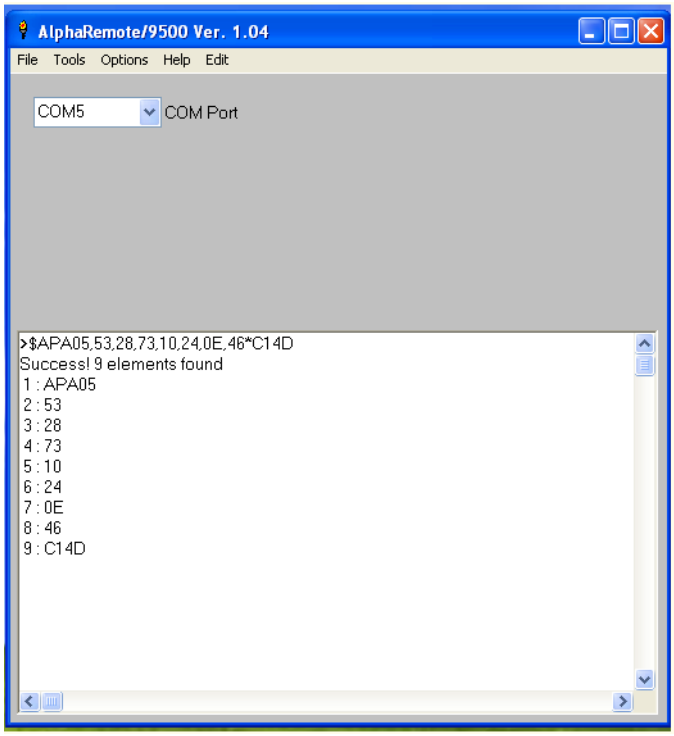
Step 5 When the application opens a window that shows graphically all of the buttons and indicators that are on the front panel, verify that the application is communicating with the amplifier by mousing over the ON1 button and left-clicking on it.

If the amplifier does not turn on, verify that the COM port is set to the correct number.

6.2 Operate from the PC

When the application opens, the main window and the front panel windows are displayed.

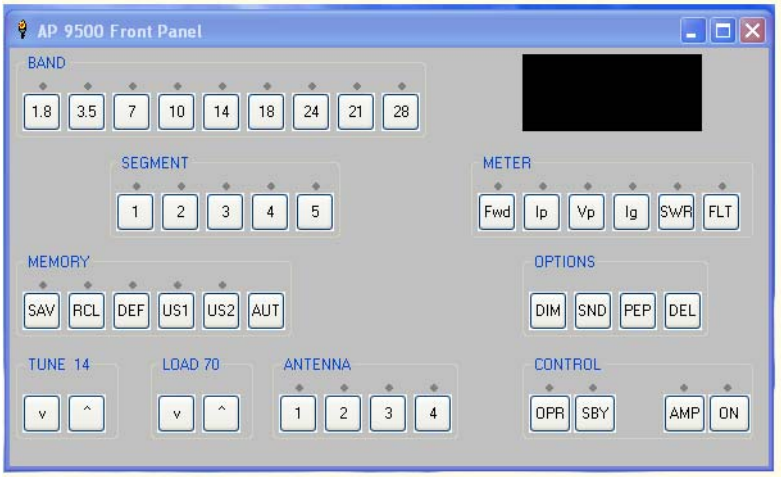
Main window



From the main window you can:

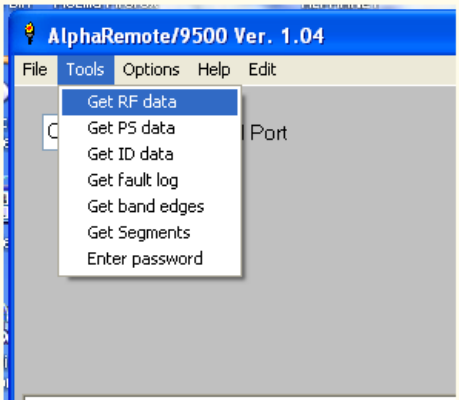
- View a list of available COM ports from the drop-down menu labeled COM Port. Scroll through the list until the port connected to your amplifier is highlighted.
- View the text editor box at the bottom of the window, which shows messages about the data being received from the amplifier.
- View the drop-down windows at the top. Below the menus is a list box for COM port setup.

Simulated front panel



From the simulated front panel you can click any button just as you would press the button from the amplifier itself.

Tools menu

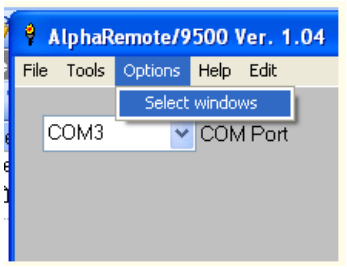


From the Tools menu you can obtain various types of information. Clicking this selection sends a telemetry request to the amplifier asking for that type of data. When the data is received, a window automatically opens to show what the amplifier sent back. Each time this option is selected, the information in the window is updated. You can get:

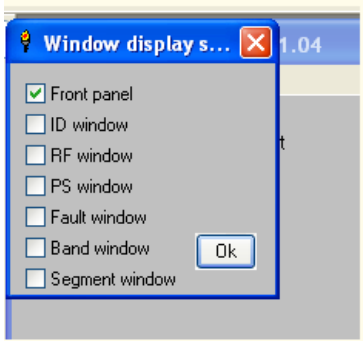
- Radio frequency (RF) data
- Power supply (PS) data
- ID and firmware data
- Fault log of the last 20 fault conditions
- Band edges
- Segment center frequencies

Whether or not any of this data is displayed is controlled by options selected in the Options menu.

Options menu



From the Options menu, if you Select Windows, the following menu appears.



From this window you can select which parameters to display.

7 Maintaining and Upgrading the Amplifier

IMPORTANT

- The Alpha 9500 is extremely easy to set up, operate, and maintain. However, failure to carry out each procedure exactly as described in this manual is likely to lead to amplifier damage, which is not covered under warranty. Damage to other station equipment may also result.
- Do not apply oil or grease to any amplifier components. There are no user-accessible lubrication points in the amplifier.

7.1 Clean the Chassis

Procedure 7-1 Clean the amplifier

Step 1 Power down the amplifier.

Step 2 Disconnect the AC line cord from the power source and lift the cover.

WARNING

WARNING! Disconnect the AC line cord from the power source before lifting the cover for any reason.

Step 3 Clean the interior, particularly high-voltage areas, with a vacuum cleaner and a soft bristle brush frequently enough to prevent visible accumulation of dust.

Step 4 Clean the exterior with a mild household liquid detergent. Do not use chemical solvents, as these may severely damage the front panel or cabinet finish. Never use an abrasive cleaner.

Step 5 In extremely dusty conditions, secure a thin air filter of the type used for window air conditioners across the air intake on the rear panel.

Step 6 Replace the cover and reconnect the AC line cord to the power source.

7.2 Retune the Amplifier

Normally you need retune the amplifier only if you change radios, antennas, or some other aspect of your shack.

When the amplifier is first keyed and RF is sensed, it measures the signal frequency, moves to the appropriate band and segment, and sets the tune and load-capacitor positions to the values that you saved for that frequency. If you saved a different antenna position for that band, it selects the new position.

Your objective in tuning the amplifier (and the drive applied to it) is to obtain optimum efficiency and linearity at the desired output power. You must adjust the amplifier for optimum efficiency and linearity at each specific power level. If you attempt to operate at higher or lower power levels than those for which you have adjusted, the following happens:

- At higher power, the amplifier flattops, splatters, and (usually) produces excessive amplifier grid current.
- At lower power, the amplifier decreases efficiency considerably.

The Alpha 2100 in-line dummy load simplifies this adjustment process by enabling you to switch between dummy load and antenna at the flip of a switch.

At the factory, the amplifier is tested and tuned into an Alpha 2100 50-ohm dummy load and the correct tune and load capacitor values are stored into the default memory-segment positions. You must retune the amplifier for your particular station setup and save those settings to the user memories. After the amplifier has switched to the correct tune and load settings for that particular frequency, you may touch up the capacitor settings to achieve maximum output.

For instructions on retuning the amplifier, see Section 5.3, “Tune the Amplifier,” page 5–7.

7.3 Replace the Tube and Fuses

Step 1 Power down the amplifier.

Step 2 Disconnect the AC line cord from the power source and lift the cover.

WARNING

WARNING! Disconnect the AC line cord from the power source before lifting the cover for any reason.

IMPORTANT

The amplifier is equipped with a cover interlock switch that removes primary power from the amplifier, and a crowbar that short-circuits high voltage to the chassis when the cover is lifted. These interlocks protect against electric shock resulting from accidental contact with the lethal voltages inside the amplifier.

Do not disable the interlock switches for any reason.

Procedure 7-2 Replace the tube and fuses

Step 3 Replace the tube.

Use a single high-quality 8877 tube.

Step 4 Replace fuses.

USE ONLY 20-A, 250-V-RATED FUSES for 190–220 VAC service. You may use 25-A fuses with caution for line voltages of 90–130 V.

Never replace a fuse with one of a different type or greater current rating. Blowing of one or both primary line fuses indicates that the maximum safe average power capability of the amplifier has been substantially exceeded or that an equipment failure has occurred.

The slow-blow fuse F3, located below the primary line fuses, may prevent damage to the step-start resistors and HV rectifiers in the event of abnormal turn-on conditions or HV faults. If the AC interlock is defeated and primary power is applied while the HV crowbar is closed, the step-start fuses normally blow.

IMPORTANT

Damage resulting from use of a fuse of incorrect size or type is not covered under and may void the warranty.

Step 5 Replace the cover and reconnect the AC line cord to the power source.

7.4 Upgrade Firmware

Occasionally, new firmware for the Alpha 9500 control board becomes available for download from the Alpha website.

Go to the Alpha website, retrieve the firmware, and store it on your PC. Then choose one of the following procedures and follow it to install firmware.

On the Primary Board

Procedure 7-3 Upgrade firmware on the primary board

Step 1 With the amplifier plugged into the power supply, turn the amplifier off.

Step 2 Connect a USB cable (Figure 7-1) between the amplifier and the PC.

Figure 7-1 USB cable

If the PC cannot see an additional COM port when the cable is plugged into the amplifier, run the VCP installer software.

Step 3 On the PC, install the USB driver, if not already done.

The USB driver allocates the amplifier USB connection to a virtual COM port (VCP), which looks and behaves like any other COM port.

Step 4 On the PC, run the Colt Bootloader and choose the correct COM port and baud rate.

IMPORTANT

It is important that you set up the bootloader parameters correctly.

NOTE: The bootloader menus for setting the COM port and the baud rate are a little quirky. Although it may look as if there are no other options from which to choose, there is a little area on the drop-down menu where you can click to show the other choices. If you have trouble with this, contact RF Concepts directly.

The bootloader recognizes only COM ports 1 to 9. The amplifier is normally assigned to COM port 6. Confirm this by going to the PC's Device Manager and checking the computer properties.

The correct baud rate is 115,200.

IMPORTANT

Check only **Reload before Program** and **Reset after Program**.

DO NOT check **Program data EEPROM**, as doing so wipes out all of your factory calibrations.

Step 5 With the amplifier still turned off, reset the master microprocessor (hereafter called the processor) by doing the following in quick succession:

5a On the PC, press **F4**.

5b On the amplifier, press the **FLT** button (just below the 7-segment display on the far right).

The firmware begins to download to the mains controller; a blue progress bar shows the progress. The process completes in a few minutes.

Step 6 After the download has completed, repeat Step 5 to reset the processor again.

Resetting the processor twice ensures that the new firmware loads correctly and takes effect.

Step 7 If the PC cannot see an additional COM port when the USB cable is plugged into the amplifier, run the VCP installer software.

On the Secondary Boards

There are four secondary boards:

- Display board
- Mains board
- Sound generator board
- Stepper motor board

These boards are shown in the figures below.

Upgrading the firmware on these boards requires a few more simple steps. The biggest difference with these upgrades is that you must remove the cover and front panel to access these boards. In addition, you must install a special cable between the USB/serial board underneath the power-supply stack and the processor that is being upgraded. You also need a processor reset cable. You keep your computer connected to the amplifier via the USB connector on the back of the amplifier and use the same COM port as before.

Figure 7-2 Display board

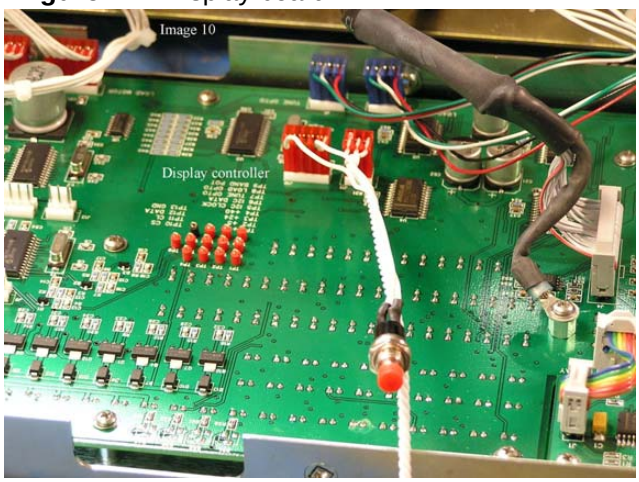


Figure 7-3 Mains board

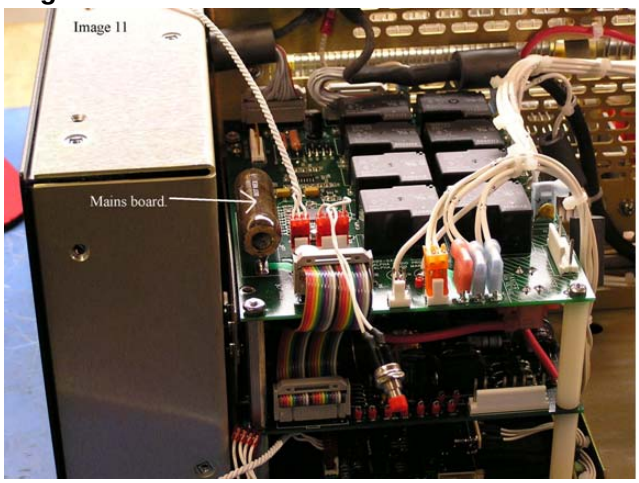


Figure 7-4 Sound generator board

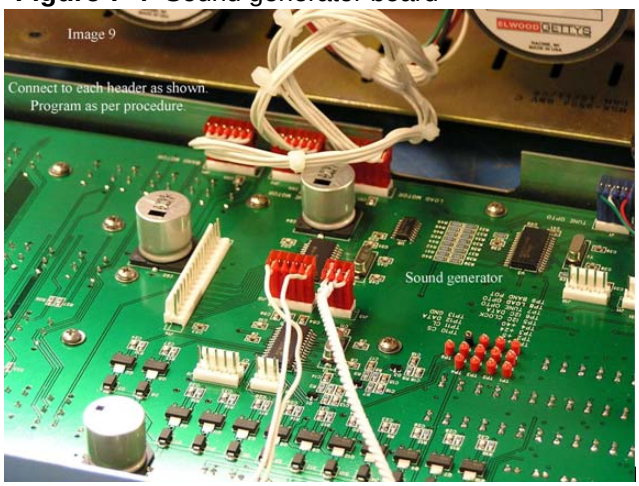
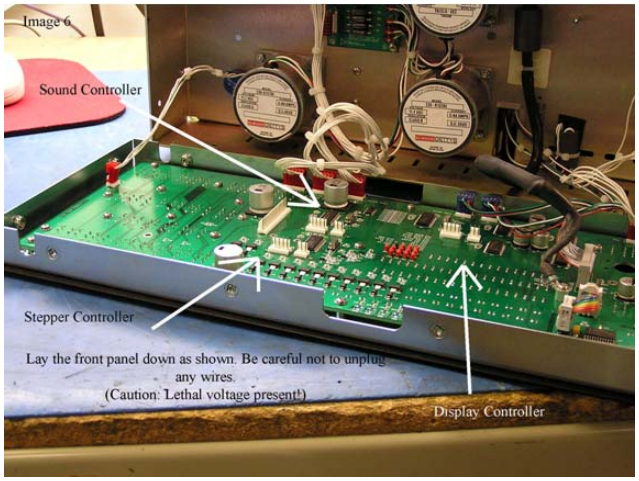


Figure 7-5 Stepper motor board



Procedure 7-4 Upgrade firmware on the secondary boards

IMPORTANT

Before you start, review all steps. If you are unsure of any step, contact RF Concepts.

Step 1 Ensure that the amplifier is connected to the PC via the USB cable.

Step 2 Power down the amplifier.

Step 3 Disconnect the AC line cord from the power source and lift the cover.

⚠ WARNING

WARNING! Disconnect the AC line cord from the power source before lifting the cover for any reason.

Step 4 Remove the transformer and front panel assembly.

Place a towel or a soft cloth in front of the amplifier so as not to scratch the panel.

Step 5 Connect: the programming cable's end 1 (Figure 7-6) to the USB/serial board (Figure 7-7).

Figure 7-6 Programming cable, end 1

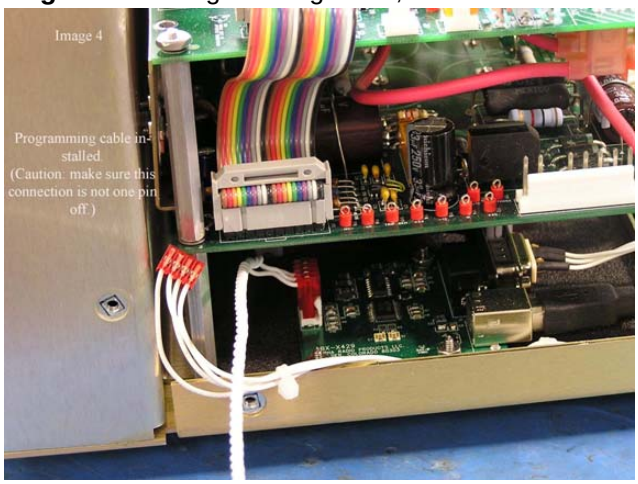


Figure 7-7 USB board

Step 6 Connect the programming cable's end 2 (Figure 7-8) to the 3-pin header adjacent to the board to be upgraded (Figure 7-9).

Figure 7-8 Programming cable, end 2

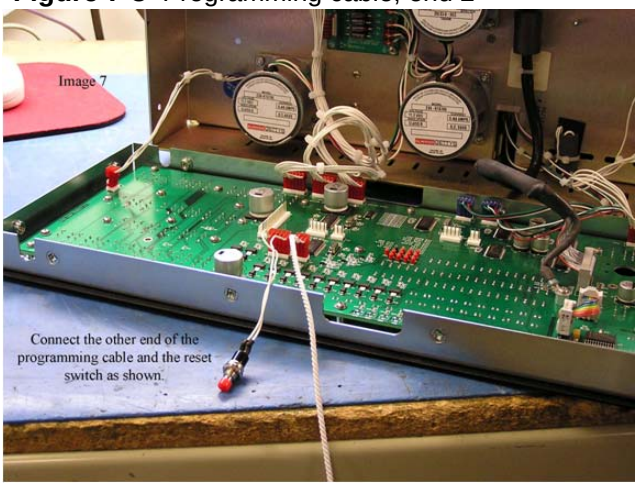
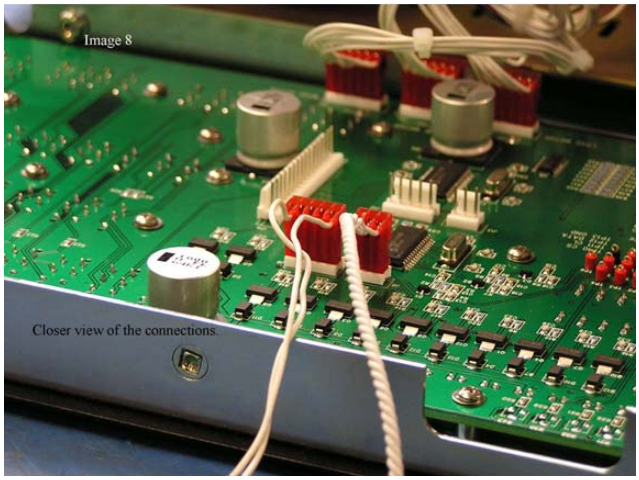


Figure 7-9 3-pin header



Step 7 Connect the reset-push-button cable to the 5-pin connector.

Step 8 Plug the amplifier in but DO NOT turn it on.

Step 9 Start the Colt Bootloader and select the COM port that was used for the main-controller upgrade, with the same communications parameters:

- 115,200 baud
- No parity
- 1 stop bit
- 8 data bits
- Flow control = NONE

Step 10 On the bootloader, choose the correct filename for the board to be upgraded.

Board	Filename[1]
Display	Display_Controller_FP_V*x_xx*.HEX
Mains	High_Voltage_Mains_Board_V*x_xx*.HEX
Sound generator	Sound_Generator_FP_V*x_xx*.HEX
Stepper motor	Stepper_Motor_FP_V*x_xx*.HEX

1. *x_xx* is the current version number.

IMPORTANT

It is critical that you load the correct firmware for each board. Check often to ensure that you do not put (for example) code for the main controller onto the mains board.

Step 11 Press F4 to start the load.

Step 12 Press the reset switch on the cable and note the blue progress bar on the bootloader.

Step 13 When the load is complete:

13a Unplug the amplifier from the wall.

13b Remove the programming cable and reset switch.

13c Replace the front panel, being careful not to crush any wires between the front panel and the stepper motors.

Step 14 Remove the other end of the programming cable from the USB/serial board and replace the original connector.

Step 15 Replace the transformer.

Step 16 Replace the cover and reconnect the AC line cord to the power source.

8 Diagnosing Faults

8.1 Overview

One of four situations typically results in a fault:

Table 8-1 Fault situations

Fault description	Fault type	Amplifier action
Incorrect gain (output too low or too high for the input power supplied)	Soft	The OPR switch turns OFF and the STBY switch turns ON.
High reflected power (SWR)		
Incorrect plate voltage (too high)	Hard	The amplifier shuts OFF completely.
RF arc in output circuit including antenna		

If the tube current exceeds about 1.6 A (causing the amplifier to switch to ON1), diagnose and resolve the fault as described below.

IMPORTANT

In the event of a fault, the tube biases off, the relays are placed in bypass mode, and RF from the amplifier goes directly to the antenna. The **FLT** (Fault) switch lights and the 7-segment display shows the number of the last recorded fault.

Do not turn the amplifier off. To clear the fault:

- For a gain fault, wait for the amplifier to reset itself.
- For all other faults, resolve the fault as described in Section 8.2, "Fault Codes and Resolutions." Then press the left ON button to release the fault and press the OPER button to continue.

8.2 Fault Codes and Resolutions

Fault numbers and descriptions are as follows:

Table 8-2 Fault code summary

Number	Description
1	Gain fault
2	Tap not found
3	Soft Ip trip
4	Hard Ip trip
5	Vp under voltage
6	Output relay closure fail
7	Output relay may be stuck
8	Bandswitch set failure
9	Tune cap zero failure
10	Load cap zero failure
11	Over-temperature
12	Reflected power too high
13	Clear over-temperature
14	Plate voltage too high
15	Grid current too high
16	Autotune failure
17	Plate current too high with amplifier unkeyed
18	Input power too high
19	Unauthorized frequency

Fault code 1

Description Gain fault.

Explanation The power gain (power output divided by power input) of the amplifier has fallen below a value of 10 (10 dB). The normal gain of the amplifier when properly tuned is around 30 (15 dB), so this represents a substantial drop in gain. It is, in fact, the first line of protection for the unit, since almost any major problem in the amplifier (or even in the load connected to the amplifier) manifests as a drop in gain.

The amplifier attempts to automatically clear this fault after 4 seconds and, if the key line is still asserted, go into OPERATE mode. If the fault reoccurs, this process repeats indefinitely. If it occurs often in a short period of time, it is important that you determine the underlying cause and correct the problem.

If you operate the amplifier remotely, the control software should be capable of taking the necessary steps over the USB or RS232 interface to "safe" the amplifier. Although no maximum number of attempts to get back online are specified, it is possible, if this fault occurs repeatedly, that consequential damage to the amplifier may result. Such damage may not be covered under warranty.

As noted previously, this fault (and several others) are inhibited (disabled) if the drive power from the exciter into the amplifier is less than 20 W. The amplifier is generally safe at this drive power level, and it provides a window for you to exercise the various controls to either get the amplifier tuned to within the nominal gain range or determine the underlying cause of the problem.

Resolution

1. Ensure that the load is good under low power. Put the amplifier in bypass mode, and note the standing wave ratio (swr) reported by the exciter. If it is very high, check the antenna/load.
2. If you have recently switched to a new exciter, ensure that it is not putting out excessive power. It has been found that even new transceivers from reputable suppliers develop problems that cause them to put out power much higher than expected, either transiently or continuously. High input power can cause the amplifier to saturate, and the reported gain to drop. Drive powers above 100 W can damage the amplifier and cause this fault. Within-range drive powers at the wrong frequency can also cause this fault.
3. Ensure that the plate voltage (Vp on the digital meter) is within limits (3.0 to 3.8 kV).
    - At the low end of this range, the amplifier struggles to meet the gain specification. It is possible that the mains board has set an inappropriate tap on the primary of the transformer. This can happen for several reasons, but a procedure has been implemented that enables you to override the automatic tap selection feature and force the amplifier to set any desired primary taps. For information on how to force tap selection, contact RF Concepts technical support.
    - At the high end of this range, it is also possible that an incorrect tap has been set, although this normally causes a different fault code.

Fault code 2

Description Tap not found.

Explanation The mains board has measured a line voltage that does not correspond to an acceptable primary tap setting.

The mains board has a set of relays that can select an appropriate combination of primary windings for the power transformer. The tap can be selected either automatically based on the mains board estimate of line voltage, or by force when you tell the amplifier which tap to use.

To ease initial installation of the amplifier, it is shipped with automatic tap selection enabled. This is appropriate for most situations, but it is possible that a particular situation may fake the voltage estimation circuitry out, and cause the amplifier to select an inappropriate tap. This can result in off-nominal conditions for the plate and heater voltages.

The reasons for this fault are several. It is likely that either the AC supply is floating (has a poorly defined ground reference) or the waveform is significantly distorted (by spikes or other irregularities).

It is possible to operate the amplifier with some of these less-than-perfect power sources by enabling the force-tap-selection option. For information on how to force tap selection, contact RF Concepts technical support.

Resolution

1. Measure the line voltage using an accurate voltmeter. Compare this value with the reported value in the amplifier telemetry stream. This is most easily done by running the Alpha Remote/AR9500 PC application. The line voltage is reported in the rectangle around the meter selection buttons. If necessary, this can be done with the amplifier plugged in but in the OFF condition.
2. If the reported and measured values differ by more than a few volts, investigate the cause. Possible reasons are:
   - Poor AC voltage waveform (check with an oscilloscope)
   - Poor ground (check from chassis to Line A and Line B)

   If neither of these cases seem to exist, it is possible that the measurement circuitry on the mains board has drifted. If this is the case, contact RF Concepts technical support.
3. Assuming the value is being reported correctly, compare this value to the values in the following table. There are 5 possible primary tap selections, with values as indicated.

Tap number	Min voltage	Max voltage
1	89.9	109.9
2	110.0	135.0

Tap number	Min voltage	Max voltage
3	189.9	209.9
4	210.0	229.9
5	230.0	265.0

The amplifier selects the tap appropriate to the range reported as being measured. If the measured value does not fall into one of the 5 ranges, the amplifier does not turn on unless you activate manual tap selection.

Fault code 3

Description Soft Ip trip.

Explanation The current in the high voltage (HV) circuit is greater than 1.6 A.

Normal plate current for the amplifier at 1.5 kW output power is in the range 0.8 to 1.1 A. Above this value, the tube may be at or above its rated plate dissipation. This trip is set so that, if the plate current exceeds 1.6 A for a short time, it trips and goes into bypass mode. You should investigate the cause and resolve the problem to avoid damage to the amplifier.

Resolution

- Ensure that the drive power to the amplifier is not too high. This could be because of a problem at the exciter. Put the amplifier in bypass mode and transmit with the exciter. The power should normally be 65 W or less, normally more like 50 W. It is even possible that the exciter has a problem that is causing it to put out brief high power spikes. It is possible that the exciter and amplifier are interacting to produce this effect.

Fault code 4

Description Hard Ip trip.

Explanation The amplifier has tripped completely off, and you have turned it on again to either of the ON positions. The HV circuit current exceeds about 2.5 A. The mains board contains a latching relay and associated circuitry that trips when the current reaches that level.

Under most circumstances, the mains board reports a fault 3 (soft Ip) when the plate current exceeds 1.6 A. If this software fault does not happen, a hardware circuit kicks in and essentially unplugs the amplifier.

This is normally caused by a direct arc from the HV circuit to ground, inside the tube or elsewhere.

Resolution

- Reduce the drive power or retune the amplifier.

Fault code 5

Description Vp under voltage.

Explanation The mains board monitors the plate voltage (HV, Vp) for approximately 2 seconds after the amplifier is turned fully on (ON 2).

If Vp fails to reach approximately 2.8 kV during this time, the mains board reports this fault code.

Resolution

1. Ensure that the mains board is selecting the correct primary transformer tap. See fault code 2 for information on how to do this.
2. If the correct primary tap is being selected, then the problem is elsewhere. Unplug the amplifier, remove the top cover, and inspect the mains board and high voltage board. Unplug each of the transformer connectors and inspect them for problems.

Fault code 6

Description Output relay closure fail.

Explanation The master controller monitors the state of the output relay using an auxiliary DC bias applied through a pair of RF chokes. This allows it to determine that the output relay has traveled to the closed condition, and that it is safe to bias the tube to OPERATE mode.

Resolution

- Call RF Concepts at **303-473-9232**.

Fault code 7

Description Output relay may be stuck.

Explanation If the output relay appears to be closed when the amplifier is keyed up, it is possible that the output relay is stuck in the ÖN condition for one of several reasons. See Fault code 6 for more information.

Resolution

- None. You should not see this fault in the field.

Fault code 8

Description Bandswitch set failure.

Explanation The stepper motor controller processor is unable to land the apparent bandswitch position on the correct setting within the precision required.

Resolution

1. Turn the amplifier off and back on.

2. If the fault does not clear, turn the amplifier off, unplug it from the AC mains., plug it back in, and power it up again.
3. If the fault still does not clear, with the amplifier on, press a bandswitch on the front of the amplifier.

Fault code 9

Description Tune cap zero failure.

Explanation The stepper motor controller is unable to determine the zero position for the tune capacitor.

The tune capacitor has an opto-interrupter that is actuated by a small vane on the drive shaft. When the amplifier is turned to the ON2 or ON/AMP position, the stepper controller attempts to move the vane until it just occludes the opto-interrupter. This position is registered as a 0 (zero) for the tune capacitor, and represents the minimum attainable capacitance for that capacitor. Maximum capacitance is attained when the stepper motor controlling the tune capacitor has taken 100 steps. The stepper motor controller counts how many steps it takes, adding when the capacitance increases and subtracting when the capacitor decreases. The count (between 0 and 100) is the tune capacitor position. When the master controller (MC) sends a command indicating that a new tune capacitor position is desired, the stepper motor controller knows in which direction and for how many steps to turn the capacitor.

Resolution

1. Unplug the amplifier, wait 30 seconds, and plug it back ON to the ON2 or ON/AMP setting.
2. Even if the last fault is still fault 9, attempt to turn the tune capacitor from the buttons on the front panel or from the AR9500 PC application. If the capacitor responds, the fault may have cleared.
3. If the fault persists, contact RF Concepts technical support. If possible, send them the contents of the fault log. To display the fault log, from the AR9500 PC application, open the Fault window and select **Tools > Get fault log**.

Fault code 10

Description Load cap zero failure.

Explanation The stepper motor controller is unable to determine the zero position for the load capacitor.

The load capacitor has an opto-interrrupter that is actuated by a small vane on the drive shaft. When the amplifier is turned to the ON2 or ON/AMP position, the stepper controller attempts to move the vane until it just

occludes the opto-interrupter. This position is registered as a 0 (zero) for the load capacitor, and represents the minimum attainable capacitance for that capacitor. Maximum capacitance is attained when the stepper motor controlling the load capacitor has taken 100 steps. The stepper motor controller counts how many steps it takes, adding when the capacitance increases and subtracting when the capacitor decreases. The count (between 0 and 100) is the load capacitor position. When the master controller (MC) sends a command indicating that a new load capacitor position is desired, the stepper motor controller knows in which direction and for how many steps to turn the capacitor.

Resolution

1. Unplug the amplifier, wait 30 seconds, and plug it back ON to the ON2 or ON/AMP setting.
2. Even if the last fault is still fault 10, attempt to turn the load capacitor from the buttons on the front panel or from the AR9500 PC application. If the capacitor responds, the fault may have cleared.
3. If the fault persists, contact RF Concepts technical support. If possible, send them the contents of the fault log. To display the fault log, from the AR9500 PC application, open the Fault window and select **Tools > Get fault log**.

Fault code 11

Description

Over-temperature.

Explanation

The amplifier has a built-in temperature sensor to ensure that the tube does not overheat. The sensor is located on the cathode board, in the tube deck compartment. Air from the blower motor impinges on this board and then flows up through the tube anode fins. Normally the temperature it reports is at approximately this air temperature. Since the air has already been drawn over other parts of the amplifier, it is some 10–20C warmer than ambient air. The trip value is currently set to 50C.

The amplifier goes to ON AMP, but in bypass mode and with the tube biased off. This should reduce plate dissipation to a minimum and, if the air system is working correctly, the temperature should start to fall. When it reaches a safe value, the amplifier can be put in service again, as indicated by fault code 13 (clear temperature).

Resolution

1. Ensure that there is air exiting the amplifier from the hexagonal pattern of holes near the rear left. If not, this is likely the cause.
2. If there is no air leaving the amplifier when it is in the ON AMP position, assuming that all other front panel displays appear normal, ensure that there is nothing obstructing the air flow at the inlet (on the right rear of the amplifier) or at the exit.

3. Ensure that the external fan is operating. The fan is at the right rear of the amplifier, covered by a wire grill. It should start to rotate in the ON AMP condition. Use a flashlight if necessary to avoid the appearance of nonrotation due to the stroboscopic effect. This can be done without removing the amplifier cover.
4. Check the internal airways of the amplifier. Unplug the amplifier, remove the cover, and ensure that the blower motor (to the right of the tube) is clean and that its impeller rotates when moved gently with a long screwdriver. Look down into the tube and ensure that the passages between the anode fins are not blocked, for example by an accumulation of dust.
5. Ensure that amplifier is being operated with a tuning condition that does not result in poor efficiency.
6. Ensure that the tube standing bias (keyed, with no RF) is not greater than 500 mA. Key the amplifier with the meter set to Ip to make this measurement. If Ip is greater than 500 mA, then there may be a problem in the cathode bias circuitry, on the cathode board, or in the tube itself.

Fault code 12

Description Reflected power too high.

Explanation The amplifier monitors the apparent reflected power at its output. If the power is above the set value, currently 375 W, the amplifier goes into BYPASS mode and attempts to clear the fault.

Resolution

- Ensure that antennas and other equipment installed after the amplifier were installed correctly.

Fault code 13

Description Clear over-temperature.

Explanation The amplifier has recovered from fault 11 (temperature fault).

Resolution

- See fault 11.

Fault code 14

Description Plate voltage too high.

Explanation The plate voltage has exceeded a safe value, currently 3800 Vdc.

Resolution

1. Ensure that the AC mains voltage is correct.

2. Unplug the amplifier, plug it back in, wait for at least 30 seconds, then turn it back on.

Fault code 15

Description Grid current too high.

Explanation The amplifier monitors the grid current and, if it exceeds a safe value for a period of time, it goes into BYPASS mode and reports this fault. The usual cause is too much drive for the current output loading condition. It may represent amplifier overdrive (excessive input power) or incorrect tune and load capacitor settings.

Resolution

- Reduce the drive or retune.

Fault code 16

Description Autotune failure.

Explanation The autotune algorithm has encountered a problem that causes it to go through a large number of iterations without being able to find an acceptable tune condition, and has been stopped.

Resolution

- Reduce the drive and restart the autotune.

Fault code 17

Description Plate current too high with amplifier unkeyed.

Explanation When the amplifier is unkeyed, the plate current should be quite low. Some failure conditions can cause the plate current to exceed a safe level and produce this fault code.

Resolution

1. If the tube is shorted out, replace it.
2. Ensure that the HV circuit is functioning properly.

Fault code 18

Description Input power too high.

Explanation The input drive power from the exciter is greater than a preset threshold, currently 100 W.

Resolution

- Reduce the input power to within proper limits.

Fault code 19

Description Unauthorized frequency.

Explanation The amplifier is not authorized to transmit on that frequency. Amateur equipment sold in the United States is not authorized to transmit between 26 and 28 MHz.

Resolution

- Change the frequency.

Terminology

NOTE: For detailed explanations of the following terms, see various publications including the latest *American Radio Relay League (ARRL) Handbook*.

A

AC — Alternating current. Electric current whose magnitude and direction vary with time.

ALC — Automatic Level Control. Technology that automatically controls output power.

ampere — Unit of electric current.

ARRL — American Radio Relay League. US national organization of amateur radio operators. For more information, go to **www.arrl.org**.

AWG — American wire gauge. Standard method of denoting wire diameter.

B

B1 — Modulation class AB1. Amplifier-circuit class that provides good linearity in push-pull configuration.

C

CW — Continuous wave. Electromagnetic wave of constant amplitude and frequency.

D

dB — Decibel. Logarithmic unit of measure of the power of sound relative to a reference level.

E

exciter — Radio that provides RF drive for the Alpha 9500 to operate. The transmitter portion of the transceiver.

F

FCC — Federal Communications Commission. For more information, go to **www.fcc.gov**.

FM — Frequency modulation. Modulation scheme in which information is conveyed over a carrier wave by variations in frequency.

FSK — Frequency-shift keying. Type of frequency modulation in which information is conveyed by shifts in the output frequency between predetermined values.

H

HF — High frequency. Radio frequency within the range 3–30 MHz.

HV — High voltage. Electrical circuit in which the voltage used presents risk of both electric shock and electrical arcing.

Hz — Hertz. One periodic event per second.

I

Ip — Idling plate current. Plate current measured when the amplifier is keyed and RF is not present.

K

key — Signal from the radio to the amplifier that instructs the amplifier to switch from receive to transmit mode because the radio is ready to generate RF power. The (programmable) delay between keydown and RF out is generally 8–12 ms. When the amplifier is keyed, it is in State 5.

kV — Kilovolt. 1000 V.

kVA — Kilovolt-ampere. 1000-W capability. kVA * 0.8 = kilowatts.

kW — Kilowatt. 1000 W.

L

LED — Light-emitting diode. Semiconductor diode that emits incoherent narrow-spectrum light, providing a form of electroluminescence.

LV — Low voltage. Electrical circuit in which the voltage used presents risk of electric shock but only minor risk of electrical arcing.

M

mA — Milliampere. 10-6 A.

MHz — Megahertz. 106 Hz.

O

OPR — Operate.

PCB — Printed circuit board. Board that mechanically supports and electrically connects electronic components.

P

PSK — Phase-shift keying. Digital modulation scheme in which information is conveyed by changes, or modulations, in the phase of a reference signal.

Q

QSK — Quadrature-shift keying. Digital modulation scheme in which the transmitter is on only for the duration of each dot or dash and switches to receive between each dot or dash, allowing the operator to hear any signal being sent.

R

RCA — Radio Corporation of America. Also a type of interconnecting plug.

RF — Radio frequency. Frequency within the range 3 Hz–300 GHz.

RG-x/x — Coaxial cable type.

RMS — Root mean square. Statistical measure of the magnitude of a varying quantity such as a wave.

RTTY — Radioteletype. Telecommunications system consisting of two or more teleprinters using radio as the transmission medium.

S

SSB — Single-sideband. Modulation scheme that refines upon amplitude modulation.

SSTV — Slow-scan television. Picture-transmission method for transmitting and receiving static pictures via radio.

STBY — Standby. Mode in which an electronic appliance is turned off but under power and ready to activate on command.

SWR — Standing-wave ratio. Ratio of the amplitude of a partial standing wave at an antinode (maximum) to the amplitude at an

adjacent node (minimum). Measure of antenna and feedline efficiency.

T

T/R — Transmit /receive.

transceiver — Device that has both a transmitter and a receiver within the same circuitry or chassis.

U

UHF — Ultra-high frequency. Radio frequency within the range 300–3000 MHz (3 GHz).

US — United States.

V

VAC — Volts of alternating current.

VDC — Volts of direct current.

VSWR — Voltage standing-wave ratio. Example: If voltage SWR = 1.2:1, the maximum standing-wave amplitude is 1.2 times greater than the minimum standing-wave amplitude.

Schematics

NOTE: The following pages contain detailed schematics for the Alpha 9500 linear amplifier.